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95th Air Base Wing
Edwards Air Force Base, California

Environmental Restoration Program

Record of Decision
South Base
Operable Unit 2
Edwards AFB, California

Final

March 2009

ENVIRONMENTAL RESTORATION PROGRAM
RECORD OF DECISION
SOUTH BASE
OPERABLE UNIT 2

EDWARDS AIR FORCE BASE
CALIFORNIA

MARCH 2009

FINAL

Prepared for

U.S. AIR FORCE 95th AIR BASE WING
ENVIRONMENTAL RESTORATION DIVISION (95 ABW/EMR)
EDWARDS AFB, CA 93524

and the

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LIST OF ABBREVIATIONS AND ACRONYMS

%	percent
§	section
μg/L	micrograms per liter
1,1,2-TCA	1,1,2-trichloroethane
1,2,4-TMB	1,2,4-trimethylbenzene
1,3,5-TMB	1,3,5-trimethylbenzene
4,4-DDE	4,4-dichlorodiphenyldichloroethylene
4,4-DDT	4,4-dichlorodiphenyltrichloroethane
95 ABW/CEVR	95th Air Base Wing/Environmental Restoration Branch
95 ABW/EMR	95th Air Base Wing/Environmental Restoration Division
ACM	asbestos containing material
AF	Air Force
AFB	Air Force Base
AFCEE/ERD	Air Force Center for Environmental Excellence, Environmental Restoration Division
AFCEE/EXEW	Air Force Center for Engineering and the Environment/ Environmental Programs Execution – West
AFCEE/ICE	Air Force Center for Engineering & Environment MAJCOM & Installation Support-CONUS (AFMC)
AFCEE/ISM	Air Force Center for Environmental Excellence/Installation Support, AFMC
AFFTC/EM	Air Force Flight Test Center, Environmental Management
AFFTC/EMR	Air Force Flight Test Center, Environmental Restoration Division
AFMC	Air Force Materiel Command
AFRL	Air Force Research Laboratory
AOC	area of concern
ARAR	Applicable or Relevant and Appropriate Requirement
AVEK	Antelope Valley-East Kern
BFTF	Birk Flight Test Facility
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
CAI	closed, abandoned, or inactive
Cal/EPA	California Environmental Protection Agency
CAMU	Corrective Action Management Unit
CHHSL	California Human Health Screening Level
CCR	California Code of Regulations
CDFG	California Department of Fish and Game
CDHS	California Department of Health Services
CE	Civil Engineering
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CESA	California Endangered Species Act
CFR	Code of Federal Regulations

LIST OF ABBREVIATIONS AND ACRONYMS *(Continued)*

CIWMB	California Integrated Waste Management Board
COC	contaminants of concern
CONUS	Continental United States
CPT/ROST™	Cone Penetrometer Test/Rapid Optical Screening Tool™
CWA	Clean Water Act
DES	dual extraction system
DEW	dual extraction well
DFRC	Dryden Flight Research Center
DNAPL	dense non-aqueous phase liquid
DTSC	Department of Toxic Substances Control
EDB	ethylene dibromide
EE/CA	engineering evaluation/cost analysis
EMI	electromagnetic induction method
EMP	Evaluation Monitoring Program
EPA	Environmental Protection Agency
ERP	Environmental Restoration Program
et seq.	et sequentia (and the following)
FEMA	Federal Emergency Management Agency
FFA	Federal Facility Agreement
FS	feasibility study
GAC	granular activated carbon
GETS	groundwater extraction and treatment system
gpd	gallons per day
gpm	gallons per minute
HAZWRAP	Hazardous Waste Remedial Actions Program
HB&A	Higginbotham/Briggs & Associates
HDPE	high-density polyethylene
HHRA	human health risk assessment
HI	Hazard Index
HVAC	heating, ventilation, and air conditioning
IRP	Installation Restoration Program
ISCO	in situ chemical oxidation
JP-4	jet propellant #4
lbs	pounds
LDRs	land disposal restrictions
LNAPL	light non-aqueous phase liquid
LTM	long-term management
LUC	land use control
MAJCOM	Major Command
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MEK	methyl ethyl ketone
mg/L	milligrams per liter

LIST OF ABBREVIATIONS AND ACRONYMS *(Continued)*

NA	not applicable
NASA	National Aeronautics and Space Administration
NC	noncarcinogenic
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NFA	No Further Action
NPL	National Priorities List
O&M	operation and maintenance
OSWER	Office of Solid Waste and Emergency Response
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
POL	petroleum, oil, and lubricants
ppm	parts per million
PRG	Preliminary Remediation Goal
RA	remedial action
RAB	Restoration Advisory Board
RACER™	Remedial Action Cost Engineering and Requirements
RAO	remedial action objective
RAWP	Remedial Action Work Plan
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
ROD	Record of Decision
RPM	Remedial Project Manager
RTS	Report to Stakeholders
RWQCB	Regional Water Quality Control Board
SARA	Superfund Amendments and Reauthorization Act
Solutions-IES	Solutions Industrial & Environmental Services, Inc.
spp.	species
STLC	soluble threshold limit concentration
SVE	soil vapor extraction
SVOC	semivolatile organic compound
SWAT	solid waste assessment test
SWRCB	State Water Resources Control Board
TCA	trichloroethane
TCE	trichloroethene
TDS	total dissolved solids
TEFA	Technical and Economic Feasibility Analysis
TRC	Technical Review Committee
TSDF	treatment, storage, and disposal facility
TTLC	total threshold limit concentration
TVPH	total volatile petroleum hydrocarbons
USACE	United States Army Corps of Engineers
USAF	United States Air Force

LIST OF ABBREVIATIONS AND ACRONYMS *(Continued)*

USC	United States Code
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UST	underground storage tank
UXO	unexploded ordnance
VLEACH	Vadose Zone Leaching Model
VOC	volatile organic compound
WQS	Water Quality Standards

1.0 Part 1: Declaration

1.0 PART 1: DECLARATION

1.1 SITE NAME AND LOCATION

Edwards Air Force Base (AFB), Kern, Los Angeles, and San Bernardino Counties, California, United States Environmental Protection Agency (USEPA) Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) Identification Number: CA1570024504.

1.2 STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedies for Operable Unit 2 (OU2) at Edwards AFB, California, which were chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by Superfund Amendments and Reauthorization Act (SARA) of 1986, and the CERCLA regulation National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision document is based on the Administrative Record File for OU2.

The United States Air Force (USAF) and the USEPA are selecting the remedies contained in this Record of Decision (ROD) in concurrence with the California Environmental Protection Agency (Cal/EPA) Department of Toxic Substances Control (DTSC) and the California Regional Water Quality Control Board (Water Board), Lahontan Region.

1.3 ASSESSMENT OF OPERABLE UNIT 2

This ROD addresses nine sites and one area of concern (AOC) located within OU2. These sites and AOC are:

- Site 5 – Former South Base Waste Petroleum, Oil, and Lubricants Storage Area;
- Site 14 – South Base Fire Fighting Training Facility;
- Site 29 – South Base Abandoned Sanitary Landfill;
- Site 69 – Old South Base North Landfill;

- Site 76 – Old South Base Assorted Facilities;
- Site 78 – Old South Base Vehicle Maintenance Area 2;
- Site 79 – Old South Base Vehicle Maintenance Area 1;
- Site 86 – Building 300 Engine Test Cell;
- Site 96 – Old South Base Motor Pool; and
- AOC 417 – South Base Rocket Sled Track – Quarter Point Area.

For four sites and the AOC (Sites 69, 78, 79, and 96, and AOC 417), the Remedial Project Managers (RPMs) have determined that no further action, including no land use controls, is necessary to protect public health or welfare or the environment because the contaminants originally found at the sites and AOC have been cleaned up and all risks reduced to acceptable levels for all use scenarios (see Appendix A and Earth Tech 2004b).

For the remaining five sites, the selected response actions presented in this ROD are necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

Sites 5, 14, 76, and 86 are sites with contaminated groundwater plumes. The groundwater beneath these sites exceeds the acceptable risk range if the groundwater is used for a drinking water supply in the future. The groundwater beneath OU2 is designated as a potential drinking water source, and there are applicable or relevant and appropriate requirements (ARARs) that provide protective cleanup standards, namely, the more stringent of Federal and State Primary Maximum Contaminant Levels (MCLs). Sites 5 and 14 are addressed in this document as a single site (the Sites 5/14 Contaminant Plume) because the contaminated groundwater plume originates at Site 5 and extends southeast to Site 14. The specific contaminants to be addressed and the cleanup standard for each contaminant are provided in Section 2 of this ROD. This ROD also documents the decision that no action is necessary for soils at Sites 5, 76, and 86 to protect public health or welfare or the environment. In the unlikely event that construction of residential and/or industrial buildings was to occur above the Sites 5/14 floating free product or at Site 14 in the future, engineering controls would be required to protect building inhabitants from vapors that could be volatilizing from contaminants at the site.

Site 29 is a site with surface and buried debris. The site includes landfills where residential, industrial, and construction debris is known to have been disposed, and minor groundwater contamination has been confirmed. Although contaminants were not detected at the site above acceptable human health risk levels, remedial actions are necessary to reduce the probability of a future release of hazardous substances (from the known buried debris) to groundwater, and to prevent potential direct exposure to future residents and industrial workers, which could result from contact with the debris.

It should be noted that remedial actions for two other sites with surface debris (Sites 81 and 102) were evaluated in *Environmental Restoration Program, South Base Feasibility Study, Operable Unit No. 2, Edwards AFB, CA* (Earth Tech 2005c), hereafter referred to as the *OU2 FS;* and included in *Environmental Restoration Program, CERCLA Proposed Plan for Operable Unit 2, Edwards Air Force Base, California* (Earth Tech 2006a), hereafter referred to as the *OU2 Proposed Plan*. Sites 81 and 102 are former skeet ranges where skeet target debris scattered on the ground surface is contaminated with polycyclic aromatic hydrocarbons (PAHs), which were used as a clay binder in the targets for a short time in the 1940s. The Air Force, with concurrence from the USEPA, Cal/EPA DTSC, and Water Board, have determined that these two sites require further investigation to fully characterize the potential impact from the skeet target debris and lead shot. Therefore, these sites are not included in this ROD, but will be addressed in a separate ROD.

1.4 DESCRIPTION OF THE SELECTED REMEDIES

Operations at OU2 resulted in releases of hazardous substances that are distinct and not commingled with hazardous substances released at other OUs at Edwards AFB. The selected remedies described below are intended to be the final actions for OU2, and are addressed independently of the other OUs at Edwards AFB.

1.4.1 SITES WITH CONTAMINATED GROUNDWATER

The selected remedies intended to be final actions for sites with contaminated groundwater are briefly summarized in the following subsections.

1.4.1.1 Sites 5/14 Contaminant Plume

The overall cleanup strategy for the Sites 5/14 Contaminant Plume involves using two in situ methods to break down the contaminants in the groundwater: aerobic biological degradation using injection of air and gaseous nutrients through vertical wells to treat areas of the plume contaminated with floating free product, and chemical reagent injection using horizontal wells to treat groundwater contaminated by chlorinated solvents (primarily trichloroethene [TCE]). The selected remedies are designed to return the groundwater to unrestricted use within 12 years. No further action is required to return the soils to unrestricted use, except for the soils at Site 14, which pose an indoor air vapor intrusion risk to residential and industrial receptors.

The main components of the selected remedies include:

1. Implementing in situ biological treatment to destroy the floating free product;
2. Implementing chemical reagent injection to remediate the dissolved chlorinated solvents in the contaminant plume;
3. Continuing operation of the existing Site 14 groundwater extraction and treatment system (GETS) to prevent further downgradient migration of the plume during remediation;
4. Performing groundwater monitoring at least annually to validate containment of the plume and the status of remediation to groundwater cleanup standards;
5. Implementing and maintaining land use controls (LUCs) during the remedial action at Sites 5 and 14 to prevent ingestion of, or dermal contact with, contaminated groundwater;
6. Implementing and maintaining LUCs that would require engineering controls on future residential and industrial construction to protect building inhabitants from vapors that could be volatilizing off soils at Site 14 and off floating free product within the Sites 5/14 plume; and
7. Maintaining LUCs until such time as the site attains unrestricted use and unlimited exposure levels.

1.4.1.2 Sites 76 and 86

The overall cleanup strategies for the Sites 76 and 86 groundwater plumes include in situ chemical oxidation (ISCO) of the dissolved chlorinated plume at Site 76 by the injection of chemical reagent through vertical wells and in situ aerobic biological degradation of the contaminants in the plume at

Site 86 by the injection of air and gaseous nutrients through vertical wells. The selected remedies are designed to return the groundwater to unrestricted use within five years. No further action is required to return the soils to unrestricted use at these sites.

The main components of the selected remedies include:

1. Implementing chemical reagent injection to remediate the dissolved chlorinated solvents in the contaminant plume at Site 76 and in situ aerobic biological degradation to metabolize and destroy the contaminants in groundwater at Site 86;
2. Performing groundwater monitoring at least annually to validate remediation of the plumes to the groundwater cleanup standards; and
3. Implementing and maintaining LUCs during the remedial actions to prevent contact with site contaminants.

1.4.2 SITE WITH DEBRIS

The selected remedies intended to be final actions for the site with debris are briefly summarized in the following subsection.

1.4.2.1 Site 29

The overall cleanup strategy for Site 29 includes removal of approximately 60,000 cubic yards of recently emplaced surface debris, implementation of LUCs, grading to improve stormwater management, and long-term management (LTM). The main components of the selected remedy include:

1. Using the existing landfill cover to contain the buried municipal waste;
2. Removing the surface debris that was deposited on the landfill cover in 1985;
3. Covering with soil any buried municipal waste in the landfill that may be exposed by the removal of the surface debris. The thickness of the soil cover shall be consistent with the existing landfill cover;
4. Regrading the landfill to fill in depressions that could cause significant ponding;
5. Applying soil stabilizer to the surface of the site after the debris has been removed, and allowing the site to naturally revegetate;
6. Enhancing the stormwater management system by installing additional stormwater drainage channels and improving existing drainage channels;

7. Using existing groundwater wells to perform groundwater monitoring at least biennially (i.e., every other year);
8. Using existing fences to provide access controls; and
9. Implementing and maintaining LUCs to prevent contact with the buried waste and prevent the unauthorized disposal of wastes.

The selected remedy is designed to bring Site 29 in compliance with ARARs within two years.

1.5 STATUTORY DETERMINATIONS

The selected remedies are protective of human health and the environment, comply with Federal and State requirements that are applicable or relevant and appropriate to the remedial actions, are cost effective, and use permanent solutions and alternative treatment technologies to the maximum extent practicable. The parties agree to disagree over whether certain Cal/EPA DTSC and Water Board requirements are ARARs. The applicability of Cal/EPA DTSC and Water Board promulgated ARARs for groundwater contaminant plumes are contained in Section 2.8.2.

All groundwater remedies satisfy the statutory preference for treatment as a principal element of the remedy (i.e., reduce the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants as a principal element through treatment).

The remedy for Site 29 does not satisfy the statutory preference for treatment as a principal element of the remedy because treatment of the buried waste at the site was found to be not practicable. The size of the landfill area and the lack of localized areas with elevated contaminant concentrations preclude a practicable remedy in which debris could be excavated and treated effectively. A full discussion of the rationale for this departure is contained in Part 2 – Decision Summary.

For the Sites 5/14 Contaminant Plume, Site 29, Site 76, and Site 86, where the selected remedies are expected to take five years or more to attain cleanup standards, a statutory review will be conducted at five years, and every five years thereafter as long as hazardous substances at the sites remain above residential concentration levels that prevent unrestricted use, to determine whether the selected remedies continue to be protective of human health and the environment. The five-year review results will be placed in the post-ROD Administrative Record File, which is located at the 95th Air Base Wing, Environmental Management Directorate (5 East Popson Avenue, Building 2650A, Edwards AFB, California, 93524).

1.6 AUTHORIZING SIGNATURES AND SUPPORT AGENCY ACCEPTANCE OF THE SELECTED REMEDIES

The USAF and USEPA, with concurrence from Cal/EPA DTSC and the Water Board, Lahontan Region, have determined that Sites 69, 78, 79, and 96, and AOC 417 are suitable for future unrestricted use based on the completed cleanup actions performed at the sites and AOC, and concur with the selected cleanup remedies for Sites 5/14, 29, 76, and 86.

Date 9APR09

JERRY L. GANDY, Colonel, USAF
Commander, 95th Air Base Wing
Edwards Air Force Base, California

Date June 24, 2009

MICHAEL M. MONTGOMERY
Assistant Director of Federal Facilities and Site Cleanup Branch
United States Environmental Protection Agency, Region 9

The Cal/EPA DTSC and the Water Board had the opportunity to review and comment on this Record of Decision, and our concerns are addressed.

Date July 8, 2009

ANTHONY J. LANDIS, P.E.
Supervising Hazardous Substances Engineer II
Sacramento Office
Brownfields and Environmental Restoration Program
California Department of Toxic Substances Control

Date July 15, 2009

HAROLD SINGER
Executive Officer
California Regional Water Quality Control Board, Lahontan Region

We the undersigned, having worked on the development of all phases of this document, hereby concur with the selected cleanup remedies in this ROD.

Date 7/9/09

AI DUONG
Remedial Project Manager
95 ABW/EMR
Edwards Air Force Base, California

Date 7/8/09

JOSEPH B. HEALY, JR.
Remedial Project Manager
Federal Facilities Cleanup Branch
U.S. Environmental Protection Agency, Region 9

Date 7/20/09

JOHN HARRIS
Remedial Project Manager
Office of Military Facilities
California Department of Toxic Substances Control

Date 7-9-09

JEHIEL W. CASS, P.E.
Remedial Project Manager
California Regional Water Quality Control Board, Lahontan Region

2.0 Part 2: Decision Summary

2.0 PART 2: DECISION SUMMARY

This decision summary provides an overview of the general characteristics for South Base OU2 at Edwards AFB, and more site-specific characteristics for the nine sites and one AOC in OU2 that are included in this ROD. In addition, the decision summary describes the remedial alternatives evaluated for each site (if applicable), and a comparative analysis of those alternatives. The decision summary concludes with the identification of the selected remedy for a site (if applicable), and the statutory determinations supporting the selected remedy.

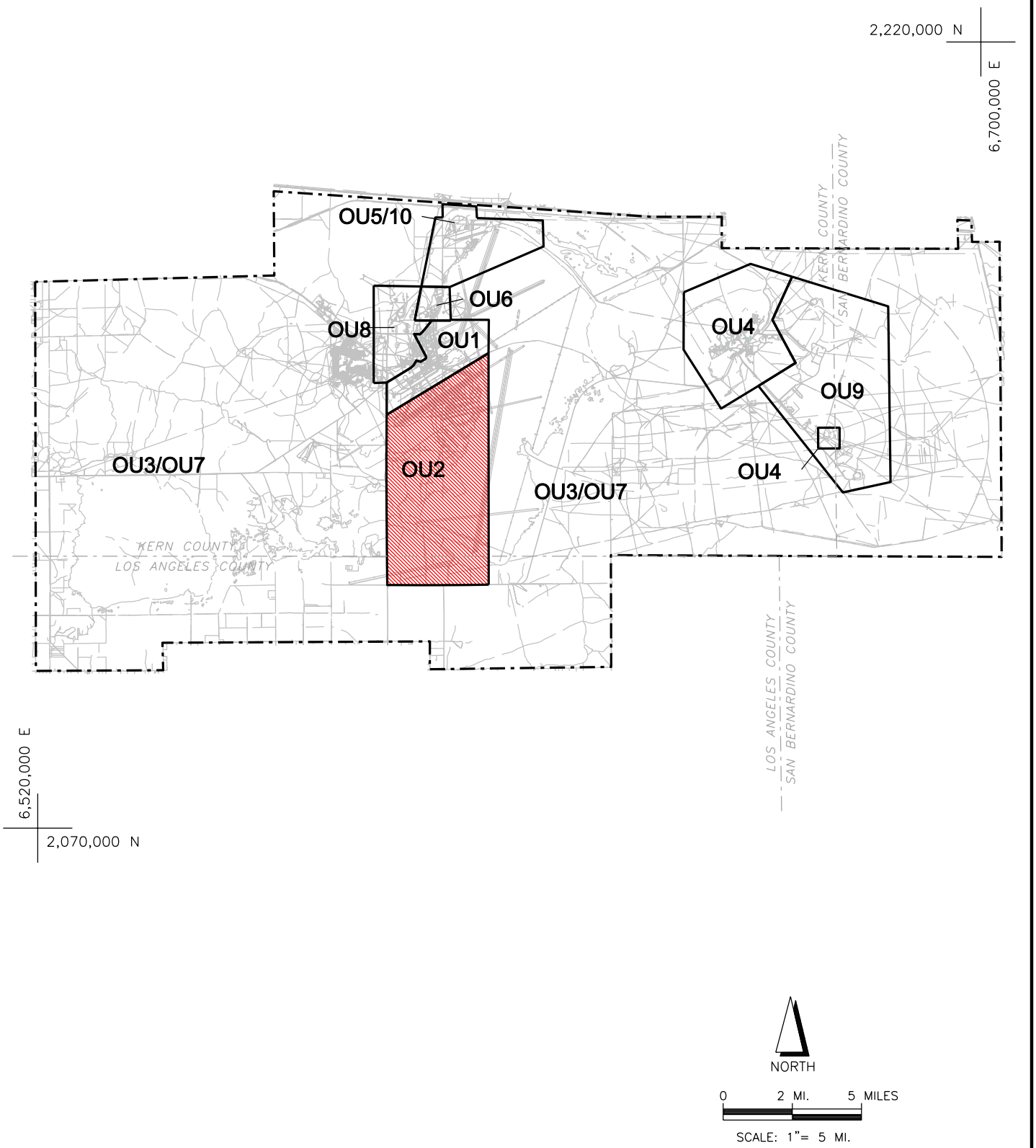
This decision summary incorporates the content recommended in *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents* (USEPA 1999). However, adjustments to the order of the recommended subsections were incorporated in this decision summary to accommodate the inclusion of site-specific information in the Site Characteristics subsection.

Details regarding the *OU2 Proposed Plan*, which addresses the nine sites and one AOC documented in this ROD, are provided in Section 2.3, Community Participation.

2.1 NAME, LOCATION, AND BRIEF DESCRIPTION OF SOUTH BASE OPERABLE UNIT 2 AT EDWARDS AIR FORCE BASE

Edwards AFB is located in southern California approximately 5 miles northeast of the city of Lancaster (Figure 2.1-1). The Base covers portions of Kern, Los Angeles, and San Bernardino Counties. The nine sites addressed in this ROD (Sites 5/14, 29, 69, 76, 78, 79, 86, and 96) are located in Kern County (Figure 2.1-2). AOC 417 is located in Los Angeles County. OU2 is located approximately two miles north of the southern boundary of Edwards AFB. The nearest on Base residential area is 2.5 miles to the northwest. The nearest off Base residential area is three miles to the southwest.

The USEPA CERCLIS identification number for Edwards AFB is CA1570024504. Edwards AFB was listed on the National Priorities List (NPL) on 30 August 1990. The lead agency for remedial investigation (RI) and remedial action (RA) at the facility is the USAF. Regulatory agencies providing support and oversight of the Environmental Restoration Program (ERP) at Edwards AFB include the



DESIGNATED OPERABLE UNITS

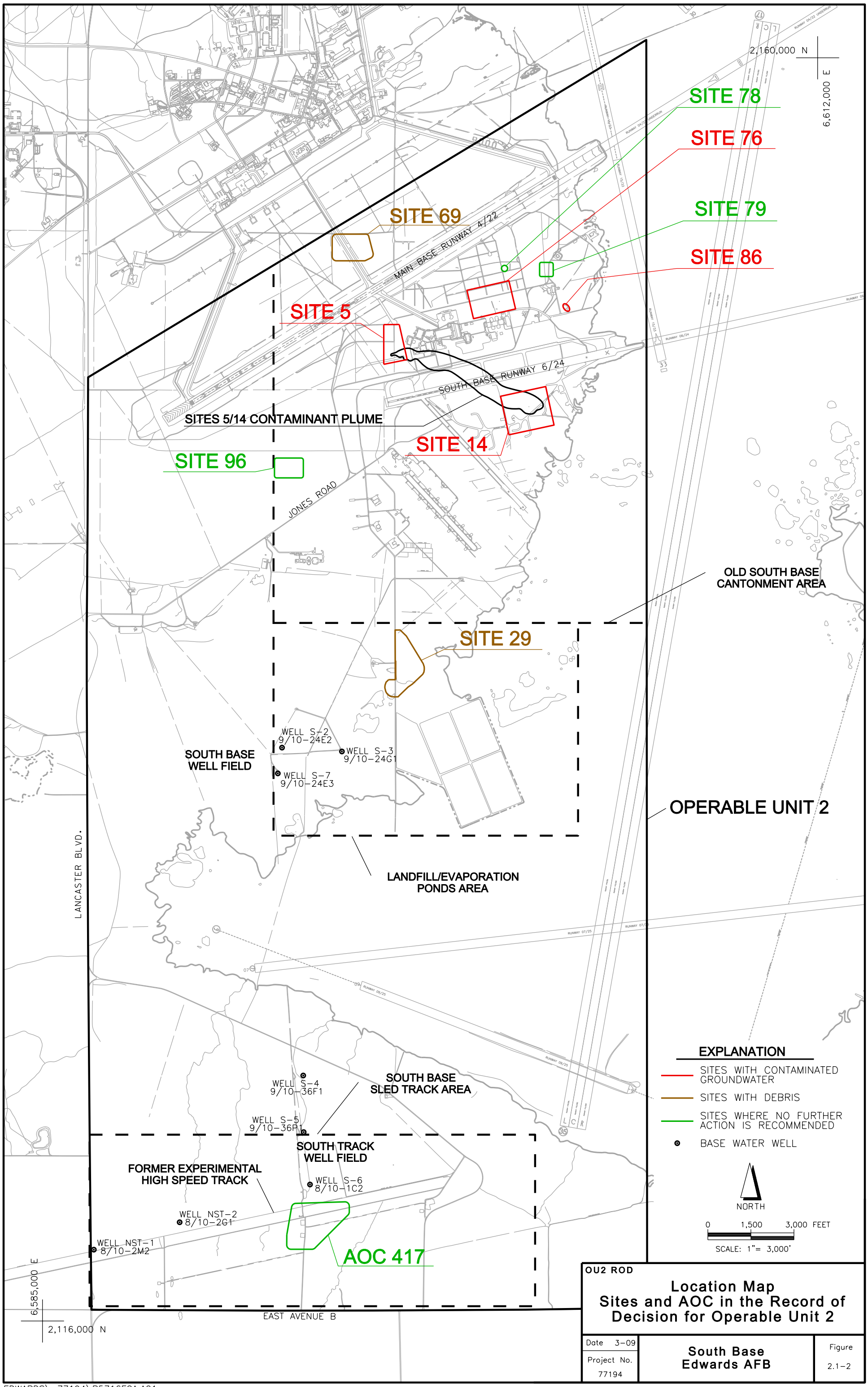
OU1	MAIN BASE FLIGHTLINE
OU2	SOUTH BASE
OU3/OU7	BASEWIDE WATER WELLS/BASEWIDE MISCELLANEOUS
OU4	AIR FORCE RESEARCH LABORATORY
OU5/10	NORTH BASE
OU6	NASA DRYDEN
OU8	NORTHWEST MAIN BASE
OU9	AIR FORCE RESEARCH LABORATORY – EAST

OU2 ROD

Location Map
Operable Unit 2
Edwards Air Force Base

Date 3–09	South Base Edwards AFB	Figure 2.1–1
Project No. 77194		

EDWARDS\ 77194\B5862FGA.A01


SITE 78
SITE 76
SITE 79
SITE 86
SITE 69
SITE 5
SITE 14
SITE 96
SITE 29
AOC 417
MAIN BASE RUNWAY 4/22
SOUTH BASE RUNWAY 6/24
JONES ROAD
SITES 5/14 CONTAMINANT PLUME
OLD SOUTH BASE CANTONMENT AREA
OPERABLE UNIT 2
SOUTH BASE WELL FIELD
WELL S-2 9/10-24E2
WELL S-3 9/10-24G1
WELL S-7 9/10-24E3
LANDFILL/EVAPORATION PONDS AREA
LANCASTER BLVD.
WELL S-4 9/10-36F1
WELL S-5 9/10-36P1
SOUTH BASE SLED TRACK AREA
SOUTH TRACK WELL FIELD
FORMER EXPERIMENTAL HIGH SPEED TRACK
WELL S-6 8/10-1C2
WELL NST-2 8/10-2G1
WELL NST-1 8/10-2M2
EAST AVENUE B
2,160,000 N
6,612,000 E
6,585,000 E
2,116,000 N
EXPLANATION
SITES WITH CONTAMINATED GROUNDWATER
SITES WITH DEBRIS
SITES WHERE NO FURTHER ACTION IS RECOMMENDED
BASE WATER WELL
NORTH
0 1,500 3,000 FEET
SCALE: 1"= 3,000'
OU2 ROD
Location Map
Sites and AOC in the Record of Decision for Operable Unit 2
Date 3-09
Project No. 77194
South Base
Edwards AFB
Figure 2.1-2
EDWARDS\ 77194\B5716FGA.A01

USEPA Region 9, Cal/EPA DTSC, and Water Board, Lahontan Region. The USAF, USEPA, Cal/EPA DTSC, and Water Board entered into a Federal Facility Agreement (FFA) for Edwards AFB in September 1990.

OU2 contains nine sites and one AOC that were former industrial facilities and landfills. These sites and AOC fall into three general categories:

- **No Further Action Sites.** Three former industrial facilities (Sites 78, 79, and 96) and an industrial support area for a former sled track (AOC 417) have been recommended for no further action because the contaminants originally found at the sites and AOC have been cleaned up, and the risks have been reduced to acceptable levels for unrestricted uses and unlimited exposures. One inactive landfill site (Site 69) contains only inert debris that is not regulated under CERCLA. Risks associated with this site are already at acceptable levels for unrestricted uses and unlimited exposures.

- **Sites with Groundwater Contamination.** Three former industrial facilities (Sites 5, 76, and 86) and a current fire fighting training facility (Site 14) are the origins for plumes of contaminated groundwater (Sites 5 and 14 are addressed in this document as a single site, the Sites 5/14 Contaminant Plume).

- **Site with Debris.** An inactive landfill (Site 29) contains debris that may leach contaminants to groundwater.

2.2 SOUTH BASE HISTORY AND ENVIRONMENTAL SETTING

2.2.1 SOUTH BASE HISTORY

Sites 5, 14, 69, 76, 78, 79, 86, and 96 are located on the western margin of Rogers Dry Lake, just south of the current Main Base runway. This area was the site of small farms and homesteads until Muroc Army Air Base was constructed in the early 1940s as a World War II test and training facility. The area was occupied until the mid-1950s when the Army turned over the facilities to the Air Force and new facilities were constructed in the current Main Base area. South Base was largely abandoned until the area was reactivated in the 1980s with the construction of the Birk Flight Test Facility (BFTF).

Site 29, the Old South Base Landfill, is located approximately 1.7 miles south of the BFTF. It was active from the late 1930s to the 1970s, a time span that saw both homestead and military use.

AOC 417 is located adjacent to the South Base rocket sled track. The original 10,000-foot Experimental High Speed Sled Track was constructed in 1948, and expanded to 20,000 feet in 1957. It is located approximately 5.5 miles south of the BFTF. Several active Edwards AFB groundwater supply wells are located near the South Base sled track.

A more comprehensive discussion of these areas within OU2 is presented in the *Environmental Restoration Program, Remedial Investigation Summary Report, South Base Operable Unit No. 2, Edwards AFB, CA* (Earth Tech 2004b), hereafter referred to as the *OU2 RI Summary Report*.

2.2.2 GEOLOGY

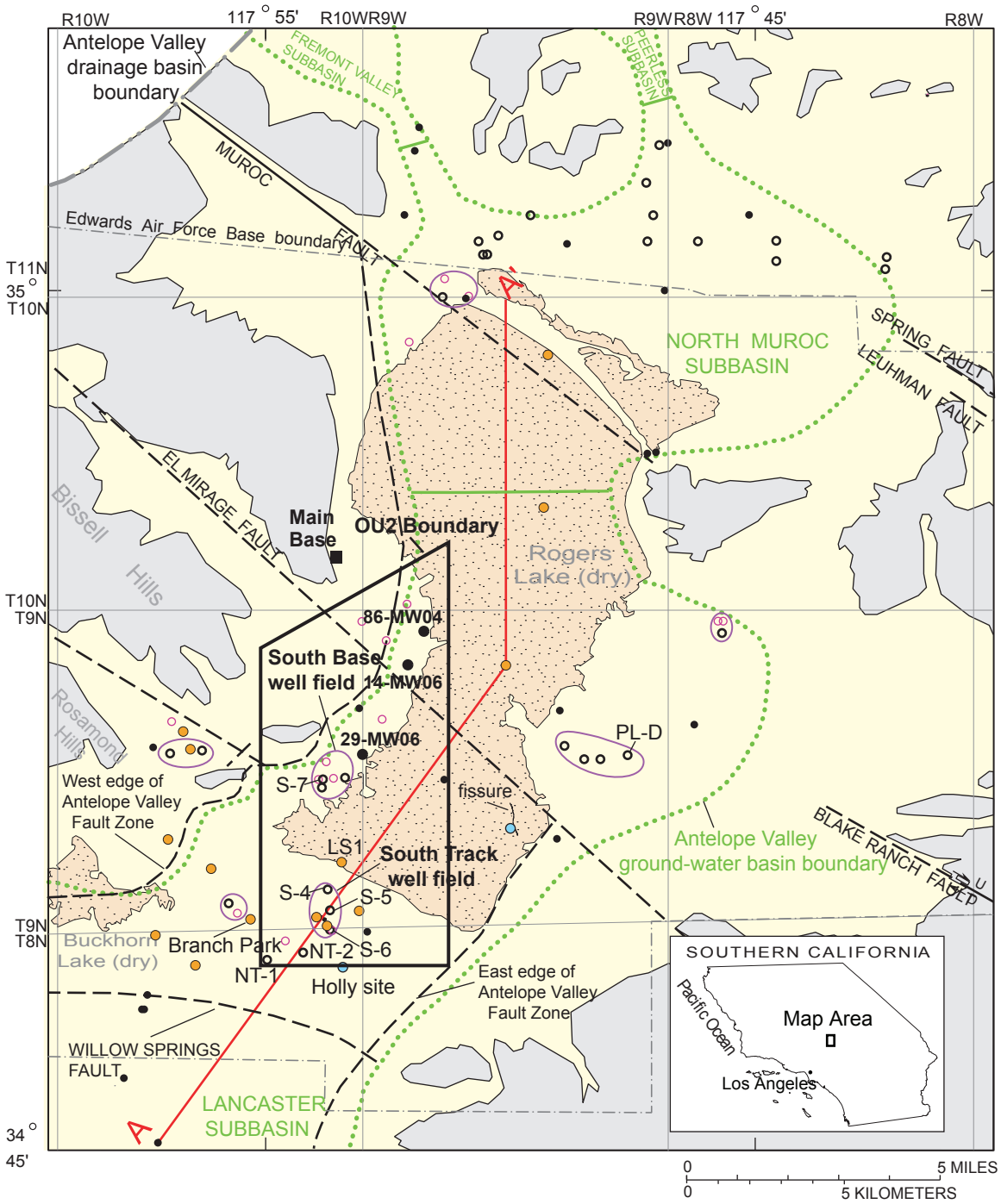
The geology at OU2 consists primarily of unconsolidated lakebed sediments composed of interfingering deposits of clay, silt, sand, clayey sand, silty sand, and gravel overlying granitic bedrock at depth (Dutcher and Worts 1963). The Bissell Hills - El Mirage Fault is a concealed (buried) fault that trends northwest to southeast across the southern part of the developed area of South Base (Rewis 1995). Bedrock is shallowest in the north-northwest part of the developed area, where it occurs at depths of approximately 85 feet below ground surface (bgs). Based on borehole logs, the top of bedrock appears to be a moderately to highly weathered, irregular surface that dips to the east-southeast beneath Rogers Dry Lake. In the areas in the vicinity of the Old South Base Landfill and South Base Sled Track, the unconsolidated sediments are more than 750 feet thick; bedrock was not encountered in any of the wells drilled in these areas.

A more comprehensive discussion of the geology at OU2 is presented in Section 1.2.1 of the *OU2 RI Summary Report* (Earth Tech 2004b).

2.2.3 HYDROGEOLOGY AND WATER SUPPLY

2.2.3.1 Hydrogeology

The main aquifer system at Edwards AFB is the Antelope Valley closed alluvial basin (Rewis 1995), which is comprised of several subbasins. OU2 is located in the Lancaster Subbasin that extends south-southwest from the southern part of Rogers Dry Lake (Figure 2.2-1). The aquifer system in the Lancaster Subbasin consists of three aquifers, the upper, middle, and lower aquifers, which were



EXPLANATION

- Playa deposits
- Younger alluvium
- Exposed basement complex
- A — A' Cross section line (see Figure 2.2-2)
- FAULT — Fault and name—Dashed where approximated
- Ground-water divide
- Monitoring well
- Piezometer(s)
- Piezometers and extensometer(s)
- Production well and name - Active, currently or recently pumped
- Inactive, abandoned; may be destroyed
- Well field

*Adapted from Sneed et. al. (2005).

OU2 ROD

Generalized Surface Geology and Groundwater Subbasins in the Area of South Base Operable Unit 2

Date 3-09	South Base	Figure
Project No. 77194	Edwards AFB	**2.2-1**

77194.30.04.92 OU2 ROD

identified on the basis of the hydrologic properties, age, and depth of the unconsolidated deposits (Leighton and Phillips 2003) (Figure 2.2-2).

In the BFTF area of OU2, groundwater in sufficient quantity to be used as a source of drinking water (including contaminated groundwater in the Sites 5/14, 76, and 86 plumes) is encountered at approximately 50 feet bgs in the upper aquifer. In this area, lakebed clays grade vertically downward into the moderately permeable alluvium of the middle aquifer. The direction of groundwater flow in the upper aquifer is to the southeast toward Rogers Dry Lake. Based on aquifer testing conducted at Site 5, the groundwater flow velocity is approximately 42 feet/year.

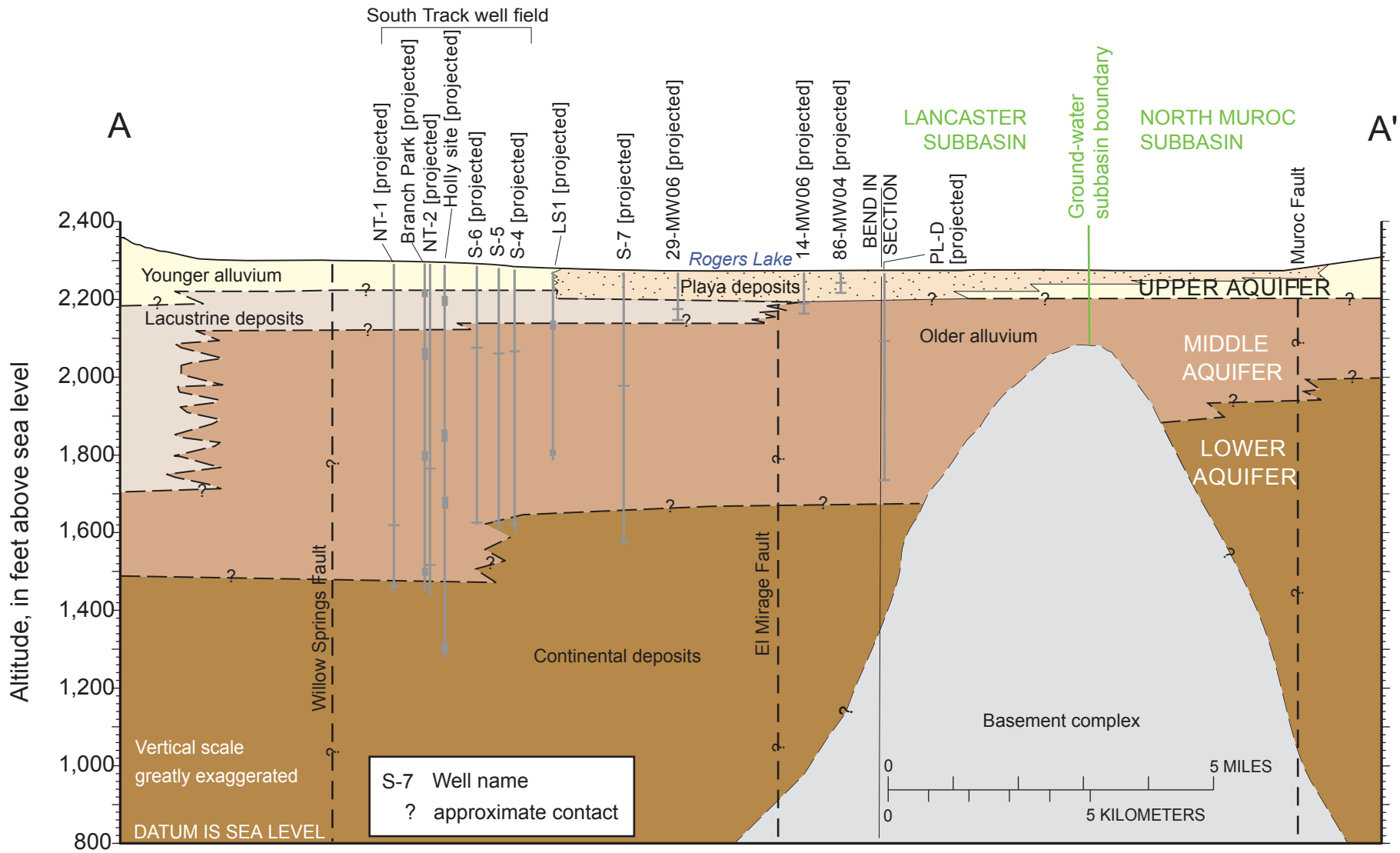
In the vicinity of Site 29, groundwater in the subsurface is present in a shallow, discontinuous zone of perched groundwater above the upper aquifer, and beneath the confining unit in the middle aquifer. The perched groundwater was encountered at a depth approximately 30 feet bgs in a zone of limited areal extent (i.e., in insufficient quantity to be a source of drinking water) (see Section 2.7.1.2); the well installed at Site 29 to sample the perched groundwater is now dry. Groundwater in the middle aquifer is encountered at 100 to 110 feet bgs.

In the South Base Sled Track Area, the unconfined upper aquifer is separated from the middle and lower aquifers by a southwest-dipping confining unit consisting primarily of bluish or greenish-gray lakebed clays of locally variable thickness (sometimes referred to as “blue clay” on lithologic logs).

2.2.3.2 Water Supply

Prior to the establishment of Edwards AFB in the 1940s, the water supply in the area was primarily from historic homestead water wells, and was used for domestic and agricultural purposes. From the 1940s until early 1993, the water supply for the Base was primarily from groundwater production wells drilled and constructed by the Base.

The Base water supply comes from Base production wells (about 60 percent) and the Antelope Valley-East Kern (AVEK) Water Agency (about 40 percent). The Base contracted with AVEK, a State water project contractor, to reduce groundwater withdrawals from the local aquifer to minimize land and lakebed subsidence. From 1961 to 1991, 3.3 feet of land subsidence was measured at the South Track Well Field (Londquist et al. 1993). The detrimental effects of the subsidence include permanent



Line of section is shown on Figure 2.2-1.
Adapted from Sneed et. al. (2005).

OU2 ROD

Generalized Geologic and Hydrogeologic Cross Section

Date 3-09	South Base Edwards AFB	Figure
Project No. 77194		**2.2-2**

loss of aquifer storage, increased flooding, cracks and fissures at land surface, damage to man-made structures, and intangible economic costs (Leighton and Phillips 2003). The formation of cracks and fissures on the surface of Rogers Dry Lake are of particular concern because they interfere with the use of the lakebed as an emergency landing surface for aircraft.

There are currently eight active Base production wells at OU2: three at the South Base Well Field and five at the South Track Well Field. These wells pump groundwater from water-bearing zones in the confined middle aquifer. At these well fields, a cone of depression with a steep hydraulic gradient has developed around the producing wells; consequently, the groundwater flow direction in the middle aquifer is toward the producing wells. Static groundwater levels in the producing wells range from approximately 128 feet bgs in wells at the South Base Well Field to approximately 270 feet bgs in a well at the South Track Well Field. Based on historical groundwater data, the groundwater level in the vicinity of the BFTF has declined approximately 16 feet since the 1940s due to groundwater withdrawal, primarily from Base water supply wells at the South Base Well Field located in the central part of OU2 (Earth Tech 2005c).

AVEK, which also supplies drinking water to the surrounding communities of Lancaster, Palmdale, Rosamond, Mojave, California City, and Boron, gets its water from the California Aqueduct which brings water to the region from northern California, not from local wells.

2.2.4 ECOLOGICAL SETTING

Two commonly recognized plant communities are present at OU2: arid-phase saltbush scrub and halophytic-phase saltbush scrub (United States Department of the Interior 1994). Joshua trees (*Yucca brevifolia*) are present in some areas of the halophytic community. Saltbush (*Atriplex* species [spp.]) occupies the hard clay pan areas around the dry lakebeds. Opportunistic plants (i.e., weeds) are now common in areas that once supported native saltbush before the area was heavily disturbed during construction activities. Typical opportunistic plants include nonnative species such as red-stemmed filaree (*Erodium cicutarium*), red brome (*Bromus rubens*), Mediterranean grass (*Schismus barbatus*), and Russian thistle (*Salsola iberica*).

The most commonly observed mammal species at OU2 are lagomorphs such as the desert cottontail (*Sylvilagus auduboni*) and the black-tailed hare (*Lepus californicus*). Coyote (*Canis latrans*), desert kit

fox (*Vulpes macrotis*), antelope ground squirrel (*Ammospermophilus leucurus*), kangaroo rat (*Dipodomys* spp.), pocket mouse (*Perognathus* spp.), and desert woodrat (*Neotoma lepida*) are also common.

The side-blotched lizard (*Uta stansburiana*) is the most commonly observed reptile at OU2. The western whiptail lizard (*Chemidophorus tigris*), glossy snake (*Arizona elegans*), and Mojave green rattlesnake (*Crotalus scutulatus*) are also common. Burrows of the California desert tortoise (*Gopherus agassizii),* a Federal- and State-listed threatened species, have been observed in the Landfill/Evaporation Ponds Area, which includes Site 29. However, OU2 does not encompass any California desert tortoise critical habitat as designated by the United States Fish and Wildlife Service (USFWS) (USAF 2002). The California desert tortoise is the only Federal-listed resident species on Edwards AFB (Higginbotham/Briggs & Associates [HB&A] 2001).

The bird population at OU2 fluctuates due to seasonal bird migrations. Typical resident species include the red-tailed hawk (*Buteo jamaicensis*), loggerhead shrike (*Lanius ludoviscianus*), sage sparrow (*Amphispiza belli*), and western meadowlark (*Sturnella neglecta*). The European starling (*Sturnus vulgaris*) and the rock dove (*Columba livia*) are common in areas that have been disturbed due to construction activities.

2.2.5 CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES

All current and potential future land and resource uses for sites contained in this ROD are equivalent to "industrial" for risk assessment purposes. According to the *General Plan for Edwards AFB (General Plan)* (HB&A 2001), the BFTF Area and the area surrounding Site 29 are located within the Developed Area of the Base that has industrial use for aircraft maintenance and support. The current land use designations in the BFTF area include Aircraft Clearances, Engineering Test, Buffer Zone, Industrial, and Lakebed - Non-Maintained Landing Site. The current land use designations in the Site 29 area include Industrial, Engineering Test/Aircraft Overflight Test Area, and Lakebed – Non-Maintained Landing Site. The current land use designation in the South Base Sled Track Area is Engineering Test/Aircraft Overflight Test Area. According to the *General Plan*, which indicates future land use out for a period of five years, land use at OU2 is expected to be similar to current use. There are no

current or anticipated residential or sensitive uses (e.g., daycares, hospitals, etc.) in any portion of OU2. No part of OU2 has been designated as critical habitat for threatened or endangered species.

The Water Board has assigned a beneficial use designation of potential drinking water supply to the groundwater at OU2.

No permanent surface water bodies exist at OU2. Stormwater at OU2 drains to Rogers Dry Lake via surface runoff, engineered drainages, and storm drains. During most winters, standing water collects on Rogers Dry Lake bed. The terrain within OU2 south of Jones Road is generally poorly-drained stabilized dune topography, with numerous small clay pans between the dunes that become shallow, ephemeral ponds after heavy rainfalls.

Southeast of Site 29, effluent from a wastewater treatment plant is present periodically in evaporation ponds. Southwest of Site 29, inactive evaporation ponds used by the former wastewater treatment plant are usually dry; however, ephemeral ponds form after heavy rainfalls due to poor drainage.

2.3 COMMUNITY PARTICIPATION

Community members and local government agencies have been kept informed on ERP activities and have had opportunities for involvement in the decision-making process for the remediation of OU2 sites throughout the CERCLA process. Highlights of the community involvement program are discussed below.

2.3.1 RESTORATION ADVISORY BOARD

The Edwards AFB Restoration Advisory Board (RAB) is a voluntary group that meets quarterly to facilitate the exchange of information and concerns between the on-Base and off-Base communities, Federal and State regulatory agencies, and the Edwards AFB environmental cleanup program managers.

The RAB was formed in late 1994, replacing the Technical Review Committee (TRC), which was established after Edwards AFB was named to the NPL in 1990. The RAB has 14 appointed public representatives (two of which are alternates); a USAF Co-chair; and Remedial Project Managers (RPMs) from Edwards AFB, the USEPA, Cal/EPA DTSC, and Water Board, Lahontan Region. Off-Base communities represented on the RAB include Boron, California City, Lancaster, Mojave,

North Edwards, and Rosamond. On-Base communities consist of Base Housing, Main Base Air Base Wing, Main Base Test Wing, National Aeronautics and Space Administration (NASA) Dryden Flight Research Center (DFRC), South Base, and the Air Force Research Laboratory (AFRL). One appointed public representative is elected by the group to serve as the Public Co-chair.

2.3.2 REPORT TO STAKEHOLDERS

The Report to Stakeholders (RTS), a monthly newsletter published by Edwards AFB, was developed for the RAB. The newsletter originally focused on hazardous waste cleanup at Edwards AFB, explaining how cleanup technologies work, providing status reports on key ERP activities, and introducing RAB members through in-depth interviews. The RAB members use the newsletter as a reference tool to educate their communities. In September 2004, the RTS began news coverage of other environmental activities at Edwards AFB to include conservation and compliance issues. Edwards AFB currently distributes 6,000 copies of the RTS every month. The public may also access the newsletter on the World Wide Web.

2.3.3 ADMINISTRATIVE RECORD AND INFORMATION REPOSITORIES

The Administrative Record File is maintained at the 95th Air Base Wing, Environmental Management Directorate, 5 East Popson Avenue, Building 2650A, Edwards AFB, California 93524. In addition, copies of a subset of the data and documents contained in the Administrative Record File and a complete listing of all documents contained in the Administrative Record File are available for public review in information repositories located in the cities of Lancaster and Rosamond, as well as at Edwards AFB.

Edwards AFB Library
5 West Yeager Boulevard
Building 2665
Edwards AFB, CA 93524-1295
(661) 275-2665

Kern County Public Library
Wanda Kirk Branch
3611 West Rosamond Boulevard
Rosamond, CA 93560
(661) 256-3236

Los Angeles County Public Library
601 West Lancaster Boulevard
Lancaster, CA 93534
(661) 948-5029

2.3.4 COMMUNITY INVOLVEMENT

Public meetings were held at Edwards AFB prior to the implementation of interim removal actions at Sites 5, 14, and 29, in order to present the findings of the Engineering Evaluation/Cost Analysis (EE/CA) prepared for each of the sites (Earth Tech 1996f, 1997e, 1997f) and to obtain public concurrence with the selected alternatives. For Site 5, meetings were held at Building 130A within the BFTF and at Building 320 in the Aero Club classroom on 21 May 1996. For Site 14, a meeting was held at the Fire Fighting Training Classroom on 30 May 1997. For Site 29, a meeting was held at Building 2650A at the Environmental Management Office on 23 January 1997.

An overview of the *OU2 Proposed Plan* was presented at a series of RAB meetings held in 2005 and 2006. Notices of availability of the *OU2 Proposed Plan* were published in the Antelope Valley Press and Mojave Desert News (local area newspapers) on 31 August 2006 and in the Desert Wings (a publication of Edwards AFB) on 1 September 2006. A public comment period was held from 31 August to 2 October 2006. During the public comment period, the *OU2 RI Summary Report*, *OU2 FS*, and *OU2 Proposed Plan* were made available to the public.

Public meetings were held on 28 September 2006 to present the *OU2 Proposed Plan* to a broader community audience. A transcript of the public meetings is available in the Administrative Record File for OU2. No public comments were received.

2.4 SCOPE AND ROLE OF THE OPERABLE UNIT

Operable Units (OUs) at Edwards AFB are used to group sites with similar site conditions and contaminants, and facilitate the administration of the ERP. OU2 is one of 10 operable units designated on Edwards AFB. OU2 is bordered to the north by OU1, Main Base Flightline, to the east by Rogers Dry Lake, and to the south and west by OU3, Basewide Water Wells and OU7, Basewide Miscellaneous.

OU2 was designated in order to identify and investigate former buildings, training facilities, maintenance facilities, underground storage tanks, and other storage areas at South Base; and to

remediate any soil and groundwater contamination that may pose a direct threat to human health or the environment. A total of 64 sites and AOCs were identified and investigated between 1993 and 2005.

Based on the results of the investigations, 34 sites and AOCs were considered closed in the Site Investigation phase of CERCLA because they only had petroleum hydrocarbons as potential contaminants (i.e., fuel underground storage tank or fuel pipeline sites), and are therefore excluded from CERCLA based on the definition of a hazardous substance (42 USC 9601(14)). The cleanup and closure of these sites is being administered by the Kern County Environmental Health Services Department. A total of 18 sites were closed in the Site Inspection phase because they were found to pose no risk to human health and the environment. Two sites require further investigation and will be documented in a future ROD.

The remaining nine sites and one AOC are documented in this ROD as follows:

- Site 69 is a landfill site that only contains inert debris that is not regulated under CERCLA. The USAF, USEPA, Cal/EPA DTSC, and Water Board agree that no further action is required for this site.

- Interim removal actions were conducted at Sites 78, 79, and 96, and AOC 417. The USAF, USEPA, Cal/EPA DTSC, and Water Board agreed that no further action was required and that the results of the interim removal actions should be documented in the *OU2 Proposed Plan* and ROD.

- Sites 5, 14, 76, and 86 are sites with contaminated groundwater that pose minimal risk to human health and the environment under current and likely future land uses, but the groundwater has been designated as a potential source of drinking water and must be remediated.

- Site 29 is a landfill site that was evaluated to pose minimal current risk to human health and the environment; however, the site may contain buried hazardous wastes and unexploded ordnance (UXO). The USAF, USEPA, Cal/EPA DTSC, and Water Board agreed that the evaluation of remedial alternatives to protect human health and the environment from potential hazardous wastes and UXO was required for this site.

2.5 DECISION SUMMARY - NO FURTHER ACTION SITES

2.5.1 SITE 69

2.5.1.1 Site Name, Location, and Brief Description

Site 69, Old South Base North Landfill, is located approximately 1,000 feet north of Main Base Active Runway 04/22. Taxiway B runs through the site, which encompasses approximately 28 acres (Figure 2.5-1). The site is thought to have been used by the military from the early 1940s to the mid-1950s, although some homestead debris may be older (circa mid-1930s). Waste is deposited in scattered pits throughout the site. The surface of the site is currently covered with scattered rusted cans, broken glass, metal wire, and railroad debris.

2.5.1.2 Site History and Enforcement Activities

Site History

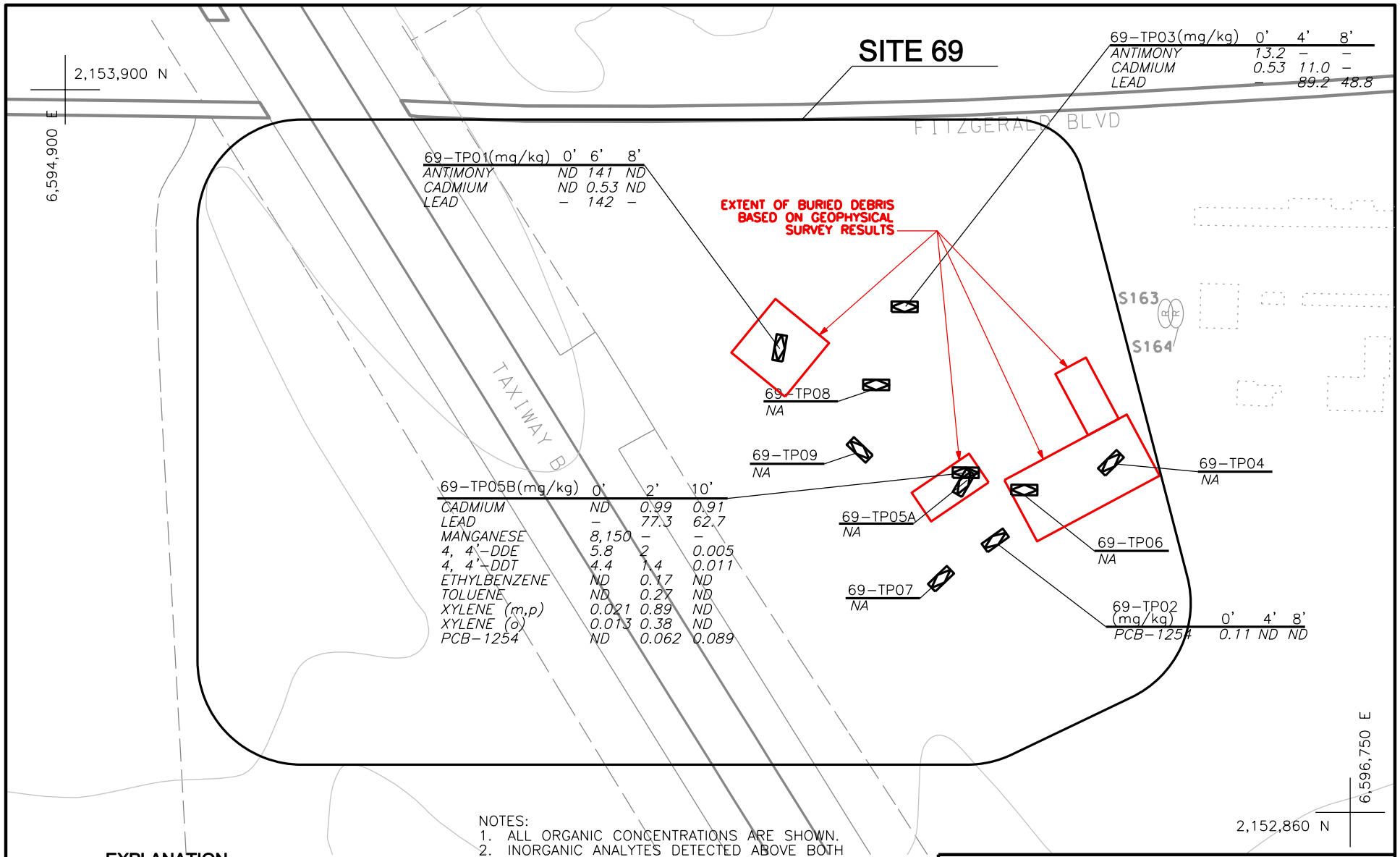
Site 69 was identified as an area requiring further investigation in *Installation Restoration Program, Remedial Investigation/Feasibility Study, Work Plan, Sampling and Analysis Plan, and Health and Safety Plan, South Base Operable Unit No. 2, Edwards AFB, CA* (The Earth Technology Corporation [Earth Technology] 1993a), hereafter referred to as the *RI/FS WP/SAP*; and *Installation Restoration Program, Expanded Source Investigation/RCRA Facility Assessment, Appendix B, South Base, Edwards AFB, CA, Technical Report* (Earth Technology 1993b), hereafter referred to as the *ESI/RFA Technical Report*.

Remedial Investigations

In June and July 1993, the USAF conducted a geophysical survey at Site 69 to map the extent of the buried wastes (Earth Technology 1994d). Four areas, encompassing approximately 0.9 acres in total, were identified by the survey.

In September 1993, a soil gas survey was conducted at 44 sample locations to further investigate the geophysical anomalies identified during the geophysical survey (Earth Technology 1993c).

In 1995, ten test pits were excavated to depths ranging from four feet bgs to 10 feet bgs in the areas of the geophysical anomalies and verified the presence of buried debris (Earth Tech 1996a). Soil samples were also collected and sent to off-Base laboratories for analysis.



NOTES:
1. ALL ORGANIC CONCENTRATIONS ARE SHOWN.
2. INORGANIC ANALYTES DETECTED ABOVE BOTH BACKGROUND VALUES AND RESIDENTIAL PRGS (USEPA 2002) ARE SHOWN.

EXPLANATION

⊠	EXISTING TEST PIT LOCATION
–	DETECTED BELOW BACKGROUND CONCENTRATION
NA	NOT ANALYZED
ND	NOT DETECTED
4,4'-DDE	DICHLORODIPHENYLDICHLOROETHYLENE
4,4'-DDT	DICHLORODIPHENYLTRICHLOROETHANE
PCB	POLYCHLORINATED BIPHENYL
mg/kg	MILLIGRAMS PER KILOGRAM

SAMPLING LOCATION (UNIT) DEPTH
PARAMETER *VALUE*

NORTH

0 100 200 FEET

SCALE: 1"= 200'

OU2 ROD

Location Map
Site 69

Date 3-09

Project No. 77194

South Base
Edwards AFB

Figure 2.5-1

EDWARDS\ 77194\B5725FGA.A01

Interim Removal Actions

No interim removal actions have been performed at Site 69.

Nature and Extent of Residual Site Contamination

The debris excavated from the test pits at Site 69 included glass jars and bottles, wood chips, burnt metal, twisted wire, porcelain fragments, charcoal, rubber cable, bricks, burnt piping, nails, and fencing materials. In addition, two drums containing tar were recovered (Earth Tech 2005c).

Organic compounds (fuel and solvents, pesticides, and polychlorinated biphenyls [PCBs]) and metals and other elements were detected in the soil samples collected at Site 69 (see Figure 2.5-1). With the exception of two detections of 4,4-dichlorodiphenyldichloroethylene (4,4-DDE) and one detection of 4,4-dichlorodiphenyltrichloroethane (4,4-DDT) in shallow soil samples (less than two feet bgs), the contaminants detected in the soil were at concentrations below the residential PRGs (Table 2.5-1). None of these contaminants are present at concentrations that could threaten groundwater, which occurs at a depth of approximately 50 feet bgs (Earth Tech 2005c).

2.5.1.3 Summary of Site Risks

Human Health Risk

The results of the human health risk assessment (HHRA) are summarized in Table 2.5-2. A more comprehensive discussion of the HHRA for this site is presented in the *Human Health Risk Assessment, South Base, Operable Unit 2, Edwards AFB, CA* (Earth Tech 2003b), hereafter referred to as the *South Base HHRA* (Earth Tech 2003b).

The cancer risk for future residents exposed to the soil at Site 69 is considered acceptable. The noncancer Hazard Index (HI) for future residents exposed to the soil at Site 69 is considered unacceptable. However, the noncancer HI may be overstated. The constituents that accounted for the majority of the noncarcinogenic risk (antinomy and manganese) only exceeded the residential PRGs in one of 15 samples.

The cancer risk and noncancer HI for industrial workers exposed to the soil at Site 69 are considered acceptable.

TABLE 2.5-1. MAXIMUM CONCENTRATIONS OF ORGANIC AND INORGANIC CONSTITUENTS DETECTED IN SOIL COMPARED TO CALCULATED BACKGROUND CONCENTRATIONS AND RESIDENTIAL PRGs - SITE 69

(Page 1 of 2)

Analyte	Maximum Concentration (mg/kg)	Location ID of Maximum Concentration	Sample Depth (ft bgs)	No. Detections/ Total No. Samples	Calculated Background Concentration [a] (mg/kg)	No. Samples Exceeding Background/ Total No. Samples	2000 Residential PRG [b] (mg/kg)	No. Samples Exceeding Residential PRG/Total No. Samples
Petroleum Hydrocarbons								
petroleum hydrocarbons, total recoverable	99	69-TP01	6	8/15	-	-	NP	-
Volatile Organics								
ethylbenzene	0.17	69-TP05B	2	1/15	-	-	230	0/15
toluene	0.27	69-TP05B	2	1/15	-	-	520	0/15
m- & p-xylene	0.89	69-TP05B	2	2/15	-	-	210	0/15
o-xylene	0.38	69-TP05B	2	2/15	-	-	210	0/15
Pesticides and PCBs								
Aroclor 1254	0.11	69-TP02	0	3/15	-	-	0.22	0/15
Aroclor 1260	0.041	69-TP02	8	1/15	-	-	0.22	0/15
alpha-chlordane	0.0082 (J1)	69-TP05B	0	1/15	-	-	NP	-
4,4'-DDD	0.0083	69-TP05B	10	1/15	-	-	2.4	0/15
4,4'-DDE	5.8	69-TP05B	0	3/15	-	-	1.7	2/15
4,4'-DDT	4.4	69-TP05B	0	4/15	-	-	1.7	1/15
Metals and Other Elements								
aluminum	8,020	69-TP01	0	15/15	35,900	0/15	76,000	0/15
antimony	141	69-TP01	6	2/15	6	2/15	31	1/15
arsenic	8.6	69-TP05B	10	15/15	22.7	0/15	0.39	15/15
barium	127	69-TP01	6	15/15	301	0/15	5,400	0/15
beryllium	0.42	69-TP01	0	12/15	1.4	0/15	150	0/15
cadmium	11.0	69-TP03	4	5/15	0.5	5/15	9	1/15
calcium	21,000	69-TP01	6	15/15	129,000	0/15	NP	-
chromium, total	36.1	69-TP01	6	15/15	39.1	0/15	210	0/15
cobalt	4.1	69-TP05B	10	14/15	18	0/15	4,700	0/15
copper	26.3	69-TP01	6	14/15	48.7	0/15	2,900	0/15
iron	27,600	69-TP05B	10	15/15	36,100	0/15	23,000	2/15
lead	142	69-TP01	6	15/15	28.2	5/15	400	0/15

TABLE 2.5-1. MAXIMUM CONCENTRATIONS OF ORGANIC AND INORGANIC CONSTITUENTS DETECTED IN SOIL COMPARED TO CALCULATED BACKGROUND CONCENTRATIONS AND RESIDENTIAL PRGs - SITE 69

(Page 2 of 2)

Analyte	Maximum Concentration (mg/kg)	Location ID of Maximum Concentration	Sample Depth (ft bgs)	No. Detections/ Total No. Samples	Calculated Background Concentration [a] (mg/kg)	No. Samples Exceeding Background/ Total No. Samples	2000 Residential PRG [b] (mg/kg)	No. Samples Exceeding Residential PRG/Total No. Samples
Metals and Other Elements *(Continued)*								
magnesium	4,330	69-TP01	0	15/15	30,900	0/15	NP	-
manganese	8,150	69-TP05B	0	15/15	905	1/15	1,800	1/15
nickel	11.8	69-TP01	6	9/15	16.9	0/15	150	0/15
potassium	3,610	69-TP01	0	15/15	10,900	0/15	NP	-
selenium	1.1	69-TP05B	10	4/15	0.5	4/15	390	0/15
sodium	744	69-TP01	6	11/15	12,500	0/15	NP	-
vanadium	19.7	69-TP01	0	15/15	74.5	0/15	550	0/15
zinc	201	69-TP05B	2	15/15	107	4/15	23,000	0/15

Notes:

Data for soil samples collected in May 1995.

[a] Background level calculated for OU2 (Earth Tech 1995).

[b] USEPA Region IX PRGs (USEPA 2000).

-	not applicable
4,4'-DDD	dichlorodiphenyldichloroethane
4,4'-DDE	dichlorodiphenyldichloroethylene
4,4'-DDT	dichlorodiphenyltrichloroethane
ft bgs	feet below ground surface
mg/kg	milligrams per kilogram
NP	not promulgated
PCBs	polychlorinated biphenyls
PRG	Preliminary Remediation Goal
USEPA	United States Environmental Protection Agency

Earth Tech Data Qualifier:

(J1) Blank contamination: indicates possible high bias and/or false positives. Blank level multiplied by 5 is higher than sample results, except for contamination from methylene chloride, acetone, 2-butanone and common phthalate esters where the multiplier is 10.

TABLE 2.5-2. SUMMARY OF HUMAN HEALTH RISK ASSESSMENT RESULTS - SITE 69

Potential Exposure Pathway	Exposure Medium	Cancer Risk[a]	Primary Risk Drivers[b]	Noncancer Hazard Index[c]	Primary Risk Drivers[b]
Residential (Hypothetical future)	Soil	$8x10^{-6}$	None	**9.5**[d]	Antimony (48%) Manganese (48%)
	Groundwater	NA	NA	NA	NA
	Indoor Air	NA	NA	NA	NA
Industrial	Soil	$1x10^{-6}$	None	0.64	None
	Groundwater	NA	NA	NA	NA
	Indoor Air	NA	NA	NA	NA
Construction Worker	Soil	$2x10^{-8}$	None	0.24	None
	Groundwater	NA	NA	NA	NA
	Indoor Air	NA	NA	NA	NA

Notes:

[a] To manage risks from known or suspected carcinogens, the United States Environmental Protection Agency (USEPA 1980) has developed the following exposure range: more than one additional cancer case for 10,000 people is unacceptable (i.e., greater than $1x10^{-4}$); one additional cancer case for 10,000 to one million people is considered generally acceptable (i.e., between $1x10^{-4}$ and $1x10^{-6}$); and one additional cancer case for one million or more people is considered acceptable (i.e., less than $1x10^{-6}$). However, if multiple contaminants are present and multiple pathways of exposure exist, the more stringent end of the range should be used to establish cleanup goals.

[b] As determined by the Human Health Risk Assessment (Earth Tech 2003b). "None" indicates that there are no primary risk drivers because the total risk is characterized as generally acceptable or acceptable according to the USEPA (1980) exposure range. If a constituent is shown as a primary risk driver, the number in parentheses is the percentage of the risk accounted for by the constituent.

[c] A Hazard Index less than 1 is considered generally acceptable (USEPA 1991).

[d] Calculated value is based on an isolated, single occurrence.

% percent

NA Not applicable; no exposure pathway identified during the risk assessment (Earth Tech 2003b)

Ecological Risk

The ecological risk assessment for Site 69 determined the potential risk to some types of wildlife might be significant because the habitat at Site 69 is attractive to certain types of wildlife, and because of the potentially slow rate of habitat recovery (United States Geological Survey [USGS] 2004). However, the risk assessors determined that the contaminants are limited to a single small isolated area, and that there was no consistent and substantial risk from the contaminants to the plant and animal communities as a whole.

Threat to Groundwater or Surface Water

There is no threat to groundwater from constituents remaining in soil at Site 69 because all constituents were evaluated and determined to be either naturally occurring, readily degradable, or at concentrations unlikely to impact groundwater. There is no surface water present at Site 69.

2.5.1.4 Statutory Determinations

The RPMs concurred at the 7 August 2008 OU2 ROD Remedial Project Manager Technical Meeting (see Appendix A, Memorandum dated 17 September 2008) that No Further Action (NFA) for soil and groundwater is required for Site 69 because the site contains inert debris that should not be regulated under CERCLA. NFA is protective of human health and the environment.

2.5.1.5 Documentation of Significant Changes from the OU2 Proposed Plan

The *OU2 Proposed Plan* includes a selected remedy for Site 69. Because test pits excavated in the landfill indicated that the debris at Site 69 was of a pre-military era origin and inert, a determination was made that the site should not be regulated under CERCLA, and the remedy in the *OU2 Proposed Plan* should not be implemented. Instead, any future remediation of Site 69 will be addressed outside this ROD and the CERCLA process.

2.5.2 SITES 78 AND 79

2.5.2.1 Site Name, Location, and Brief Description

Sites 78 and 79 are located north of South Base Active Runway 06/24 (see Figure 2.1-2).

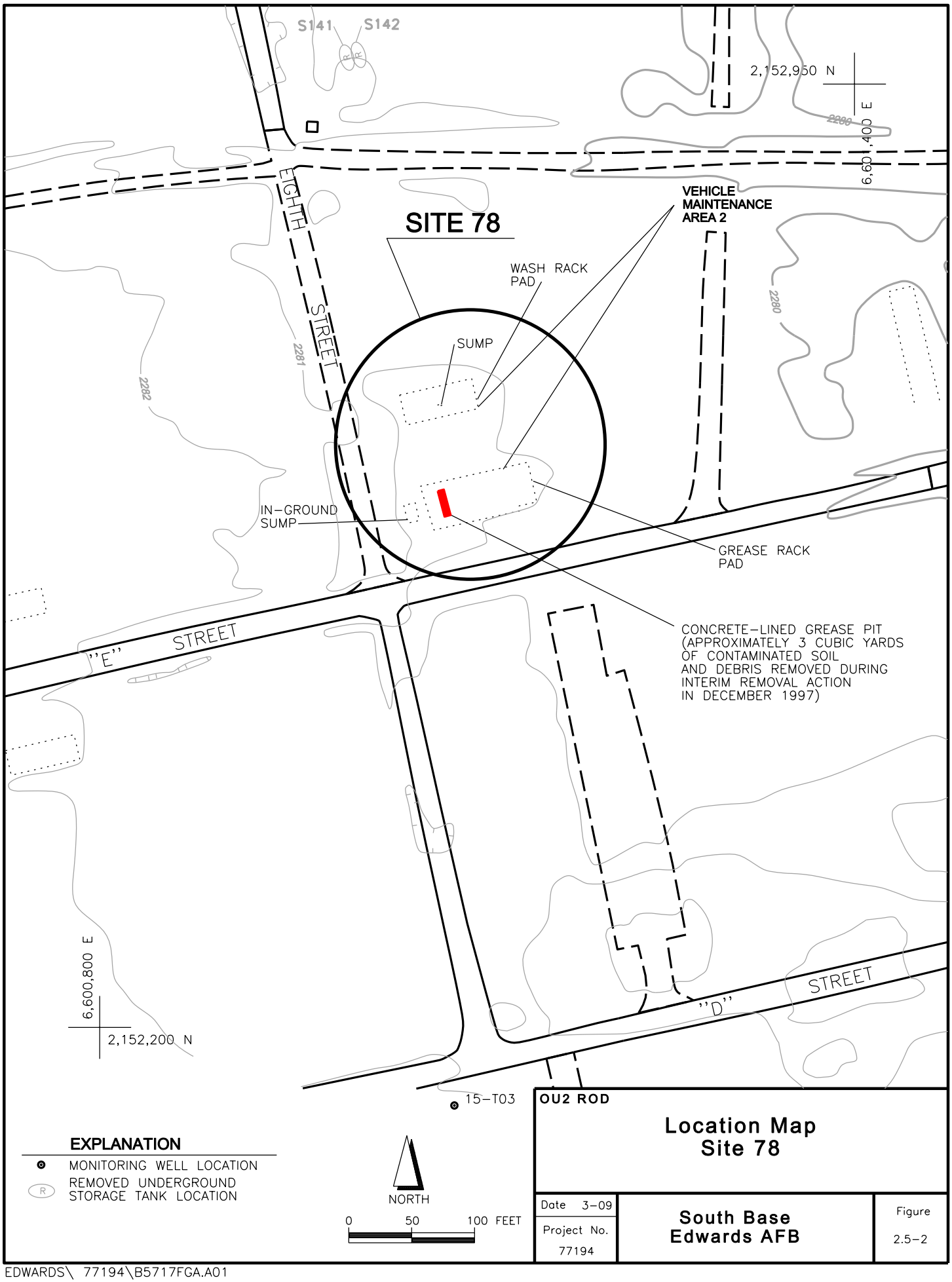
Site 78

Site 78, Old South Base Vehicle Maintenance Area 2, is located on the northeastern corner of "E" and 8th Streets, and encompasses approximately 0.8 acres (Figure 2.5-2). The maintenance area consisted of a wash rack and a grease rack used in the 1940s to service vehicles. Structures at the site are no longer standing. During a 1991 site visit, concrete pads for a wash rack (25 feet by 60 feet) and a grease rack (40 feet by 85 feet) were identified.

A vehicle lubrication grease pit (20 feet by 3 feet by 5 feet deep) is located in the grease rack pad. The grease pit is concrete-lined, and was partially filled with soil, paint, piping, tires, timber, and construction debris. A sump (8 feet by 4 feet by 6 feet deep) is located near the grease rack. Another sump (4 feet by 1 foot by 1 foot deep) is located in the center of the wash rack pad. The purpose of these two sumps is unknown.

Site 79

Site 79, Old South Base Vehicle Maintenance Area 1, is located west of 10th Street and encompasses approximately five acres (Figure 2.5-3). The maintenance area included a repair shop and a wash rack used in the 1940s to service vehicles at the Old South Base. Structures at the site are no longer standing. Concrete pads for the repair shop and wash rack remain at the site. A grease pit (3 feet by 16 feet by 4 feet deep), located at one end of the repair shop, is concrete-lined and was partially filled with grease-stained soil. A second concrete pit (6 feet by 3 feet by 2 feet deep), located approximately 30 feet from the wash rack pad, may have been used as a sump for the wash rack. Site 79 also includes a pump house foundation containing a former Base water supply well (Well MB-05), which the USGS selected to use as a groundwater observation well in 1995. An underground storage tank (UST) was reportedly located adjacent to the foundation, and was used to store motor gas for the engine-driven pump. The UST was constructed of steel, and reportedly had a capacity of 285 gallons. A magnetometer survey was conducted in 1994 as part of the Underground Storage Tank Investigation (USTI) program that was administered by Kern County. No magnetic anomalies consistent with the presence of the UST were found, and it is presumed to have been removed when the facility was demolished.



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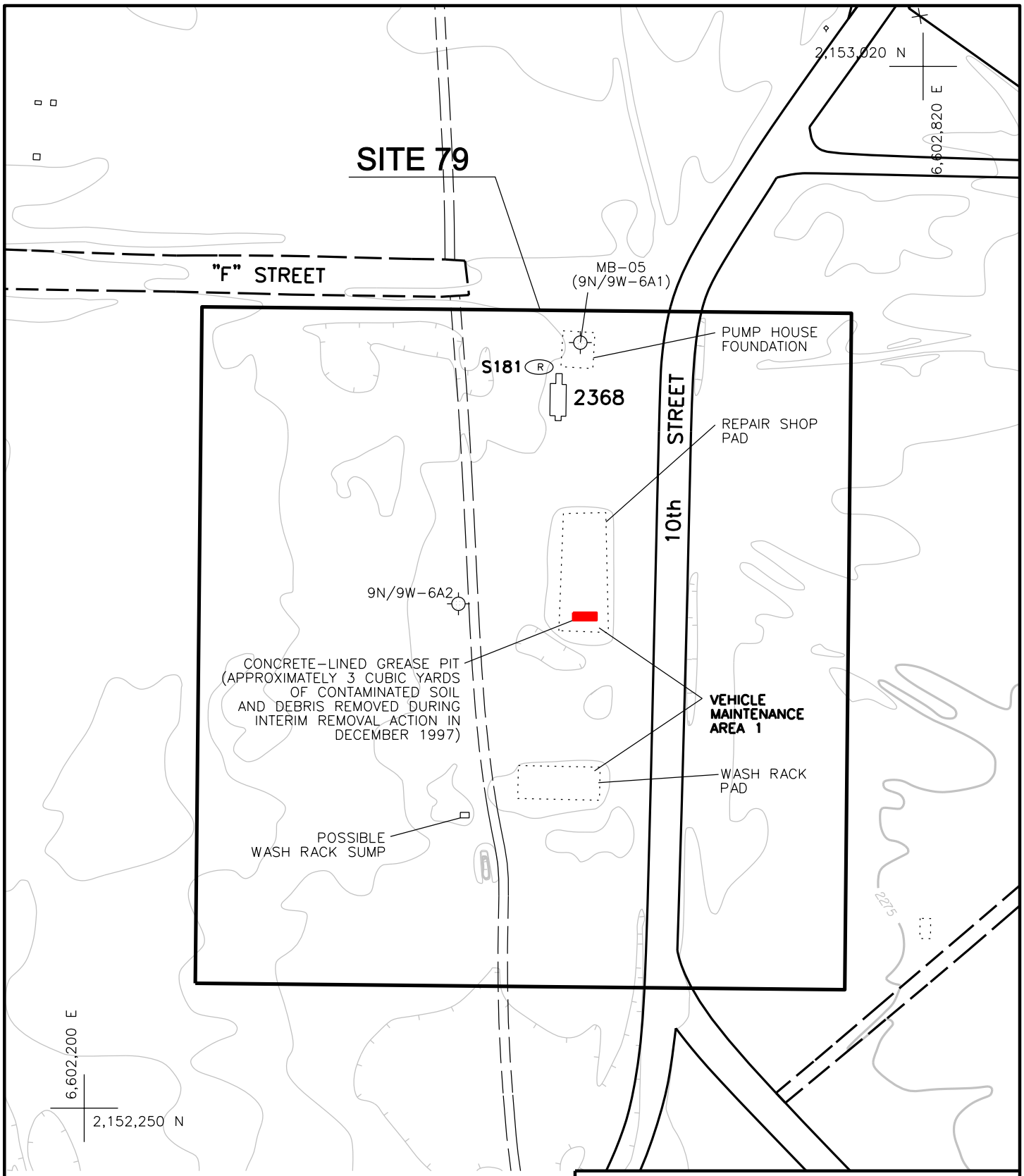

EXPLANATION

- HISTORIC WELL LOCATION
- (R) REMOVED UNDERGROUND STORAGE TANK LOCATION

NORTH

0 50 100 FEET

SCALE: 1"= 100'

OU2 ROD

Location Map
Site 79

Date 3-09	South Base Edwards AFB	Figure 2.5-3
Project No. 77194		

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2.5.2.2 Site History and Enforcement Activities

Site History

The facilities at Sites 78 and 79 were constructed in the early 1940s, and were demolished in the mid-1950s when activities were moved to the current Main Base area of Edwards AFB (U.S. Air Force Flight Test Center 2001).

Sites 78 and 79 were identified as areas requiring further investigation in the *RI/FS WP/SAP* (Earth Technology 1993a); and the *ESI/RFA Technical Report* (Earth Technology 1993b).

Remedial Investigations

RI activities performed at Sites 78 and 79 included soil gas sampling at one sample location at Site 78 in 1986, soil sampling at both sites from two hand-augered boreholes and six boreholes drilled to depths ranging from 40.5 feet bgs to 51.5 feet bgs using hollow-stem auger drilling methods in 1994 and 1995, and groundwater sampling from a groundwater monitoring well 600 feet east of Site 79 in 1993 and 1994. Borehole samples were collected adjacent to sumps, wash racks, and grease pits associated with the vehicle maintenance areas. Hand auger samples were collected within the soil-filled grease pits. Soil samples were analyzed for oil and grease, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and metals and other elements. Soil samples within the grease pits were found to be contaminated with oil and grease and lead, at maximum concentrations of 31,000 mg/kg and 871 mg/kg, respectively.

Groundwater samples were analyzed for VOCs, SVOCs, metals and other elements, and cyanide. Groundwater contaminants above background were limited to a detection of a single organic analyte, bis (2-ethylhexyl) phthalate, which is a common laboratory and field contaminant.

A more comprehensive discussion of the RI activities is presented in the *OU2 RI Summary Report* (Earth Tech 2004b).

Interim Removal Actions

Contamination at Sites 78 and 79 was limited to approximately three cubic yards of soil and debris contaminated with petroleum products and lead in concrete-lined grease pits at each site. A Treatability Study Work Plan was prepared to excavate and transport the contaminated soil and debris

(Earth Tech 1997d). The contaminated soil and debris were removed from the sites in December 1997. Soil was disposed at an off-Base disposal facility. Nonmetallic debris was transported to the Main Base Active Landfill, and metallic debris was transported to the Defense Reutilization Marketing Office Salvage Yard (Earth Tech 1998d). No cracks were found in the concrete lining of the grease pits; therefore, no soil samples were collected from under the grease pits. The grease pits were subsequently backfilled with clean soil.

Following the interim removal actions, at Site 78 no constituents other than arsenic remain on site above both background concentrations and residential PRGs (Table 2.5-3). The elevated arsenic concentration was only detected in one of the 10 samples collected at the site. Antimony and cadmium exceeded background concentrations in three of 10 samples and one of 10 samples, respectively, but were both below residential PRGs. Although these inorganic constituents were carried forward in the risk assessment, they are believed to be naturally occurring because there are no known anthropogenic sources of these constituents at the site.

At Site 79, no constituents other than arsenic remain on site above background concentrations (Table 2.5-4). The elevated arsenic concentration was only detected in one of the 10 samples collected at the site, and is considered to be naturally occurring because there are no known anthropogenic sources of arsenic at the site.

Nature and Extent of Residual Site Contamination

Because all contaminated soil was removed from the concrete-lined grease pits, and the pits were found to be intact with no cracks, no residual contaminants remain at Sites 78 and 79 that would limit exposure or restrict use.

2.5.2.3 Summary of Site Risks

Human Health Risk

An HHRA was conducted after the completion of the IRA for Sites 78 and 79. The results of the HHRA are summarized in Tables 2.5-5 and 2.5-6, respectively.

As shown in the tables, the calculated cancer risk estimates for soil in the residential, industrial, and construction worker scenarios are acceptable based on the risk ranges developed by the USEPA (1980).

TABLE 2.5-3. MAXIMUM CONCENTRATIONS OF ORGANIC AND INORGANIC CONSTITUENTS DETECTED IN SOIL COMPARED TO CALCULATED BACKGROUND CONCENTRATIONS AND RESIDENTIAL PRGs - SITE 78

Analyte	Maximum Concentration (mg/kg)	Location ID of Maximum Concentration	Sample Depth (ft bgs)	No. Detections/ Total No. Samples	Calculated Background Concentration [a] (mg/kg)	No. Samples Exceeding Background/ Total No. Samples	2000 Residential PRG [b] (mg/kg)	No. Samples Exceeding Residential PRG/Total No. Samples
Petroleum Hydrocarbons								
oil & grease	3,500	78-B01	0	1/10	-	-	NP	-
Metals and Other Elements								
aluminum	27,400	78-B03	25	10/10	35,900	0/10	76,000	0/10
antimony	10.1	78-B01	15	3/10	6	3/10	31	0/10
arsenic	23.2	78-B03	25	10/10	22.7	1/10	0.39	10/10
barium	202	78-B03	25	10/10	301	0/10	5,400	0/10
beryllium	1.1	78-B01	15	4/10	1.4	0/10	150	0/10
cadmium	0.64	78-B01	0	1/10	0.5	1/10	9	0/10
calcium	105,000	78-B01	15	10/10	129,000	0/10	NP	-
chromium, total	20.3	78-B03	25	10/10	39.1	0/10	210	0/10
cobalt	10.6	78-B03	25	8/10	18	0/10	4,700	0/10
copper	19.9	78-B01	0	6/10	48.7	0/10	2,900	0/10
iron	30,100	78-B01	15	10/10	36,100	0/10	23,000	3/10
lead	19.6	78-B01	0	4/10	28.2	0/10	400	0/10
magnesium	13,500	78-B01	0	10/10	30,900	0/10	NP	-
manganese	708	78-B03	25	10/10	905	0/10	1,800	0/10
nickel	14.0	78-B03	25	4/10	16.9	0/10	150	0/10
potassium	6,280	78-B01	0	10/10	10,900	0/10	NP	-
sodium	9,590	78-B03	10	5/10	12,500	0/10	NP	-
vanadium	45.9	78-B03	25	10/10	74.5	0/10	550	0/10
zinc	73.7	78-B03	25	10/10	107	0/10	23,000	0/10

Notes:

Data for soil samples collected in April and May 1994.

[a] Background level calculated for OU2 (Earth Tech 1995).

[b] USEPA Region IX PRGs (USEPA 2000).

- not applicable
ft bgs feet below ground surface
mg/kg milligrams per kilogram
NP not promulgated
PRG Preliminary Remediation Goal
USEPA United States Environmental Protection Agency

TABLE 2.5-4. MAXIMUM CONCENTRATIONS OF INORGANIC CONSTITUENTS DETECTED IN SOIL COMPARED TO CALCULATED BACKGROUND CONCENTRATIONS AND RESIDENTIAL PRGs - SITE 79

Analyte	Maximum Concentration (mg/kg)	Location ID of Maximum Concentration	Sample Depth (ft bgs)	No. Detections/ Total No. Samples	Calculated Background Concentration [a] (mg/kg)	No. Samples Exceeding Background/ Total No. Samples	2000 Residential PRG [b] (mg/kg)	No. Samples Exceeding Residential PRG/Total No. Samples
Metals and Other Elements								
aluminum	12,600	79-B03	30	10/10	35,900	0/10	76,000	0/10
arsenic	25.7	79-B03	30	10/10	22.7	1/10	0.39	10/10
barium	49.8	79-B01	30	10/10	301	0/10	5,400	0/10
beryllium	0.43	79-B02	30	6/10	1.4	0/10	150	0/10
calcium	20,000	79-B01	5	10/10	129,000	0/10	NP	-
chromium, total	10.0	79-B03	30	10/10	39.1	0/10	210	0/10
cobalt	4.3	79-B01	30	8/10	18	0/10	4,700	0/10
copper	7.0	79-B03	30	10/10	48.7	0/10	2,900	0/10
iron	16,100	79-B03	30	10/10	36,100	0/10	23,000	0/10
magnesium	5,740	79-B03	30	10/10	30,900	0/10	NP	-
manganese	222	79-B03	30	10/10	905	0/10	1,800	0/10
nickel	5.0	79-B01	30	2/10	16.9	0/10	150	0/10
potassium	1,800	79-B03	30	10/10	10,900	0/10	NP	-
sodium	710	79-B02	5	8/10	12,500	0/10	NP	-
vanadium	28.1	79-B03	30	10/10	74.5	0/10	550	0/10
zinc	34.4	79-B03	30	10/10	107	0/10	23,000	0/10

Notes:

Data for soil samples collected in May 1994.

[a] Background level calculated for OU2 (Earth Tech 1995).

[b] USEPA Region IX PRGs (USEPA 2000).

- not applicable
ft bgs feet below ground surface
mg/kg milligrams per kilogram
NP not promulgated
PRG Preliminary Remediation Goal
USEPA United States Environmental Protection Agency

TABLE 2.5-5. SUMMARY OF HUMAN HEALTH RISK ASSESSMENT RESULTS - SITE 78

Potential Exposure Pathway	Exposure Medium	Cancer Risk[a]	Primary Risk Drivers[b]	Noncancer Hazard Index[c]	Primary Risk Drivers[b]
Residential (Hypothetical future)	Soil	$6x10^{-5}$	None	0.32	None
	Groundwater	NA	NA	NA	NA
	Indoor Air	NA	NA	NA	NA
Industrial	Soil	$9x10^{-6}$	None	0.012	None
	Groundwater	NA	NA	NA	NA
	Indoor Air	NA	NA	NA	NA
Construction Worker	Soil	$1x10^{-7}$	None	0.005	None
	Groundwater	NA	NA	NA	NA
	Indoor Air	NA	NA	NA	NA

Notes:

[a] To manage risks from known or suspected carcinogens, the United States Environmental Protection Agency (USEPA 1980) has developed the following exposure range: more than one additional cancer case for 10,000 people is unacceptable (i.e., greater than $1x10^{-4}$); one additional cancer case for 10,000 to one million people is considered generally acceptable (i.e., between $1x10^{-4}$ and $1x10^{-6}$); and one additional cancer case for one million or more people is considered acceptable (i.e., less than $1x10^{-6}$). However, if multiple contaminants are present and multiple pathways of exposure exist, the more stringent end of the range should be used to establish cleanup goals.

[b] As determined by the Human Health Risk Assessment (Earth Tech 2003b). "None" indicates that there are no primary risk drivers because the total risk is characterized as generally acceptable or acceptable according to the USEPA (1980) exposure range. If a constituent is shown as a primary risk driver, the number in parentheses is the percentage of the risk accounted for by the constituent.

[c] A Hazard Index less than 1 is considered generally acceptable (USEPA 1991).

NA A Hazard Index less than 1 is considered generally acceptable (USEPA 1991)

TABLE 2.5-6. SUMMARY OF HUMAN HEALTH RISK ASSESSMENT RESULTS – SITE 79

Potential Exposure Pathway	Exposure Medium	Cancer Risk[a]	Primary Risk Drivers[b]	Noncancer Hazard Index[c]	Primary Risk Drivers[b]
Residential (Hypothetical future)	Soil	$7x10^{-5}$	None	*	None
	Groundwater[d]	NA	NA	NA	NA
	Indoor Air	NA	NA	NA	NA
Industrial	Soil	$9x10^{-6}$	None	*	None
	Groundwater	NA	NA	NA	NA
	Indoor Air	NA	NA	NA	NA
Construction Worker	Soil	$1x10^{-7}$	None	*	None
	Groundwater	NA	NA	NA	NA
	Indoor Air	NA	NA	NA	NA

Notes:

[a] To manage risks from known or suspected carcinogens, the United States Environmental Protection Agency (USEPA 1980) has developed the following exposure range: more than one additional cancer case for 10,000 people is unacceptable (i.e., greater than $1x10^{-4}$); one additional cancer case for 10,000 to one million people is considered generally acceptable (i.e., between $1x10^{-4}$ and $1x10^{-6}$); and one additional cancer case for one million or more people is considered acceptable (i.e., less than $1x10^{-6}$). However, if multiple contaminants are present and multiple pathways of exposure exist, the more stringent end of the range should be used to establish cleanup goals.

[b] As determined by the Human Health Risk Assessment (Earth Tech 2003b). "None" indicates that there are no primary risk drivers because the total risk is characterized as generally acceptable or acceptable according to the USEPA (1980) exposure range. If a constituent is shown as a primary risk driver, the number in parentheses is the percentage of the risk accounted for by the constituent.

[c] A Hazard Index less than 1 is considered generally acceptable (USEPA 1991).

[d] Groundwater data assessed during the risk assessment process (Earth Tech 2003b) is not associated with site.

* No analytes were carried forward in the risk assessment process (Earth Tech 2003b)

NA Not applicable; no exposure pathway identified during the risk assessment (Earth Tech 2003b)

Noncancer HI estimates calculated for the residential, industrial, and construction worker scenarios at Site 78 are considered acceptable. Noncancer HI estimates were not calculated for the residential, industrial, and construction worker scenarios at Site 79 because there were no analytes carried forward in the risk assessment process. A more comprehensive discussion of the HHRA for these sites is presented in the *South Base HHRA* (Earth Tech 2003b).

Ecological Risk

A pre-scoping ecological risk assessment conducted for Sites 78 and 79 determined that the risk to ecological receptors at the sites due to the potential exposure to the facility-related contaminants was considered acceptable (USGS 2004).

Threat to Groundwater or Surface Water

There is no threat to groundwater from constituents remaining in soil at Sites 78 and 79 because all constituents were evaluated and determined to be naturally occurring. There is no surface water present at either site.

2.5.2.4 Statutory Determinations

The RPMs concurred in the *Memorandum for Record* (see Appendix A, Memorandum dated 20 May 2004) that No Further Action (NFA) for soil and groundwater is required for Sites 78 and 79 due to the low potential cancer and noncancer risks to human health, and that the sites should be approved for unrestricted use and unlimited exposure. NFA is protective of human health and the environment.

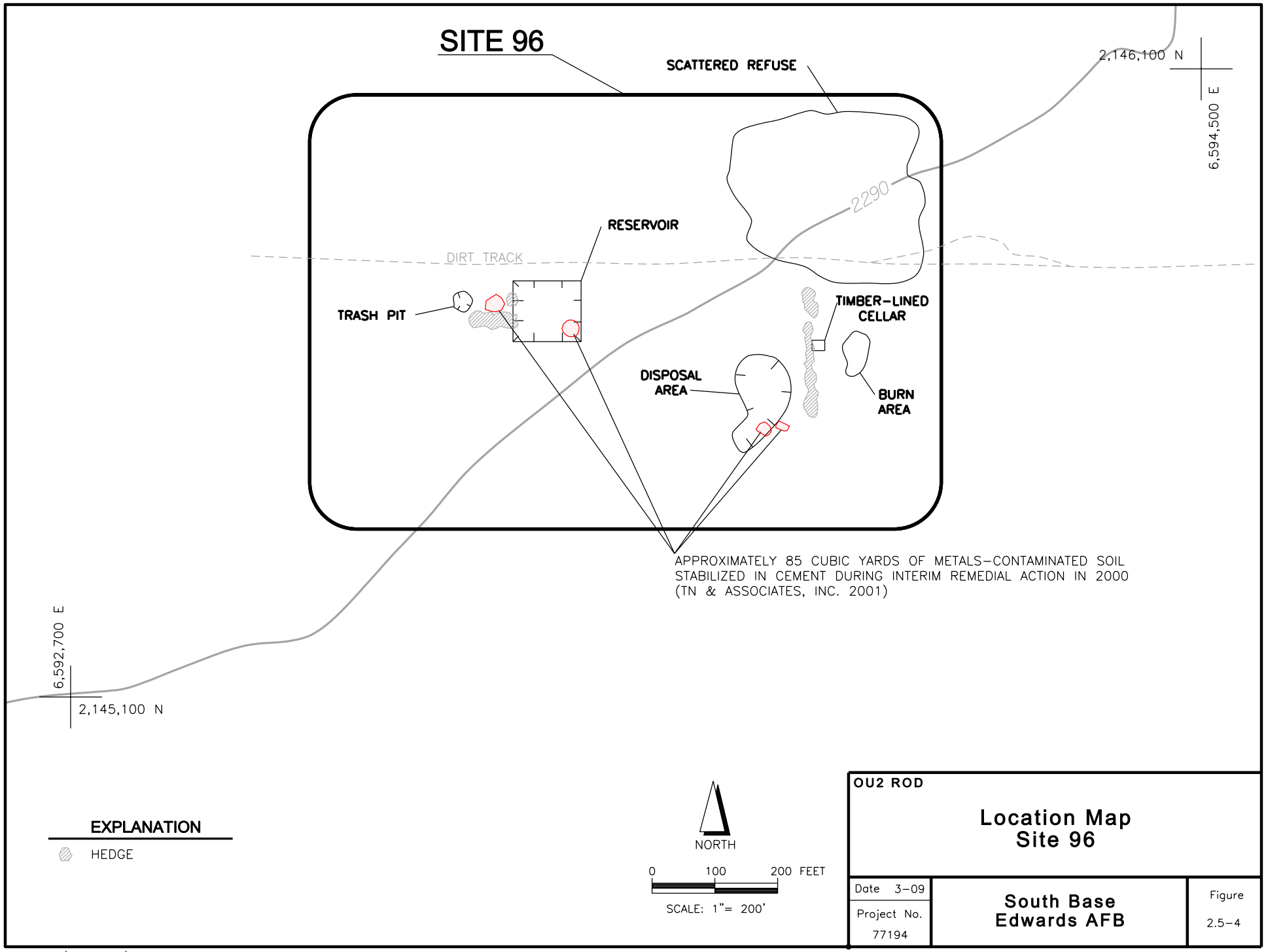
2.5.2.5 Documentation of Significant Changes from the OU2 Proposed Plan

There are no significant changes from the *OU2 Proposed Plan*.

2.5.3 SITE 96

2.5.3.1 Site Name, Location, and Brief Description

Site 96, Old South Base Motor Pool, is located southwest of South Base Active Runway 06/24 (see Figure 2.1-2). The site encompasses approximately 15 acres (Figure 2.5-4). The former motor pool was used by the Army Air Corps in the early 1940s to park and service vehicles. Prior to military



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use, the area was a homestead site with features that included one water well and an irrigation holding pond. Other features at the site include a debris disposal area, a trash pit area, scattered refuse, and a burn area. The disposal and trash pit areas contained paint cans, grease cans, solvent cans, auto parts, and empty 55-gallon drums. No infrastructure that could convey contaminants, such as storm drains or sewers, is known to exist at the site.

Although there are no monitoring wells at the site, based on nearby homestead water wells, the estimated depth to groundwater is approximately 80 feet bgs (Earth Tech 2005c).

2.5.3.2 Site History and Enforcement Activities

Site History

Site 96 was identified as an area requiring further investigation in the *RI/FS WP/SAP* (Earth Technology 1993a) and the *ESI/RFA Technical Report* (Earth Technology 1993b). Based on the results of the RI and interim removal action performed at Site 96, the RPMs concurred that no further investigation was required on 1 June 2001.

Remedial Investigations

RI activities performed at Site 96 included soil gas sampling at 36 sample locations in May 1994 and soil sampling at 10 hand-augered boreholes in February 1997. Soil samples were analyzed for diesel and jet fuel, VOCs, SVOCs, pesticides and PCBs, and metals and other elements. Selected samples were analyzed for dioxins and furans.

No organic constituents were detected at concentrations above the residential PRGs. Maximum concentrations of arsenic (31.4 mg/kg), cadmium (26.3 mg/kg), iron (62,500 mg/kg), and lead (1,510 mg/kg) were detected at concentrations above both the calculated background concentrations and residential PRGs. Because no organic constituents were detected in soils at concentrations above the screening levels, and the inorganic contaminants were detected at concentrations above the screening levels only in shallow soils (less than 3.5 feet bgs), no groundwater monitoring wells were installed.

A more comprehensive discussion of the RI activities is presented in the *OU2 RI Summary Report* (Earth Tech 2004b).

Interim Removal Actions

In 2000, the USAF excavated four areas within Site 96 to remove metals-contaminated soil (see Figure 2.5-4). Each area was excavated to approximately two feet bgs, and 85 cubic yards of soil were temporarily stockpiled on site. Soil samples collected from the bottoms of the excavations were analyzed, and the results confirmed that contaminant concentrations, except for a single detection of iron, were below the residential Preliminary Remediation Goals (PRGs). The excavated soil was mixed with cement and water to stabilize the metals, and the soil-cement slurry was used to backfill the shallow excavations (TN & Associates, Inc. 2001).

Following the interim removal action, no constituents other than arsenic and iron remain on site at concentrations above both background concentrations and residential PRGs (Table 2.5-7). A single surface detection of TCE (0.007 mg/kg) remains at a concentration below the residential PRG of 2.8 mg/kg. The elevated concentrations of arsenic and iron were only detected in one of the 17 samples collected at the site. Molybdenum, vanadium, and zinc exceeded background concentrations in only one or two of 17 samples and were all below residential PRGs. There is no known anthropogenic source of molybdenum or vanadium in this World War II-era site.

In 2002, the abandoned water well at the site was destroyed and the well shaft sealed with cement grout to prevent contaminants from entering the well shaft and migrating to the groundwater.

Nature and Extent of Residual Site Contamination

Because the contaminants present in the soil were stabilized as a result of the interim removal action, no residual contaminants remain at the site that would limit exposure or restrict use.

2.5.3.3 Summary of Site Risks

Human Health Risk

After the interim removal action to stabilize the metals-contaminated soil was completed at Site 96, the USAF calculated the potential risk to human health if future residents or industrial workers are exposed to soils at the site through ingestion, inhalation, or dermal contact. The results of the HHRA for Site 96 are summarized in Table 2.5-8. A more comprehensive discussion of the HHRA for this site is presented in the *South Base HHRA* (Earth Tech 2003b).

TABLE 2.5-7. MAXIMUM CONCENTRATIONS OF ORGANIC AND INORGANIC CONSTITUENTS DETECTED IN SOIL COMPARED TO CALCULATED BACKGROUND CONCENTRATIONS AND RESIDENTIAL PRGs - SITE 96

(Page 1 of 2)

Analyte	Maximum Concentration (mg/kg)	Location ID of Maximum Concentration	Sample Depth (ft bgs)	No. Detections/ Total No. Samples	Calculated Background Concentration [(a)] (mg/kg)	No. Samples Exceeding Background/ Total No. Samples	2000 Residential PRG [(b)] (mg/kg)	No. Samples Exceeding Residential PRG/Total No. Samples
Petroleum Hydrocarbons								
unknown extractable hydrocarbon	74 y	96-HB09	1.5	1/17	-	-	NP	-
Volatile Organics								
trichloroethene (TCE)	0.0070 (L)	96-HB09	0	1/17	-	-	2.8	0/17
Metals and Other Elements								
aluminum	32,800	96-HB08	3.5	17/17	35,900	0/17	76,000	0/17
arsenic	31.4	96-HB08	3.5	17/17	22.7	1/17	0.39	17/17
barium	174	96-HB08	3.5	17/17	301	0/17	5,400	0/17
beryllium	1.4	96-HB08	3.5	15/17	1.4	0/17	150	0/17
calcium	149,000	96-HB03	3	17/17	129,000	2/17	NP	-
chromium, total	21.6	96-HB08	3.5	17/17	39.1	0/17	210	0/17
cobalt	12.1	96-HB08	3.5	16/17	18	0/17	4,700	0/17
copper	20.1	96-HB08	3.5	16/17	48.7	0/17	2,900	0/17
iron	37,700	96-HB08	3.5	17/17	36,100	1/17	23,000	3/17
lead	26.9	96-HB09	1.5	17/17	28.2	0/17	400	0/17
magnesium	18,000	96-HB08	3.5	17/17	30,900	0/17	NP	-
manganese	824	96-HB08	3.5	17/17	905	0/17	1,800	0/17
molybdenum	4.9	96-HB08	3.5	2/17	2	2/17	390	0/17
nickel	13.4	96-HB08	3.5	13/17	16.9	0/17	150	0/17
potassium	7,710	96-HB08	3.5	17/17	10,900	0/17	NP	-
sodium	8,580	96-HB08	3.5	17/17	12,500	0/17	NP	-

TABLE 2.5-7. MAXIMUM CONCENTRATIONS OF ORGANIC AND INORGANIC CONSTITUENTS DETECTED IN SOIL COMPARED TO CALCULATED BACKGROUND CONCENTRATIONS AND RESIDENTIAL PRGs - SITE 96
(Page 2 of 2)

Analyte	Maximum Concentration (mg/kg)	Location ID of Maximum Concentration	Sample Depth (ft bgs)	No. Detections/ Total No. Samples	Calculated Background Concentration [a] (mg/kg)	No. Samples Exceeding Background/ Total No. Samples	2000 Residential PRG [b] (mg/kg)	No. Samples Exceeding Residential PRG/Total No. Samples
Metals and Other Elements *(Continued)*								
vanadium	76.9	96-HB08	3.5	17/17	74.5	1/17	550	0/17
zinc	134	96-HB10	0	17/17	107	2/17	23,000	0/17

Notes:

Data for soil samples collected in February 1997.
[a] Background level calculated for OU2 (Earth Tech 1995).
[b] USEPA Region IX PRGs (USEPA 2000).

-	not applicable
ft bgs	feet below ground surface
mg/kg	milligrams per kilogram
NP	not promulgated
PRG	Preliminary Remediation Goal
QC	quality control
USEPA	United States Environmental Protection Agency

Laboratory Data Qualifier:

y Chromatographic profile is not consistent with pattern(s) exhibited by reference fuel standards. Quantitation of unknown hydrocarbons in sample is based on diesel fuel.

Earth Tech Data Qualifier:

(L) Estimated value. Recoveries for one or more surrogates are below QC limits. Values may be biased low.

TABLE 2.5-8. SUMMARY OF HUMAN HEALTH RISK ASSESSMENT RESULTS – SITE 96

Potential Exposure Pathway	Exposure Medium	Cancer Risk[a]	Primary Risk Drivers[b]	Noncancer Hazard Index[c]	Primary Risk Drivers[b]
Residential (Hypothetical future)	Soil	$8x10^{-5}$	None	1.8	Iron (91%)
	Groundwater	NA	NA	NA	NA
	Indoor Air	NA	NA	NA	NA
Industrial	Soil	$1x10^{-5}$	None	0.38	None
	Groundwater	NA	NA	NA	NA
	Indoor Air	NA	NA	NA	NA
Construction Worker	Soil	$2x10^{-7}$	None	0.15	None
	Groundwater	NA	NA	NA	NA
	Indoor Air	NA	NA	NA	NA

Notes:

[a] To manage risks from known or suspected carcinogens, the United States Environmental Protection Agency (USEPA 1980) has developed the following exposure range: more than one additional cancer case for 10,000 people is unacceptable (i.e., greater than $1x10^{-4}$); one additional cancer case for 10,000 to one million people is considered generally acceptable (i.e., between $1x10^{-4}$ and $1x10^{-6}$); and one additional cancer case for one million or more people is considered acceptable (i.e., less than $1x10^{-6}$). However, if multiple contaminants are present and multiple pathways of exposure exist, the more stringent end of the range should be used to establish cleanup goals.

[b] As determined by the Human Health Risk Assessment (Earth Tech 2003b). "None" indicates that there are no primary risk drivers because the total risk is characterized as generally acceptable or acceptable according to the USEPA (1980) exposure range. If a constituent is shown as a primary risk driver, the number in parentheses is the percentage of the risk accounted for by the constituent.

[c] A Hazard Index less than 1 is considered generally acceptable (USEPA 1991).

% percent

NA Not applicable; no exposure pathway identified during the risk assessment (Earth Tech 2003b)

As shown in the table, the calculated cancer risk estimates are acceptable based on the risk ranges developed by the USEPA (1980 and 1991). The calculated noncancer HI estimates associated with the potential exposure to soil in the industrial and construction worker scenarios are considered acceptable. The HI for the hypothetical future residential scenario is considered unacceptable. However; the HI may be overstated because it is driven by a single detection of iron above the background concentration that occurred in an isolated "hot spot" that is not representative of the site as a whole.

Ecological Risk

A pre-scoping ecological risk assessment conducted for Site 96 determined that the chemicals of potential ecological concern include metals, dioxin, and TCE (USGS 2004). However, soils contaminated with metals and dioxins were stabilized in place during the interim removal action conducted in 2000. In addition, TCE was detected in only one of 17 soil samples at an estimated concentration of 0.007 mg/kg. This result is below levels of concern and is not considered representative of conditions at Site 96. Therefore, the potential risk to wildlife (including the threatened California desert tortoise) and habitat is considered acceptable.

Threat to Groundwater or Surface Water

A single surface detection of TCE (0.007 mg/kg) remains at a concentration below the residential PRG of 2.8 mg/kg. The USEPA's Vadose Zone Leaching Model (VLEACH), Version 2.2 (Ravi and Johnson 1997) was used to evaluate the potential for TCE to leach to groundwater. Model results are contained in *Evaluation of the Potential Impact to Groundwater due to the Mobilization and Migration of Organic Contaminants in Soil at Operable Unit 2 Using the Vadose Zone Leaching Model (VLEACH)* (USAF 2008). For TCE in soil at Site 96, the model predicted a mass flux of 1.49×10^{-8} g/yr/ft^2 (grams per year per unit area) impacting the groundwater at a simulation time of 500 years. Using the predicted TCE mass flux in a mixing model (USAF 2008), the predicted TCE concentration in groundwater at a simulation time of 500 years is 6.25×10^{-5} micrograms per liter [μg/L] per unit volume of groundwater, which is below the MCL for TCE (5 μg/L).

There is no threat to groundwater from constituents remaining in soil at Site 96 because all constituents were evaluated and determined to be either naturally occurring or at concentrations unlikely to impact groundwater. There is no surface water present at the site.

2.5.3.4 Statutory Determinations

The RPMs concurred in the *Memorandum for Record* (see Appendix A, Memorandum dated 20 May 2004) that NFA for soil and groundwater is required for Site 96 due to the low potential cancer and noncancer risks to human health and lack of a threat to groundwater, and that the site should be approved for unrestricted use and unlimited exposure. NFA is protective of human health and the environment.

2.5.4 AREA OF CONCERN 417

2.5.4.1 Site Name, Location, and Brief Description

AOC 417, South Base Rocket Sled Track – Quarter Point Area, is located south of Rogers Dry Lake, and encompasses approximately 53 acres on both sides of a former rocket sled track (the Experimental High Speed Track) (see Figure 2.1-2). Facilities and buildings at AOC 417 that supported the sled track operations included a receiving station, an electronics laboratory, a photo and supply shop, and a fabrication shop (Figure 2.5-5). Other features at the site included a suspected burn area, a pit containing empty drums and debris, a drainage channel containing several punctured empty 55-gallon drums, a former UST (addressed under AOC 408 as part of the USTI program that was administered by Kern County), and an inactive Base water supply well. The well was installed to a depth of 150 feet bgs in 1948; the screen interval is unknown. Depth to groundwater measured in the well was 38 feet bgs in 1994.

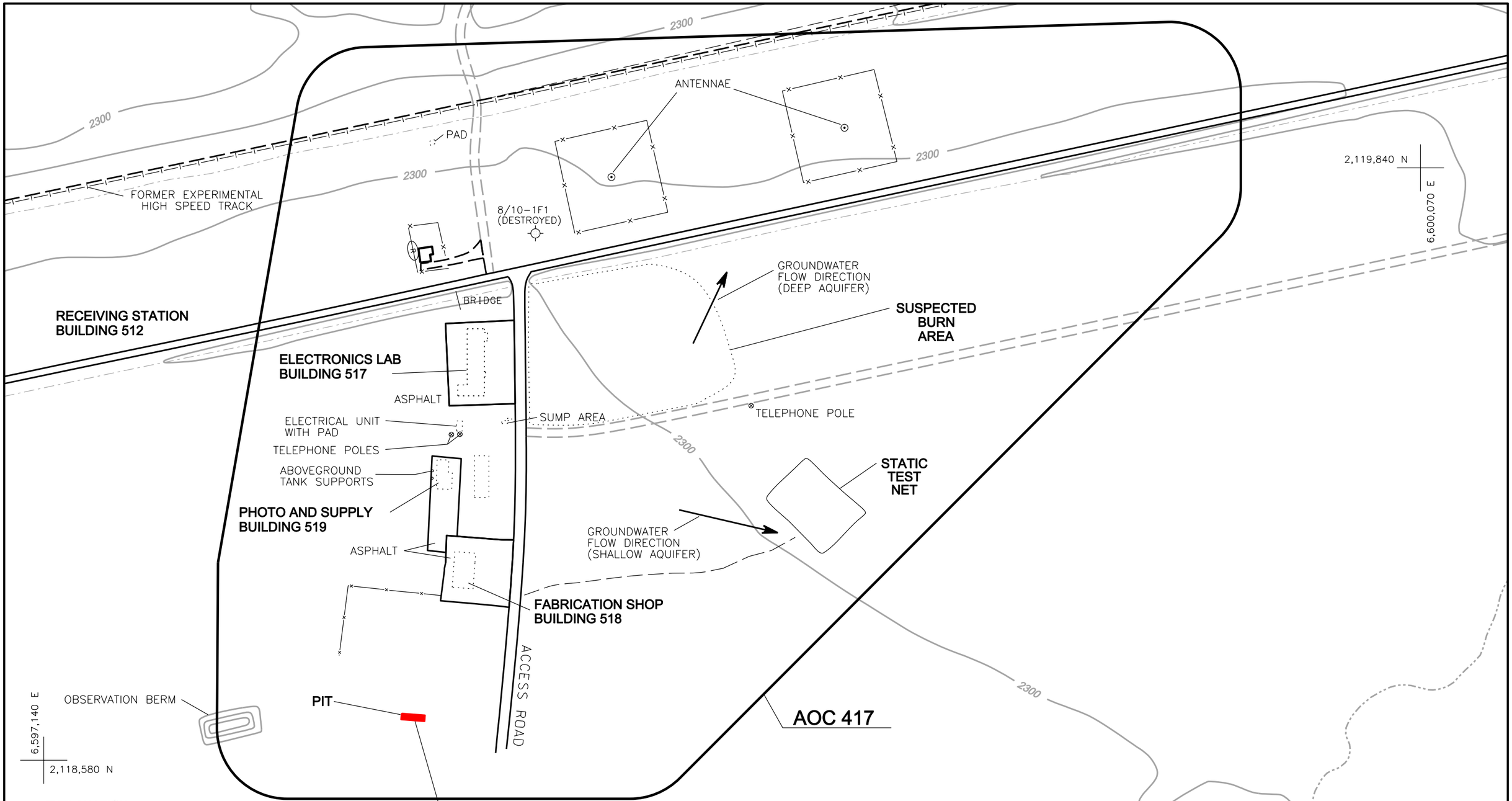
2.5.4.2 Site History and Enforcement Activities

Site History

The original 10,000-foot sled track was completed in 1948, lengthened to 20,000 feet in 1957, and deactivated in 1963 (U.S. Air Force Flight Test Center 2001).

Remedial Investigations

RI activities were performed at AOC 417 from 1992 through 1995. These activities included soil gas sampling at 49 sample locations, soil sampling at six hand-augered boreholes, and groundwater sampling of the inactive Base water supply well. No aromatic, halogenated, or total petroleum hydrocarbons were detected in the soil gas samples.



EXPLANATION

- BASE WATER SUPPLY WELL LOCATION
- REMOVED UNDERGROUND STORAGE TANK LOCATION
- TELEPHONE POLE LOCATION
- ANTENNA LOCATION
- LIMITS OF EXCAVATION
- REMOVED BUILDINGS
- CHAIN-LINK FENCE

APPROXIMATELY 52 CUBIC YARDS OF METALLIC AND NON-METALLIC DEBRIS REMOVED DURING INTERIM REMOVAL ACTION IN DECEMBER 1997. IN ADDITION, AN ESTIMATED 280 CUBIC YARDS OF METALS-CONTAMINATED SOIL WAS STABILIZED IN PLACE AND USED TO BACKFILL THE PIT.

NORTH

0 100 200 FEET

SCALE: 1"= 200'

OU2 ROD

Location Map AOC 417

Date 3-09	South Base Edwards AFB	Figure 2.5-5
Project No. 77194		

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Soil samples were analyzed for TPH, VOCs, SVOCs, metals and other elements, pesticides, and PCBs in and around the pit containing drums and debris and in the drainage area where the drums were found. Low concentrations of TPH (10 mg/kg to 14 mg/kg) were found in the pit containing drums and debris. Samples taken from the pit also had maximum concentrations of cadmium (20.3 mg/kg) and iron (90,800 mg/kg) above background concentrations and residential PRGs.

Groundwater samples were analyzed for TPH, VOCs, metals, and nitrate. No organic analytes were present, and no inorganic analytes were detected at concentrations exceeding MCLs.

A more comprehensive discussion of the RI activities is presented in the *OU2 RI Summary Report* (Earth Tech 2004b).

Interim Removal Actions

In February 1997, the inactive Base water supply well was destroyed and the well shaft sealed with cement grout to prevent contaminants from migrating down the well bore from the ground surface.

In December 1997, the 55-gallon drums and surface debris in the pit were removed. The pit was then excavated to a depth of approximately 10 feet bgs, the vertical extent of debris and stained soil, to remove the low-level metals-contaminated soil. Buried metallic and nonmetallic debris was separated from the excavated soil using screens. The 280 cubic yards of soil, metallic debris, and nonmetallic debris were temporarily stockpiled on site. Soil samples collected from the bottom of the excavation were analyzed, and the results confirmed that the contaminant concentrations were below both background concentrations and residential PRGs (Table 2.5-9). The soil was mixed with cement and water to stabilize the metals and the soil-cement slurry was then used to backfill the pit. Approximately 20 cubic yards of metallic debris was sent to an on-Base recycling facility for later transport off-Base. Approximately 32 cubic yards of nonmetallic debris was transport to the Main Base Active Landfill for disposal. The drums were taken to the on-Base recycling center for later disposal off-Base.

Nature and Extent of Residual Site Contamination

No constituents remain on site above background concentrations. No residual contaminants remain at the site that would limit exposure or restrict use.

TABLE 2.5-9. MAXIMUM CONCENTRATIONS OF INORGANIC CONSTITUENTS DETECTED IN SOIL COMPARED TO CALCULATED BACKGROUND CONCENTRATIONS AND RESIDENTIAL PRGs – AOC 417

Analyte	Maximum Concentration (mg/kg)	Location ID of Maximum Concentration	Sample Depth (ft bgs)	No. Detections/ Total No. Samples	Calculated Background Concentration [a] (mg/kg)	No. Samples Exceeding Background/ Total No. Samples	2000 Residential PRG [b] (mg/kg)	No. Samples Exceeding Residential PRG/Total No. Samples
Metals and Other Elements								
aluminum	10,300	417-EXB	9.5	5/5	35,900	0/5	76,000	0/5
arsenic	3.4	417-EXB	9.5	5/5	22.7	0/5	0.39	5/5
barium	174	417-EXB	9.5	5/5	301	0/5	5,400	0/5
beryllium	0.41	417-EXB	9.5	2/5	1.4	0/5	150	0/5
calcium	8,670	417-EXW	9.5	5/5	129,000	0/5	NP	-
chromium, total	20.4	417-EXB	9.5	5/5	39.1	0/5	210	0/5
cobalt	9.0	417-EXB	9.5	5/5	18	0/5	4,700	0/5
copper	18.4	417-EXB	9.5	5/5	48.7	0/5	2,900	0/5
iron	20,400	417-EXB	9.5	5/5	36,100	0/5	23,000	0/5
lead	4.4	417-EXB	9.5	5/5	28.2	0/5	400	0/5
magnesium	7,450	417-EXB	9.5	5/5	30,900	0/5	NP	-
manganese	259	417-EXB	9.5	5/5	905	0/5	1,800	0/5
molybdenum	2.0	417-EXE	9.5	1/5	2	0/5	390	0/5
nickel	16.4	417-EXB	9.5	5/5	16.9	0/5	150	0/5
potassium	3,030	417-EXB	9.5	5/5	10,900	0/5	NP	-
sodium	162	417-EXB	9.5	2/5	12,500	0/5	NP	-
vanadium	38.4	417-EXB	9.5	5/5	74.5	0/5	550	0/5
zinc	47.3	417-EXB	9.5	5/5	107	0/5	23,000	0/5

Notes:

Data for remediation status soil samples collected in December 1997.

[a] Background level calculated for OU2 (Earth Tech 1995).

[b] USEPA Region IX PRGs (USEPA 2000).

-	not applicable
ft bgs	feet below ground surface
mg/kg	milligrams per kilogram
NP	not promulgated
PRG	Preliminary Remediation Goal
USEPA	United States Environmental Protection Agency

2.5.4.3 Summary of Site Risks

Human Health Risk

As part of the RI, the USAF evaluated the potential risk to human health if future industrial workers are exposed to the residual soils at AOC 417 through ingestion, inhalation, or dermal contact. The results of the HHRA for AOC 417 are summarized in Table 2.5-10. A more comprehensive discussion of the HHRA for this site is presented in the *South Base HHRA* (Earth Tech 2003b).

The organic and inorganic substances detected in the soil samples did not exceed the calculated background concentrations for OU2; therefore, cancer risk and noncancer HI estimates were not calculated for the soils at AOC 417.

Organic substances were not detected in a groundwater sample collected from a former Base water supply well at AOC 417, and inorganic substances were not detected in the sample at concentrations exceeding the calculated background concentrations for OU2. However, the maximum concentration of nitrate detected was used in the risk assessment calculation because a background concentration for nitrate was not established (the highest nitrate level detected at OU2 was 2.1 milligrams per liter (mg/L) at Site 86), and the resulting calculated noncancer HI estimate for groundwater in the residential scenario is considered acceptable. The concentration of nitrate (0.16 mg/L) is below its MCL of 10 mg/L (California Department of Health Services [CDHS] 2003).

Ecological Risk

A pre-scoping ecological risk assessment conducted for AOC 417 determined that the risk to ecological receptors at the site due to the potential exposure to the facility-related contaminants was considered acceptable (USGS 2004).

Threat to Groundwater or Surface Water

There is no threat to groundwater from constituents remaining in soil at Site 417 because all constituents were evaluated and determined to be naturally occurring. There is no surface water present at the site.

TABLE 2.5-10. SUMMARY OF HUMAN HEALTH RISK ASSESSMENT RESULTS – AREA OF CONCERN 417

Potential Exposure Pathway	Exposure Medium	Cancer Risk[a]	Primary Risk Drivers[b]	Noncancer Hazard Index[c]	Primary Risk Drivers[b]
Residential (Hypothetical future)	Soil	*	None	*	None
	Groundwater	*	None	0.016	None
	Indoor Air	NA	NA	NA	NA
Industrial	Soil	*	None	*	None
	Groundwater	NA	NA	NA	NA
	Indoor Air	NA	NA	NA	NA
Construction Worker	Soil	*	None	*	None
	Groundwater	NA	NA	NA	NA
	Indoor Air	NA	NA	NA	NA

Notes:

[a] To manage risks from known or suspected carcinogens, the United States Environmental Protection Agency (USEPA 1980) has developed the following exposure range: more than one additional cancer case for 10,000 people is unacceptable (i.e., greater than $1x10^{-4}$); one additional cancer case for 10,000 to one million people is considered generally acceptable (i.e., between $1x10^{-4}$ and $1x10^{-6}$); and one additional cancer case for one million or more people is considered acceptable (i.e., less than $1x10^{-6}$). However, if multiple contaminants are present and multiple pathways of exposure exist, the more stringent end of the range should be used to establish cleanup goals.

[b] As determined by the Human Health Risk Assessment (Earth Tech 2003b). "None" indicates that there are no primary risk drivers because the total risk is characterized as generally acceptable or acceptable according to the USEPA (1980) exposure range. If a constituent is shown as a primary risk driver, the number in parentheses is the percentage of the risk accounted for by the constituent.

[c] A Hazard Index less than 1 is considered generally acceptable (USEPA 1991).

* No analytes were carried forward in the risk assessment process (Earth Tech 2003b)

NA Not applicable; no exposure pathway identified during the risk assessment (Earth Tech 2003b)

2.5.4.4 Statutory Determinations

The RPMs concurred in the *Memorandum for Record* (see Appendix A, Memorandum dated 20 May 2004) that NFA for soil and groundwater is required for AOC 417 due to the low potential cancer and noncancer risks to human health and lack of a threat to groundwater, and that the AOC should be approved for unrestricted use and unlimited exposure. NFA is protective of human health and the environment.

2.6 DECISION SUMMARY - SITES WITH GROUNDWATER CONTAMINATION

2.6.1 SITES 5/14 CONTAMINANT PLUME

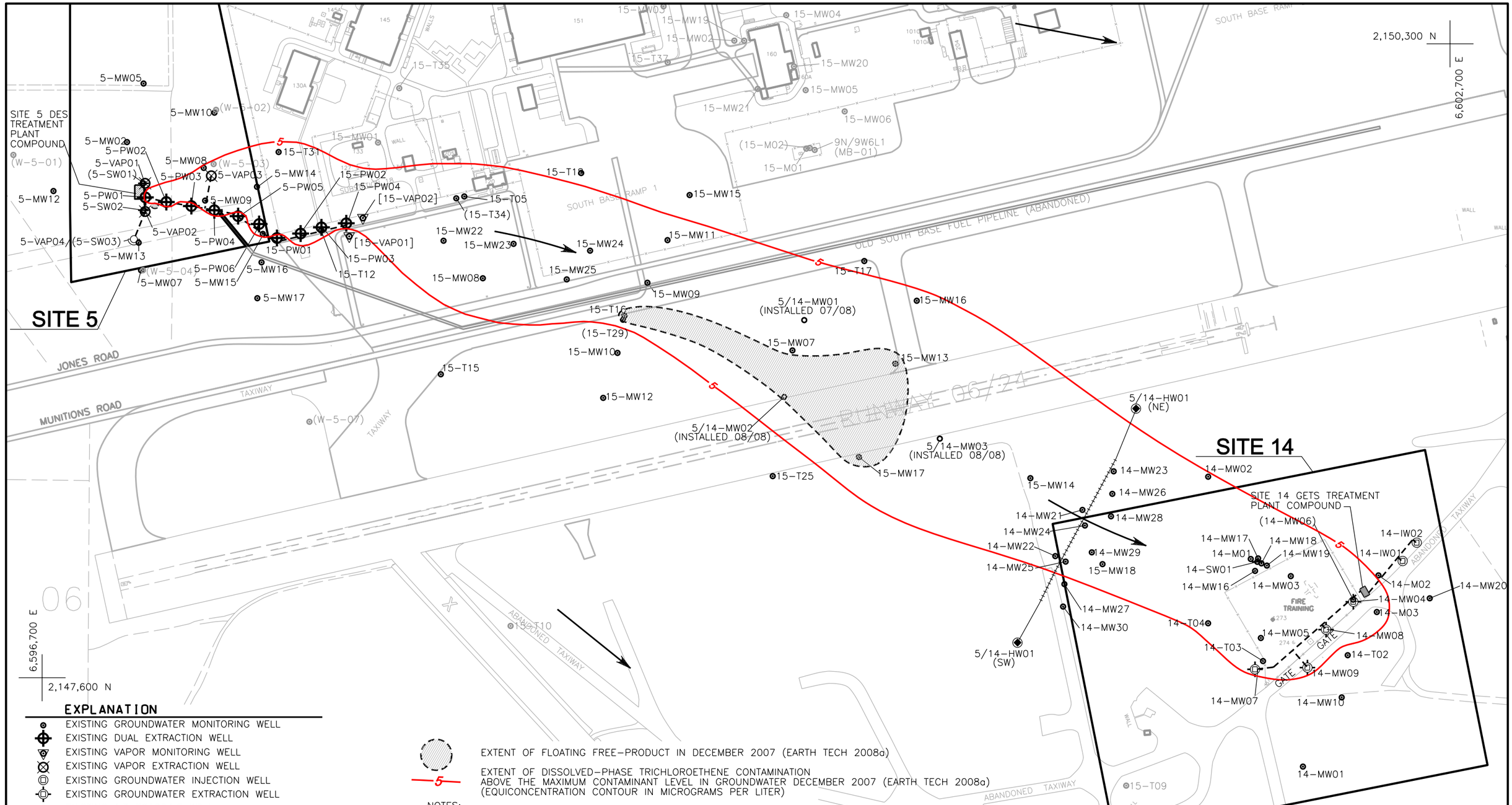
2.6.1.1 Site Name, Location, and Brief Description

The Sites 5/14 Contaminant Plume is a commingled jet fuel and solvent (primarily TCE) plume that originates in the southern portion of Site 5 (Figure 2.6-1). The groundwater contamination occurs in the unconsolidated alluvial sediments of the upper aquifer of the Lancaster Subbasin. The plume extends southeast from Site 5 (the former South Base Waste Petroleum, Oil, and Lubricants [POL] Storage Area) for approximately 5,600 feet beneath the southwestern corner of the BFTF, the South Base Taxiway, and South Base Active Runway 06/24. The leading edge of the plume is presently beneath Site 14 (the South Base Fire Fighting Training Facility).

2.6.1.2 Site History and Enforcement Activities

Site History

Site 5, Former South Base Waste POL Storage Area, is located west of the BFTF and encompasses approximately 20 acres. The site included three clusters of USTs - the former Fuel Oil Depot, the former Southern Fuel Depot, and the Waste POL Tanks (Earth Tech 2004b). The USTs were installed in the early 1940s, and were in use until the mid-1950s. From 1972 to 1984, five former Southern Fuel Depot USTs (the Waste POL Tanks) were used to store waste jet fuels, aviation and motor gasoline, engine oils, and waste petroleum oil. The USTs at Site 5 were removed between November 1993 and April 1994 (Earth Tech 1998a). Prior to their removal, fuels and waste solvents leaked into the soil and subsequently reached the groundwater, which occurs at a depth of



EXPLANATION

- EXISTING GROUNDWATER MONITORING WELL
- EXISTING DUAL EXTRACTION WELL
- EXISTING VAPOR MONITORING WELL
- EXISTING VAPOR EXTRACTION WELL
- EXISTING GROUNDWATER INJECTION WELL
- EXISTING GROUNDWATER EXTRACTION WELL
- EXISTING AIR SPARGING WELL
- EXISTING NESTED AIR SPARGING/VAPOR EXTRACTION WELL
- ( ) WELL SCREEN BELOW WATER TABLE
- [ ] WELL SCREEN ABOVE WATER TABLE
- HORIZONTAL WELL SURFACE COMPLETION
- HORIZONTAL WELL CASING
- HORIZONTAL WELL SCREEN
- DES DUAL EXTRACTION SYSTEM
- GETS GROUNDWATER EXTRACTION AND TREATMENT SYSTEM
- GROUNDWATER FLOW DIRECTION

EXTENT OF FLOATING FREE-PRODUCT IN DECEMBER 2007 (EARTH TECH 2008a)

5 EXTENT OF DISSOLVED-PHASE TRICHLOROETHENE CONTAMINATION ABOVE THE MAXIMUM CONTAMINANT LEVEL IN GROUNDWATER DECEMBER 2007 (EARTH TECH 2008a) (EQUICONCENTRATION CONTOUR IN MICROGRAMS PER LITER)

NOTES:

1. ABANDONED WELL 5-MW11 NOT SHOWN.
2. WELLS IN GREY ARE NOT ASSOCIATED WITH THE SITES 5/14 CONTAMINANT PLUME OR ARE NOT BEING MONITORED.
3. LOCATION OF WELLS 14-M02, 14-M03, 14-T02, 14-T03, 14-T04, 15-T05, 15-T12, 15-T18, 15-T25, 15-T31 AND 15-T34 BASED ON GLOBAL POSITIONING SYSTEM SURVEY.
4. STATE PLANE COORDINATES ARE NORTH AMERICAN DATUM 1983 IN FEET.

NORTH

0 200 400 FEET

SCALE: 1"= 400'

OU2 ROD

Location Map Sites 5/14 Contaminant Plume

Date 3-09	South Base Edwards AFB	Figure 2.6-1
Project No. 77194		

EDWARDS\ 77194\B5834FGA.A01

approximately 55 feet bgs. A portion of this fuel/solvent mixture floats on the surface of the groundwater as free product. The free product thickness has been evaluated to be less than two inches. The remainder became dissolved in the groundwater and the TCE was carried southeastward for approximately 5,600 feet to Site 14 (see Figure 2.6-1).

Site 14, South Base Fire Fighting Training Facility, is located approximately 500 feet southeast of South Base Active Runway 06/24, and encompasses approximately 51 acres. The site consists of two training areas constructed around 1960, one referred to as the Current Fire Fighting Training Area (the location of the present day training area) and one referred to as the Former Fire Fighting Training Area. Both training areas were constructed on open ground, and were surrounded by six-inch earthen berms. Jet fuel and waste TCE were used during the fire fighting exercises conducted at the two training areas.

Following Installation Restoration Program (IRP) investigations conducted during the mid-1980s, the Current Fire Fighting Training Area was reconstructed in 1988 (Earth Tech 2004b). The reconstruction included the installation of a clay cap overlain by two high-density polyethylene (HDPE) liners with gravel to protect the liners, and a Fuel/Water Recovery System. In 1992, a propane-fueled fire fighting training system was constructed, and the use of jet fuel was discontinued. In 1997, the Fuel/Water Recovery System was removed. A small amount of the TCE in the groundwater at Site 14 is attributable to past fire fighting training activities.

Remedial Investigations

Site investigations conducted to date include the following:

- Between 1982 and 1989, Engineering-Science, Inc. performed initial site investigations at South Base in an area that included the current Sites 5 and 14. In the vicinity of the Sites 5/14 Contaminant Plume, the investigations included conducting two soil gas surveys, drilling and sampling 23 boreholes and four hand-augered boring locations, and sampling 23 groundwater monitoring wells installed to total depths ranging from 51 feet bgs to 150 feet bgs.

- In 1993 and 1994, in conjunction with an interim removal action conducted at Site 5 (see Interim Removal Actions subsection), soil samples were collected beneath the locations of 20 removed USTs and below the locations of piping associated with these USTs.

- Between 1993 and 2000, Earth Tech conducted additional RIs to further define the nature and extent of the soil, groundwater, and floating free product contamination. Investigations

included collecting groundwater samples from existing wells, conducting soil gas surveys, drilling and sampling boreholes, installing and sampling groundwater monitoring wells, and surveying Cone Penetrometer Test/Rapid Optical Screening Tool™ (CPT/ROST™) test points.

- In 2005, an additional monitoring well was installed at Site 14 to further delineate the lateral extent of the contaminant plume (Earth Tech 2006b).

A more detailed discussion of the site investigations is contained in the *OU2 RI Summary Report* (Earth Tech 2004b).

Groundwater Monitoring

Between 1994 and 1996, groundwater samples were collected from selected groundwater monitoring wells. Beginning in 1996 and continuing to the present, long-term groundwater monitoring and sampling of selected monitoring and extraction wells has been performed. Groundwater samples were collected from the wells once each year in 1996 and 1997, semiannually from 1998 to 2004, and annually from 2005 through 2007. The maximum concentrations of organic constituents detected in groundwater samples collected in 2006 and 2007, and the maximum detected concentrations of filtered metals and other elements and general inorganics from all groundwater samples collected at the site (Earth Tech 2004b, 2007d, and 2008a) are shown in Table 2.6-1. Of the organic constituents, maximum concentrations of benzene, carbon tetrachloride, tetrachloroethene (PCE), and TCE were detected above Primary MCLs. The only inorganic constituent detected above both background concentrations and MCLs was arsenic, and only in one of 8 samples. High concentrations of arsenic are common in the Lancaster Subbasin and the detection is believed to be naturally occurring.

Plate 1 shows the estimated horizontal extent of groundwater contamination for the Sites 5/14 Contaminant Plume. Figures 2.6-2 and 2.6-3 show the estimated vertical extent of groundwater contamination. Note that in the source area, no contaminants were detected in several wells which had tops of screen ranging from 59 feet to 65 feet bgs, in an area where the depth to groundwater is 54 feet bgs. The only deep well that showed contamination greater than 15 feet below the top of the aquifer was in the middle section of the plume under the floating free product.

Free product floating on top of the groundwater contaminant plume covers an area of approximately 6.5 acres. The free product is primarily JP-4 that contains the VOCs n-butylbenzene, sec-butylbenzene,

TABLE 2.6-1. MAXIMUM CONCENTRATIONS OF ORGANIC AND INORGANIC CONSTITUENTS DETECTED IN GROUNDWATER COMPARED TO CALCULATED BACKGROUND CONCENTRATIONS AND PRIMARY MCLs - SITES 5/14

(Page 1 of 3)

Analyte	Unit	Maximum Concentration	Location ID of Maximum Concentration	No. Detections/ Total No. Samples	Calculated Background Concentration [a]	No. Samples Exceeding Background/ Total No. Samples	Maximum Contaminant Level [b] (MCL)	No. Samples Exceeding MCL/Total No. Samples
Petroleum Hydrocarbons								
diesel fuel #2	mg/L	0.058 J	15-MW07	1/22	-	-	NP	-
gasoline	mg/L	2.1	15-MW13	10/22	-	-	NP	-
jet fuel #4	mg/L	3.3 HG	15-MW07	2/22	-	-	NP	-
UEH as Diesel (C10 - C24)	mg/L	0.12 HD	15-PW04	5/11	-	-	NP	-
UEH as JP4 (C8 - C18)	mg/L	0.052 J	5-PW06	1/11	-	-	NP	-
UEH	mg/L	4.7	15-MW13	4/11	-	-	NP	-
UVH	mg/L	3.6 (J+4K)	15-MW07	2/11	-	-	NP	-
Volatile Organics								
benzene	µg/L	2.6	15-MW23	3/27	-	-	1	1/27
tert-butanol	µg/L	23 J	15-MW23	3/27	-	-	NP	-
sec-butylbenzene	µg/L	4.3	15-MW13	4/27	-	-	NP	-
tert-butylbenzene	µg/L	0.68 J	15-MW13	3/27	-	-	NP	-
carbon tetrachloride	µg/L	22	15-PW04	2/27	-	-	0.5	2/27
chloroethane	µg/L	7.9	5-PW03	1/27	-	-	NP	-
chloroform	µg/L	6.3	15-MW23	3/27	-	-	NP	-
1,2-dichloroethane	µg/L	0.46 J	15-MW13	2/27	-	-	0.5	0/27
1,1-dichloroethene	µg/L	5.4	5-PW03	4/27	-	-	6	0/27
cis-1,2-dichloroethene	µg/L	6.0	15-MW07	15/27	-	-	6	0/27
trans-1,2-dichloroethene	µg/L	0.68 J	15-MW23	3/27	-	-	10	0/27
ethylbenzene	µg/L	7.8	15-MW07	5/27	-	-	300	0/27
2-hexanone	µg/L	22 (UJ1)	15-T17	4/27	-	-	NP	-
isopropylbenzene	µg/L	9.1	15-MW13	7/27	-	-	NP	-
p-isopropyltoluene	µg/L	5.9	15-MW13	4/27	-	-	NP	-
methyl tert-butyl ether (MTBE)	µg/L	0.33 J	5-PW03	1/27	-	-	13	0/27
n-propylbenzene	µg/L	4.4 J	15-MW07	4/27	-	-	NP	-
tetrachloroethene (PCE)	µg/L	6.9	5-PW02	4/27	-	-	5	1/27
toluene	µg/L	1.2	5-PW03	5/27	-	-	150	0/27
1,1,1-trichloroethane	µg/L	2.3	5-PW02	1/27	-	-	200	0/27

TABLE 2.6-1. MAXIMUM CONCENTRATIONS OF ORGANIC AND INORGANIC CONSTITUENTS DETECTED IN GROUNDWATER COMPARED TO CALCULATED BACKGROUND CONCENTRATIONS AND PRIMARY MCLs - SITES 5/14
(Page 2 of 3)

Analyte	Unit	Maximum Concentration	Location ID of Maximum Concentration	No. Detections/ Total No. Samples	Calculated Background Concentration [a]	No. Samples Exceeding Background/ Total No. Samples	Maximum Contaminant Level [b] (MCL)	No. Samples Exceeding MCL/Total No. Samples
Volatile Organics *(Continued)*								
trichloroethene (TCE)	µg/L	270	15-MW07	23/27	-	-	5	16/27
trihalomethanes, total	µg/L	6.3	15-MW23	3/27	-	-	80	0/27
1,2,4-trimethylbenzene	µg/L	72	15-MW13	10/27	-	-	NP	-
1,3,5-trimethylbenzene	µg/L	32	15-MW13	9/27	-	-	NP	-
m- & p-xylene	µg/L	43	15-MW13	9/27	-	-	NP	-
o-xylene	µg/L	29	15-MW13	9/27	-	-	NP	-
xylenes, total	µg/L	72	15-MW13	9/27	-	-	1,750	0/27
Semivolatile Organics								
naphthalene	µg/L	16	15-MW13	9/27	-	-	NP	-
Metals and Other Elements (filtered)								
arsenic	mg/L	0.024	5-MW12	4/8	0.013	1/8	0.01	1/8
barium	mg/L	0.055	14-MW02	7/8	0.49	0/8	1	0/8
calcium	mg/L	242	15-T17	8/8	586	0/8	NP	-
chromium, total	mg/L	0.011	15-T29	1/8	0.01	1/8	0.05	0/8
iron	mg/L	0.061	14-MW02	1/8	0.061	0/8	0.3	0/8
magnesium	mg/L	57.9	15-T17	8/8	407	0/8	NP	-
manganese	mg/L	0.22	5-MW10	3/8	0.043	1/8	0.05 [c]	1/8
molybdenum	mg/L	0.021	15-T29	2/8	0.022	0/8	NP	-
nickel	mg/L	0.072	14-MW02	1/8	0.04	1/8	0.1	0/8
potassium	mg/L	3.2	14-MW02	7/8	13.23	0/8	NP	-
selenium	mg/L	0.013	15-T17	1/8	0.05	0/8	0.05	0/8
sodium	mg/L	271	15-T17	8/8	513	0/8	NP	-
vanadium	mg/L	0.029	5-MW12	4/8	0.027	1/8	NP	-
zinc	mg/L	0.028	5-MW10	1/8	0.025	1/8	5[c]	0/8
General Inorganics								
alkalinity, bicarb. (as CaCO3)	mg/L	548	15-T05	46/46	428	2/46	NP	-
alkalinity, carb. (as CaCO3)	mg/L	32.1	14-T03	3/46	-	-	NP	-
chloride	mg/L	2,180	15-T05	46/46	2,332	0/46	250	8/46
COD - chemical oxygen demand	mg/L	73.2	14-M03	28/40	-	-	NP	-

TABLE 2.6-1. MAXIMUM CONCENTRATIONS OF ORGANIC AND INORGANIC CONSTITUENTS DETECTED IN GROUNDWATER COMPARED TO CALCULATED BACKGROUND CONCENTRATIONS AND PRIMARY MCLs - SITES 5/14

(Page 3 of 3)

Analyte	Unit	Maximum Concentration	Location ID of Maximum Concentration	No. Detections/ Total No. Samples	Calculated Background Concentration [a]	No. Samples Exceeding Background/ Total No. Samples	Maximum Contaminant Level [b] (MCL)	No. Samples Exceeding MCL/Total No. Samples
General Inorganics *(Continued)*								
fluoride	mg/L	1.3	5-MW02	45/46	2.6	0/46	2	0/46
hardness (as CaCO3)	mg/L	2,240	15-T05	46/46	-	-	NP	-
MBAS	mg/L	0.44	5-MW03	5/40	-	-	0.5	0/40
nitrogen, Kjeldahl, total	mg/L	2.9	5-OW02	8/68	-	-	NP	-
phosphorus	mg/L	0.32	5-OW02	8/70	-	-	NP	-
total dissolved solids	mg/L	66,400 Q[d]	5-VAP02	117/117	-	-	500[c]	40/117

Notes:

Data for volatile organics were from groundwater samples collected in 2006 and 2007. Data for filtered metals and other elements and general inorganics were from all groundwater samples collected at the site.

[a] Background level calculated for OU2 (Earth Tech 1996). Background levels for metals and other elements were calculated from analytical results from filtered groundwater samples.

[b] Federal (USEPA) and Title 22 California Code of Regulations (CDHS) - MCLs (10/18/2007).

[c] California Secondary MCL (10/18/2007).

[d] Elevated level from persulfate pilot test

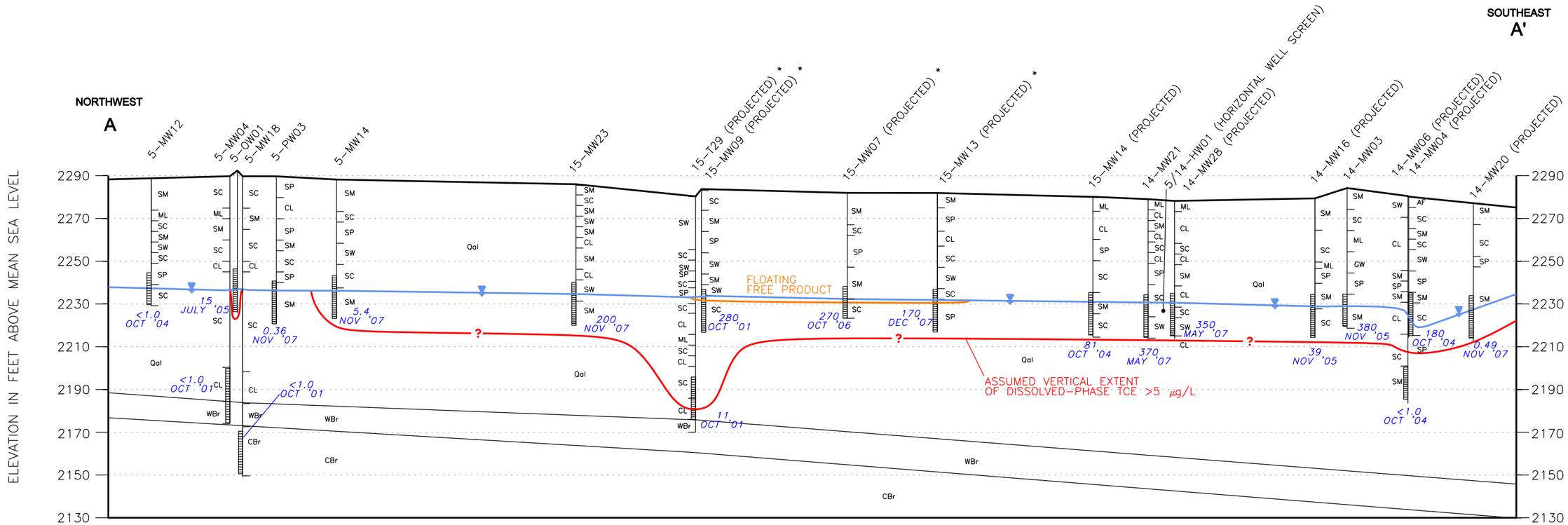
-	not applicable
CDHS	California Department of Health Services
HC	Hydrocarbon
MBAS	methylene active blue substances
MCL	Maximum Contaminant Level
mg/L	milligrams per liter
NP	not promulgated
QC	Quality Control
UEH	unknown extractable hydrocarbon
USEPA	United States Environmental Protection Agency
UVH	unknown volatile hydrocarbon

Laboratory Data Qualifiers:

HD	HC pattern does not match JP-4/Diesel. UEH as JP-4 quantitated as C8-C10 and UEH as diesel quantitated as C10-C24.
HG	HC pattern matches JP-4. UEH as Diesel quantitated as C18-C24.
J	Estimated result. Result is below the reporting limit.
Q	Elevated reporting limit. The reporting limit is elevated due to high analyte levels.

Earth Tech Data Qualifiers:

(J+4K)	Estimated value. Recoveries for one or more surrogates are above the QC limit. Values may be biased high.
(UJ1)	Estimated value. Blank contamination; the value in the laboratory blank is below the reporting limit. Indicates possible high bias and/or false positives. Blank level multiplied by 5 is higher than sample results, except for contamination from methylene chloride, acetone, 2-butanone and common phthalate esters where the multiplier is 10.



EXPLANATION

- SCREEN INTERVAL
- POTENTIOMETRIC SURFACE
- 5.4 NOV '07 — TCE CONCENTRATION IN µg/L; DATE SAMPLED
- * — WELL CONTAINS FLOATING FREE PRODUCT (THICKNESS EVALUATED TO BE LESS THAN TWO INCHES)
- > — GREATER THAN
- µg/L — MICROGRAMS PER LITER
- TCE — TRICHLOROETHENE

AF	ARTIFICIAL FILL
GW	WELL GRADED GRAVEL
SC	CLAYEY SAND, SILTY CLAYEY SAND
SM	SILTY SAND
SP	POORLY GRADED SAND
SW	WELL GRADED SAND
ML	SILT, SANDY SILT
CL	CLAY, SANDY CLAY, SILTY CLAY
Qal	QUATERNARY ALLUVIUM
WBr	WEATHERED BEDROCK
CBr	COMPETENT BEDROCK

NOTE:

REFER TO PLATE 1 FOR THE LOCATION OF CROSS SECTION A-A'.

0 200 400 FEET

HORIZONTAL SCALE: 1"= 400'
VERTICAL SCALE: 1"= 50'
VERTICAL EXAGERATION= 1:8

OU2 ROD

Sites 5/14
Geologic Cross Section A-A'

Date 3-09	South Base Edwards AFB	Figure
Project No. 101302		2.6-2

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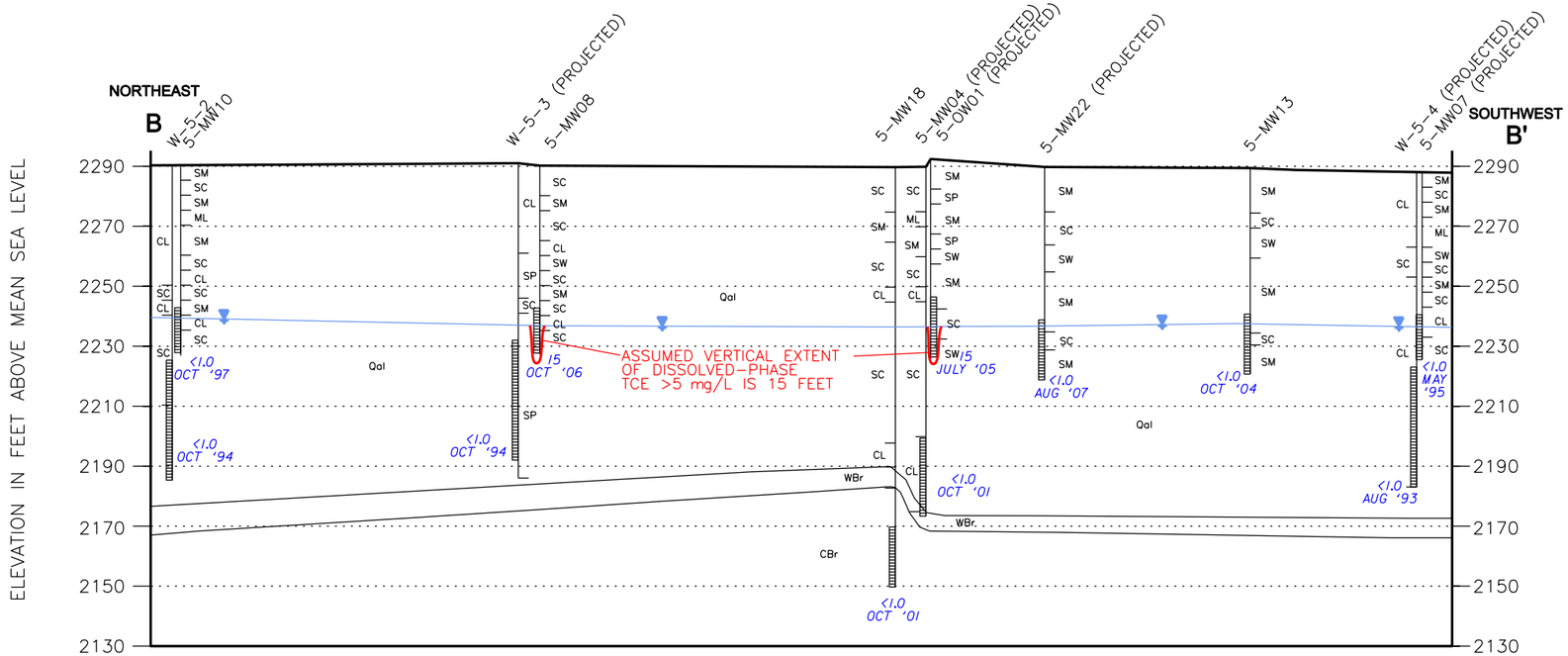

EXPLANATION

- SCREEN INTERVAL
- POTENTIOMETRIC SURFACE
- 5.4 / NOV '07 — TCE CONCENTRATION IN µg/L / DATE SAMPLED
- * — WELL CONTAINS FLOATING PRODUCT (THICKNESS EVALUATED TO BE LESS THAN TWO INCHES)
- > — GREATER THAN
- µg/L — MICROGRAMS PER LITER
- TCE — TRICHLOROETHENE

SW	WELL GRADED SAND
SC	CLAYEY SAND, SILTY CLAYEY SAND
SM	SILTY SAND
SP	POORLY GRADED SAND
ML	SILT, SANDY SILT
CL	CLAY, SANDY CLAY, SILTY CLAY
Qal	QUATERNARY ALLUVIUM
WBr	WEATHERED BEDROCK
CBr	COMPETENT BEDROCK

NOTES:

1. REFER TO PLATE 1 FOR THE LOCATION OF CROSS SECTION B–B'.

0 50 100 FEET

HORIZONTAL SCALE: 1"= 100'
VERTICAL SCALE: 1"= 50'
VERTICAL EXAGERATION= 1:2

OU2 ROD

Sites 5/14
Geologic Cross Section B-B'

Date 3–09	South Base Edwards AFB	Figure 2.6–3
Project No. 101302		

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ethylbenzene, isopropylbenzene, p-isopropyltoluene, n-propylbenzene, TCE, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, and xylenes; and the SVOC naphthalene (Table 2.6-2).

Pilot Testing

A series of pilot tests were conducted to evaluate potential remedial alternatives for the Sites 5/14 Contaminant Plume:

- A dual extraction/soil vapor extraction (SVE) pilot test was conducted in 1995 (Earth Tech 1996b) to develop design parameters for the Site 5 Dual Extraction System (DES). The pilot test indicated that a DES was a viable technology for remediation of the source area at Site 5.

- An air sparging test was conducted in January 1999 (Earth Tech 2000a) at Site 5 to determine whether air sparging should be used in conjunction with the DES to enhance remediation of free product. Due to the mounding created by the air sparging, it was determined that the air sparging could not be used to enhance DES operations.

- Between October 1999 and June 2000, a series of free product recovery pilot tests were performed to investigate the connectivity/continuity of the floating free product between the source area (Site 5) and the middle section of the plume (Earth Tech 2000b). The testing indicated that the free product plume was not continuous between the two areas. In addition, free product bail-down test results indicated that the true free product thickness in the middle section of the plume was less than two inches.

- Between September 2000 and October 2003, Solutions Industrial & Environmental Services, Inc. (Solutions-IES) performed a pilot study at Site 14 to determine whether reductive dechlorination of TCE could be enhanced by the injection of an edible oil substrate (soybean oil) into the aquifer (Solutions-IES 2002). Although TCE concentrations declined significantly in the test area, it was inconclusive if the decline was due to sorption of the TCE in the oil or reductive dechlorination.

- Between April 2005 and September 2006, pilot tests were performed to evaluate in situ bioremediation using the PHOSter® technology (Earth Tech 2007a). The technology includes the injection of air, gaseous nutrients (nitrogen and phosphorus), and methane into the saturated zone of the contaminant plume with the objective of stimulating bacteria that biodegrade the contaminants. One test was performed at Site 5 to determine whether the technology could remediate both free product and dissolved contaminants in the plume. A second test was performed at Site 14 to determine whether the technology could remediate the chlorinated-only portion of the plume. Over an initial 3-month period of operation, the PHOSter® technology appeared to reduce the free product thickness in the source area. Over a later 4-month period of operation, no further reduction in free product thickness was measured. However, over the following 11 months, free product thicknesses decreased to

TABLE 2.6-2. CONCENTRATIONS OF ORGANIC CONTAMINANTS DETECTED IN FREE PRODUCT - SITES 5/14 CONTAMINANT PLUME

Analyte	Well 15-T16	
	25-Sep-95	20-Nov-97
Total Extractable Petroleum Hydrocarbons (in mg/L)		
jet fuel #4	660,000 a	1,900,000 (J11e)
Total Volatile Petroleum Hydrocarbons (in mg/L)		
UVH	660,000 z	470,000 z=
Volatile Organics (in μg/L)		
n-butylbenzene	ND	420,000 (K)
sec-butylbenzene	370,000	230,000 (K)
ethylbenzene	510,000	140,000 (K)
isopropylbenzene	500,000	230,000 (K)
p-isopropyltoluene	530,000	640,000 (K)
n-propylbenzene	550,000	240,000 (K)
trichloroethene (TCE)	220,000	57,000 J
1,2,4-trimethylbenzene	3,600,000	1,900,000 (K)
1,3,5-trimethylbenzene	1,400,000	800,000 (K)
m- & p-xylene	550,000	220,000 (K)
o-xylene	400,000	93,000 J
Semivolatile Organics (in μg/L)		
naphthalene	510,000	330,000 (K)

Notes:

μg/L micrograms per liter
mg/L milligrams per liter
ND not detected
UVH unknown volatile hydrocarbons

Laboratory Data Qualifiers:

a The chromatographic pattern for jet fuel #4 was not a perfect match to the standards. Enough similarity was present to report the result as jet fuel #4.
J Estimated result. Result is below the reporting limit.
z Chromatographic profile is not consistent with pattern exhibited by reference fuel standard. Quantitation of unknown volatile hydrocarbons is based on gasoline.
z= Gasoline analysis yielded a chromatographic profile consistent with the heavier end of the gasoline standard. Based on the analyst's judgment, the contamination might be attributed to weathered gasoline.

Earth Tech Data Qualifiers:

(J11e) Estimated value. Due to the required number of dilutions and the matrix of the sample (pure product) there is uncertainty in the measurement, and therefore the value is estimated high.
(K) Estimated value. Recoveries for one or more surrogates are above QC limits. Values may be biased high.

non-detectable levels in the source area. At Site 14, the technology was successful in reducing TCE concentrations between 86.6 and 99.8 percent within a radius of 44 feet from the injection well over a 3-month period of operation.

- Between August 2007 and February 2008, pilot tests were performed to evaluate the effectiveness of ISCO using alkaline-activated persulfate, alone and in combination with air sparging, in treating residual free product at Site 5. The tests indicated that alkaline-activated persulfate without air sparging was effective in promoting free product dissolution and degradation, but at a radius of influence of less than 20 feet. The addition of air sparging enhanced the radius of influence of persulfate distribution to greater than 44 feet. Although persulfate was not in an activated state at that distance, it was still effective in degrading fuels and fuel constituents (Earth Tech 2008b).

- Between May 2007 and May 2008, a pilot test was performed to evaluate the effectiveness of ISCO using potassium permanganate (permanganate) injected into a horizontal well in treating TCE at Site 14. One continuous horizontal injection well with a 700-foot stainless steel screen, and 10 groundwater monitoring wells, were installed. A bench scale test was performed to determine the total oxidant demand. Approximately 8,000 gallons of a 3 percent permanganate solution were injected. Following the injection, permanganate was only detected in two of the downgradient monitoring wells; one 20 feet downgradient and (Earth Tech 2003b)the other 100 feet downgradient of the injection well. However, TCE concentrations initially decreased by 97 to 99 percent in four of the monitoring wells. Due to an upgradient source, these TCE concentrations have since rebounded in all but one of the wells. Based on detections of permanganate and reductions in TCE concentrations, groundwater velocity across the width of the plume has been calculated to vary from less than 20 feet per year to 320 feet per year. The results indicate the distribution of permanganate is influenced by preferential groundwater flow paths (Earth Tech 2008e).

Interim Removal Actions

The USAF has performed interim removal actions to remove the possible sources of contamination, as well as to treat the contaminated soil and groundwater, as follows:

- Between 1983 and 1984, the contents of five 50,000 gallon USTs at Site 5 were removed and taken to an off-Base recycling facility. The tanks were steam cleaned, filled with sand, and left in place (Earth Tech 1998a).

- Between November 1993 and April 1994, 22 USTs were removed under the UST Investigation Program at Site 5. Contents (if present) and decontamination rinsates (for USTs where decontamination was required) were taken to an off-Base recycling facility. Concrete and metals from the tank bodies and fill stands were also taken to off-Base recycling facilities (Earth Tech 1998a).

- In May 1994, the contents of the Fuel/Water Recovery System at Site 14 were removed and taken to an off-Base recycling facility.

- A bioventing system was installed at the location of former UST S191 (Earth Tech 1997c) to treat petroleum-contaminated soil. The system became operational in October 1995, and was shut down in 1996 after the site tested clean. Subsequently, lines were run from the bioventing system to another area of soil contamination associated with former USTs S165 to S169 (Earth Tech 1998c). The bioventing system to address these USTs began operation in March 1999 (Earth Tech 1999b). It was shut down in 2005, pending closure of the former USTs by the Kern County Environmental Health Services Department. Because the contamination from these USTs was limited to petroleum hydrocarbons in the soils, it is being addressed outside the CERCLA program.

- An EE/CA was prepared to evaluate remedial alternatives for the source area at Site 5 (Earth Tech 1996f). Based on the results of the EE/CA, a DES was designed and installed at Site 5 (Earth Tech 1997b). The system includes ten dual extraction wells (DEWs), four vapor extraction wells, a groundwater treatment system, and a vapor treatment system. Through April 2006, the system had treated approximately 2.8 billion cubic feet of soil vapor and 101.4 million gallons of groundwater. The cumulative mass of contaminants removed was 630,641 pounds in the vapor phase; 1,035 pounds in the dissolved phase; and 7,803 pounds in the free phase (i.e., as free product) (Earth Tech 2007c). The system was shut down in May 2007, pending implementation of the final remedy for the site.

- In February 1997, the Fuel/Water Recovery System at Site 14 was removed. The steel from the system was taken to an off-Base recycling facility. Approximately 925 cubic yards of petroleum-contaminated soils were also removed at this time and taken to an on-Base bioremediation treatment facility. Because contamination from the Fuel/Water Recovery System is limited to petroleum hydrocarbons in the soils, it is being addressed outside the CERCLA program. A bioventing system was installed in 2000 to remediate the remaining soils contaminated with petroleum hydrocarbons and jet fuel. The bioventing system was shut down in 2005, pending closure of the former USTs by the Kern County Environmental Health Services Department.

- In November 1997, an EE/CA was prepared to address the groundwater contamination at Site 14 (Earth Tech 1997e). Based on the results of the EE/CA, a GETS was selected to prevent further downgradient migration of the plume. The GETS became operational in December 1998 (Earth Tech 1998b). The system consists of four extraction wells, two injection wells, and a groundwater treatment system. The groundwater is treated using liquid-phase granular activated carbon (GAC) and reinjected into the aquifer at two injection wells. Through February 2006, the system had treated approximately 24.7 million gallons of groundwater and removed approximately 22.2 pounds of TCE (Earth Tech 2007b). The Site 14 GETS is preventing the further downgradient migration of the Sites 5/14 Contaminant Plume.

- In March 2004, 10 remediation status soil boreholes were drilled and sampled to assess the progress of soil remediation by the Site 5 DES (Earth Tech 2005c).

- In June 2005, three remediation status borings were drilled and sampled to assess the progress of soil remediation by the Site 14 bioventing system (FPM 2007b).

- A GeoTech Solar Sipper, a mobile free product recovery system, removed free product from the middle section of the Sites 5/14 Contaminant Plume in 2005 and 2006. During a six month period, the system removed only 47 gallons of free product, indicating that the technology would not be effective in remediating the estimated 94,000 gallons of free product which remains at Sites 5/14.

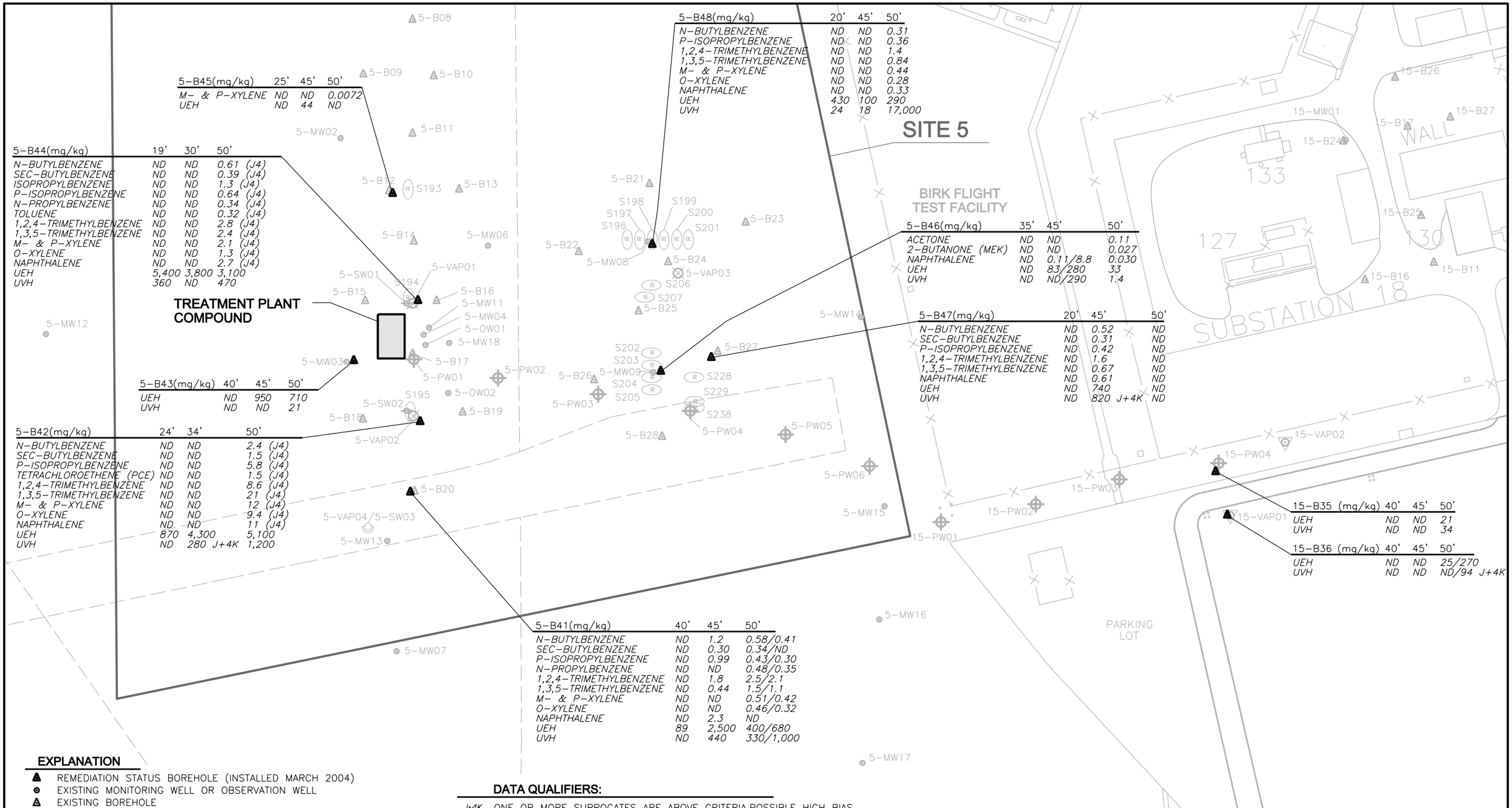
The extent of soil contamination at Sites 5 and 14 based on the most recent soil sampling events is shown on Figures 2.6-4 and 2.6-5, respectively. The maximum concentrations of the contaminants detected in soil at Sites 5 and 14 are compared to their respective calculated background concentrations and residential PRGs in Tables 2.6-3 and 2.6-4, respectively. No organic constituents were detected at concentrations above residential PRGs, and no inorganic constituents were detected at concentrations above either the calculated background concentrations or residential PRGs.

Nature and Extent of Residual Site Contamination

Prior to the startup of the soil remediation systems at Sites 5 and 14, PCE, TCE, and benzene were the primary organic contaminants detected in soil samples at these sites (Earth Tech 2005c). No inorganic constituents were detected above both background concentrations and residential PRGs. However, based on the results of soil sampling at Site 5 in March 2004 (Earth Tech 2005a) and at Site 14 in June 2005 (FPM Group 2007b), the soil remediation activities at the Site 5 DES and the Site 14 bioventing system have mitigated the concentrations of organic compounds in the soil to levels where they do not pose an unacceptable risk to human health or the environment except as noted in Section 2.6.1.4.

However, contamination still remains in the groundwater at the Sites 5/14 Contaminant Plume. The contaminant plume extending from Site 5 to Site 14 is approximately 5,600 feet long, approximately 900 feet wide at its widest point, and covers an area of approximately 77.5 acres (see Figure 2.6-1).

Assuming the contamination within the plume is limited to the upper 10 to 15 feet of the groundwater aquifer, the estimated total volume of groundwater that is potentially contaminated at concentration levels above the MCLs is 76 million gallons. All of the contaminated groundwater contains TCE (see Table 2.6-1). An estimated 30 percent of the groundwater is also contaminated with fuel-related constituents. Based on the 2007 sampling results, the estimated dissolved-phase mass of fuels and TCE in the plume is 950 pounds (lbs) and 63 lbs, respectively.



5-B45(mg/kg)	25'	45'	50'
M- & P-XYLENE	ND	ND	0.0072
UEH	ND	44	ND

5-B44(mg/kg)	19'	30'	50'
N-BUTYLBENZENE	ND	ND	0.61 (J4)
SEC-BUTYLBENZENE	ND	ND	0.39 (J4)
ISOPROPYLBENZENE	ND	ND	1.3 (J4)
P-ISOPROPYLBENZENE	ND	ND	0.64 (J4)
N-PROPYLBENZENE	ND	ND	0.34 (J4)
TOLUENE	ND	ND	0.32 (J4)
1,2,4-TRIMETHYLBENZENE	ND	ND	2.8 (J4)
1,3,5-TRIMETHYLBENZENE	ND	ND	2.4 (J4)
M- & P-XYLENE	ND	ND	2.1 (J4)
O-XYLENE	ND	ND	1.3 (J4)
NAPHTHALENE	ND	ND	2.7 (J4)
UEH	5,400	3,800	3,100
UVH	360	ND	470

5-B43(mg/kg)	40'	45'	50'
UEH	ND	950	710
UVH	ND	ND	21

5-B42(mg/kg)	24'	34'	50'
N-BUTYLBENZENE	ND	ND	2.4 (J4)
SEC-BUTYLBENZENE	ND	ND	1.5 (J4)
P-ISOPROPYLBENZENE	ND	ND	5.8 (J4)
TETRACHLOROETHENE (PCE)	ND	ND	1.5 (J4)
1,2,4-TRIMETHYLBENZENE	ND	ND	8.6 (J4)
1,3,5-TRIMETHYLBENZENE	ND	ND	21 (J4)
M- & P-XYLENE	ND	ND	12 (J4)
O-XYLENE	ND	ND	9.4 (J4)
NAPHTHALENE	ND	ND	11 (J4)
UEH	870	4,300	5,100
UVH	ND	280 J+4K	1,200

5-B48(mg/kg)	20'	45'	50'
N-BUTYLBENZENE	ND	ND	0.31
P-ISOPROPYLBENZENE	ND	ND	0.36
1,2,4-TRIMETHYLBENZENE	ND	ND	1.4
1,3,5-TRIMETHYLBENZENE	ND	ND	0.84
M- & P-XYLENE	ND	ND	0.44
O-XYLENE	ND	ND	0.28
NAPHTHALENE	ND	ND	0.33
UEH	430	100	290
UVH	24	18	17,000

5-B46(mg/kg)	35'	45'	50'
ACETONE	ND	ND	0.11
2-BUTANONE (MEK)	ND	ND	0.027
NAPHTHALENE	ND	0.11/8.8	0.030
UEH	ND	83/280	33
UVH	ND	ND/290	1.4

5-B47(mg/kg)	20'	45'	50'
N-BUTYLBENZENE	ND	0.52	ND
SEC-BUTYLBENZENE	ND	0.31	ND
P-ISOPROPYLBENZENE	ND	0.42	ND
1,2,4-TRIMETHYLBENZENE	ND	1.6	ND
1,3,5-TRIMETHYLBENZENE	ND	0.67	ND
NAPHTHALENE	ND	0.61	ND
UEH	ND	740	ND
UVH	ND	820 J+4K	ND

15-B35 (mg/kg)	40'	45'	50'
UEH	ND	ND	21
UVH	ND	ND	34

15-B36 (mg/kg)	40'	45'	50'
UEH	ND	ND	25/270
UVH	ND	ND	ND/94 J+4K

5-B41(mg/kg)	40'	45'	50'
N-BUTYLBENZENE	ND	1.2	0.58/0.41
SEC-BUTYLBENZENE	ND	0.30	0.34/ND
P-ISOPROPYLBENZENE	ND	0.99	0.43/0.30
N-PROPYLBENZENE	ND	ND	0.48/0.35
1,2,4-TRIMETHYLBENZENE	ND	1.8	2.5/2.1
1,3,5-TRIMETHYLBENZENE	ND	0.44	1.5/1.1
M- & P-XYLENE	ND	ND	0.51/0.42
O-XYLENE	ND	ND	0.46/0.32
NAPHTHALENE	ND	2.3	ND
UEH	89	2,500	400/680
UVH	ND	440	330/1,000

EXPLANATION

- REMEDIATION STATUS BOREHOLE (INSTALLED MARCH 2004)
- EXISTING MONITORING WELL OR OBSERVATION WELL
- EXISTING BOREHOLE
- EXISTING AIR SPARGING WELL
- EXISTING NESTED AIR SPARGING/VAPOR EXTRACTION WELL
- EXISTING SOIL VAPOR EXTRACTION WELL
- EXISTING DUAL EXTRACTION WELL
- EXISTING VAPOR MONITORING WELL
- (R) REMOVED UNDERGROUND STORAGE TANK
- mg/kg MILLIGRAMS PER KILOGRAM
- UEH UNKNOWN EXTRACTABLE HYDROCARBON
- UVH UNKNOWN VOLATILE HYDROCARBON
- ND NOT DETECTED

DATA QUALIFIERS:

J+4K ONE OR MORE SURROGATES ARE ABOVE CRITERIA.POSSIBLE HIGH BIAS.
J4 SURROGATE RECOVERIES ARE OUTSIDE OF CRITERIA BOTH HIGH AND LOW. BIAS NOT READILY DETERMINED.

NOTES:

1. VOLATILE ORGANIC COMPOUNDS DETECTED IN THE REMEDIATION STATUS BOREHOLES AT CONCENTRATIONS BELOW THE REPORTING LIMIT ARE NOT SHOWN.
2. NO INORGANIC ANALYTES DETECTED IN SOILS ABOVE BOTH BACKGROUND VALUES AND RESIDENTIAL PRGs (USEPA 2002).

NORTH

0 50 100 FEET

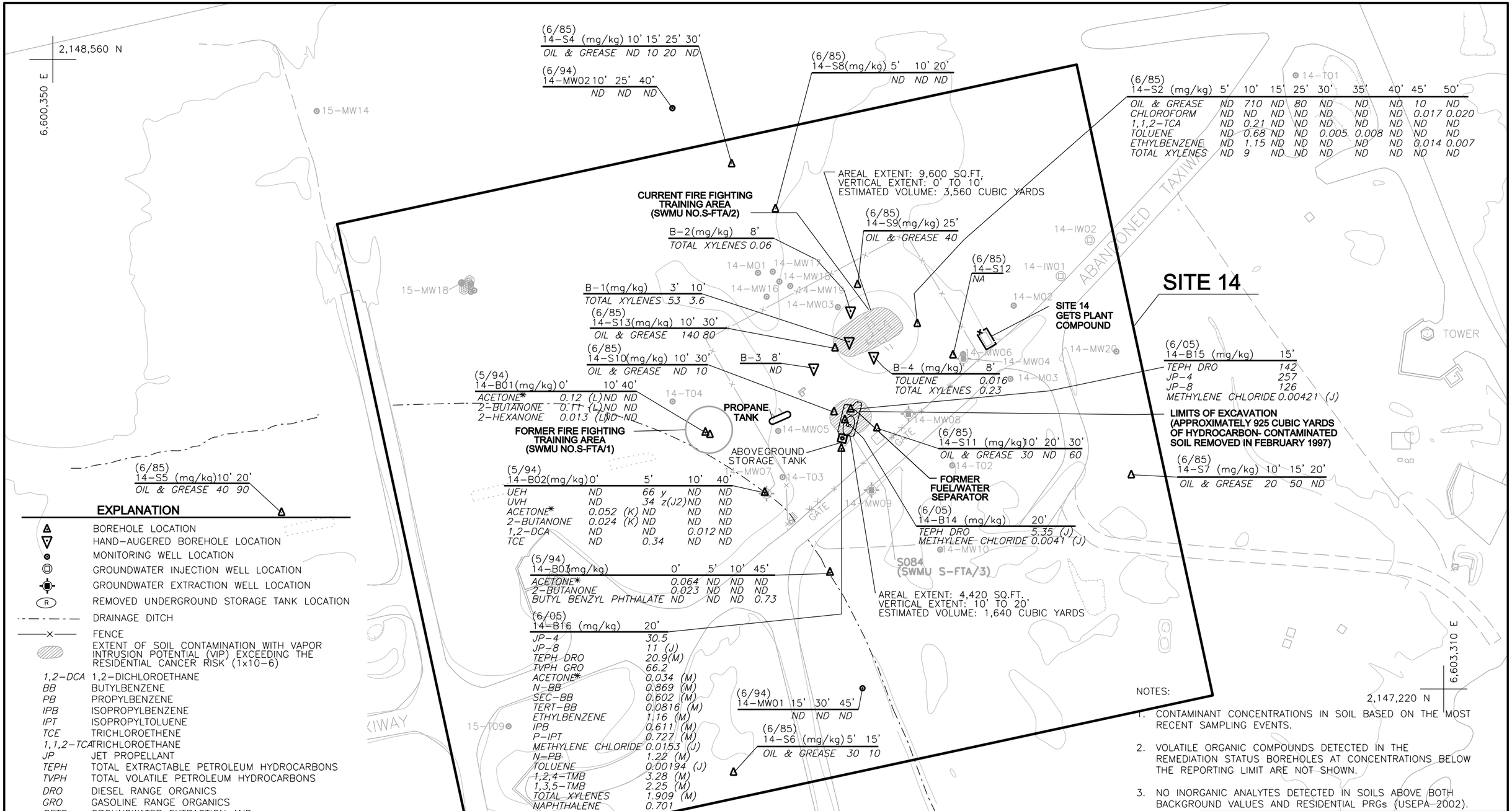
SCALE: 1"= 100'

OU2 ROD

Extent of Soil Contamination Source Area Sites 5/14 Contaminant Plume

Date 3-09	South Base Edwards AFB	Figure
Project No. 77194		2.6-4

EDWARDS\ 77194\B5835FGA.A01



EXPLANATION

- BOREHOLE LOCATION
- HAND-AUGERED BOREHOLE LOCATION
- MONITORING WELL LOCATION
- GROUNDWATER INJECTION WELL LOCATION
- GROUNDWATER EXTRACTION WELL LOCATION
- REMOVED UNDERGROUND STORAGE TANK LOCATION
- DRAINAGE DITCH
- FENCE
- EXTENT OF SOIL CONTAMINATION WITH VAPOR INTRUSION POTENTIAL (VIP) EXCEEDING THE RESIDENTIAL CANCER RISK (1x10-6)

1,2-DCA	1,2-DICHLOROETHANE
BB	BUTYLBENZENE
PB	PROPYLBENZENE
IPB	ISOPROPYLBENZENE
IPT	ISOPROPYLTOLUENE
TCE	TRICHLOROETHENE
1,1,2-TCA	TRICHLOROETHANE
JP	JET PROPELLANT
TEPH	TOTAL EXTRACTABLE PETROLEUM HYDROCARBONS
TVPH	TOTAL VOLATILE PETROLEUM HYDROCARBONS
DRO	DIESEL RANGE ORGANICS
GRO	GASOLINE RANGE ORGANICS
GETS	GROUNDWATER EXTRACTION AND TREATMENT SYSTEM
SWMU	SOLID WASTE MANAGEMENT UNIT
TMB	TRIMETHYLBENZENE
UEH	UNKNOWN EXTRACTABLE HYDROCARBONS
UVH	UNKNOWN VOLATILE HYDROCARBONS
ND	NOT DETECTED
NA	NOT ANALYZED
*	A COMMON LABORATORY CONTAMINANT

SAMPLING LOCATION (UNIT) DEPTH SAMPLED
PARAMETER VALUE

DATA QUALIFIERS:

y	CHROMATOGRAPHIC PROFILE IS NOT CONSISTENT WITH PATTERN(S) EXHIBITED BY REFERENCE FUEL STANDARDS. QUANTITATION OF UNKNOWN HYDROCARBONS IN SAMPLE IS BASED ON DIESEL FUEL.
z	CHROMATOGRAPHIC PROFILE IS NOT CONSISTENT WITH PATTERN(S) EXHIBITED BY REFERENCE FUEL STANDARDS. QUANTITATION OF UNKNOWN HYDROCARBONS IN SAMPLE IS BASED ON GASOLINE.
(J)	THE ANALYTE WAS POSITIVELY IDENTIFIED,THE QUANTITATION IS AN ESTIMATION.
(J2)	ESTIMATED VALUE. CALIBRATION RANGE EXCEEDED. RESULT FROM A DILUTION NOT AVAILABLE OR NOT USABLE.
(K)	ESTIMATED VALUE. RECOVERIES FOR ONE OR MORE SURROGATES ARE ABOVE QC LIMITS. VALUES MAY BE BIASED HIGH.
(L)	ESTIMATED VALUE. RECOVERIES FOR ONE OR MORE SURROGATES ARE BELOW QC LIMITS. VALUES MAY BE BIASED LOW.
(M)	A MATRIX EFFECT WAS PRESENT.

NOTES:

1. CONTAMINANT CONCENTRATIONS IN SOIL BASED ON THE MOST RECENT SAMPLING EVENTS.
2. VOLATILE ORGANIC COMPOUNDS DETECTED IN THE REMEDIATION STATUS BOREHOLES AT CONCENTRATIONS BELOW THE REPORTING LIMIT ARE NOT SHOWN.
3. NO INORGANIC ANALYTES DETECTED IN SOILS ABOVE BOTH BACKGROUND VALUES AND RESIDENTIAL PRGs (USEPA 2002).

NORTH

0 100 200 FEET

OU2 ROD

Extent of Soil Contamination Site 14

Date 3-09	South Base Edwards AFB	Figure
Project No. 77194		2.6-5

EDWARDS\ 77194\B5836FGA.A01

TABLE 2.6-3. MAXIMUM CONCENTRATIONS OF ORGANIC AND INORGANIC CONSTITUENTS DETECTED IN SOIL COMPARED TO CALCULATED BACKGROUND CONCENTRATIONS AND RESIDENTIAL PRGs - SITE 5

(Page 1 of 3)

Analyte	Maximum Concentration (mg/kg)	Location ID of Maximum Concentration	Sample Depth (ft bgs)	No. Detections/ Total No. Samples	Calculated Background Concentration [a] (mg/kg)	No. Samples Exceeding Background/ Total No. Samples	2000 Residential PRG [b] (mg/kg)	No. Samples Exceeding Residential PRG/Total No. Samples
Petroleum Hydrocarbons								
unknown extractable hydrocarbon	5,400	5-B44	19	23/33	-	-	NP	-
unknown volatile hydrocarbon	17,000	5-B48	50	16/33	-	-	NP	-
Volatile Organics								
acetone	1.1 (UJ1)	5-B44	50	22/33	-	-	1,600	0/33
benzene	0.0019 J	5-B45	50	1/33	-	-	0.65	0/33
2-butanone (MEK)	0.027	5-B46	50	1/33	-	-	7,300	0/33
n-butylbenzene	2.4 (J4)	5-B42	50	9/33	-	-	140	0/33
sec-butylbenzene	1.5 (J4)	5-B42	50	7/33	-	-	110	0/33
tert-butylbenzene	0.22 J	5-B41	45	1/33	-	-	130	0/33
ethylbenzene	0.21 J	5-B44	50	2/33	-	-	230	0/33
isopropylbenzene	1.3 (J4)	5-B44	50	6/33	-	-	160	0/33
p-isopropyltoluene	5.8 (J4)	5-B42	50	9/33	-	-	NP	-
n-propylbenzene	0.48	5-B41	50	6/33	-	-	140	0/33
tetrachloroethene (PCE)	1.5 (J4)	5-B42	50	1/33	-	-	5.7	0/33
toluene	0.32 (J4)	5-B44	50	2/33	-	-	520	0/33
1,2,4-trichlorobenzene	0.0013 J	5-B44	30	1/33	-	-	650	0/33
trichloroethene (TCE)	0.67 J	5-B42	50	2/33	-	-	2.8	0/33
1,2,4-trimethylbenzene	8.6 (J4)	5-B42	50	12/33	-	-	52	0/33
1,3,5-trimethylbenzene	21 (J4)	5-B42	50	7/33	-	-	21	0/33
m- & p-xylene	12 (J4)	5-B42	50	6/33	-	-	NP	-
o-xylene	9.4 (J4)	5-B42	50	5/33	-	-	NP	-
xylenes, total	21.4 (J4, J4)	5-B42	50	6/33	-	-	210	0/33

TABLE 2.6-3. MAXIMUM CONCENTRATIONS OF ORGANIC AND INORGANIC CONSTITUENTS DETECTED IN SOIL COMPARED TO CALCULATED BACKGROUND CONCENTRATIONS AND RESIDENTIAL PRGs - SITE 5

(Page 2 of 3)

Analyte	Maximum Concentration (mg/kg)	Location ID of Maximum Concentration	Sample Depth (ft bgs)	No. Detections/ Total No. Samples	Calculated Background Concentration [a] (mg/kg)	No. Samples Exceeding Background/ Total No. Samples	2000 Residential PRG [b] (mg/kg)	No. Samples Exceeding Residential PRG/Total No. Samples
Semivolatile Organics								
naphthalene	11 (J4)	5-B42	50	16/33	-	-	56	0/33
Metals and Other Elements								
aluminum	24,400	5-B21	50	130/130	35,900	0/130	76,000	0/130
antimony	7.8	5-B21	50	2/130	6	2/130	31	0/130
arsenic	13.8	5-B04	45	130/130	22.7	0/130	0.39	130/130
barium	134	5-MW02	45	130/130	301	0/130	5,400	0/130
Metals and Other Elements (continued)								
beryllium	1.2	5-B21	50	98/130	1.4	0/130	150	0/130
cadmium	0.77	5-B08	40	6/130	0.5	6/130	9	0/130
calcium	34,200	5-B09	40	130/130	129,000	0/130	NP	-
chromium, total	21.3	5-B21	50	130/130	39.1	0/130	210	0/130
cobalt	8.6	5-B21	50	126/130	18	0/130	4,700	0/130
copper	235	5-MW02	45	123/130	48.7	1/130	2,900	0/130
iron	24,200	5-B21	50	130/130	36,100	0/130	23,000	1/130
lead	30.7	5-VAP01	19	130/130	28.2	1/130	400	0/130
magnesium	8,870	5-B21	50	130/130	30,900	0/130	NP	-
manganese	396	5-B21	50	130/130	905	0/130	1,800	0/130
molybdenum	2.6	5-VAP01	19	1/130	2	1/130	390	0/130
nickel	12.9	5-B21	50	39/130	16.9	0/130	150	0/130
organic lead	2.7	S202-T2	22	2/324	-	-	0.0061	2/324
potassium	6,430	5-B21	50	130/130	10,900	0/130	NP	-
sodium	3,850	5-B17	15	128/130	12,500	0/130	NP	-
vanadium	42.8	5-B21	50	130/130	74.5	0/130	550	0/130
zinc	244	5-MW02	45	130/130	107	1/130	23,000	0/130

TABLE 2.6-3. MAXIMUM CONCENTRATIONS OF ORGANIC AND INORGANIC CONSTITUENTS DETECTED IN SOIL COMPARED TO CALCULATED BACKGROUND CONCENTRATIONS AND RESIDENTIAL PRGs - SITE 5

(Page 3 of 3)

Notes:

Data for organic analyses from remediation status boreholes collected March 2004. Data for inorganic analyses from all samples collected.

[(a)] Background level calculated for OU2 (Earth Tech 1995).

[(b)] USEPA Region IX PRGs (USEPA 2000).

-	not applicable
ft bgs	feet below ground surface
mg/kg	milligrams per kilogram
NP	not promulgated
PRG	Preliminary Remediation Goal
QC	Quality Control
USEPA	United States Environmental Protection Agency

Laboratory Data Qualifier:

J Estimated result. Result is less than the reporting limit.

Earth Tech Data Qualifiers:

(J4) Estimated value. Surrogate recoveries are out both above and below QC limits, or no value supplied for one or more surrogates. Bias not readily determined.

(UJ1) Estimated value. Blank contamination; the value in the laboratory blank is below the reporting limit. Indicates possible high bias and/or false positives. Blank level multiplied by 5 is higher than sample results, except for contamination from methylene chloride, acetone, 2-butanone and common phthalate esters where the multiplier is 10.

TABLE 2.6-4. MAXIMUM CONCENTRATIONS OF ORGANIC AND INORGANIC CONSTITUENTS DETECTED IN SOIL COMPARED TO CALCULATED BACKGROUND CONCENTRATIONS AND RESIDENTIAL PRGs - SITE 14

(Page 1 of 3)

Analyte	Maximum Concentration (mg/kg)	Location ID of Maximum Concentration	Sample Depth (ft bgs)	No. Detections/ Total No. Samples	Calculated Background Concentration [a] (mg/kg)	No. Samples Exceeding Background/ Total No. Samples	2000 Residential PRG [b] (mg/kg)	No. Samples Exceeding Residential PRG/Total No. Samples
Petroleum Hydrocarbons								
jet fuel #4	257	14-B15	15	2/18	-	-	NP	-
jet fuel #8	126	14-B15	15	2/18	-	-	NP	-
oil & grease	710	14-S2	10	19/31	-	-	NP	-
PHC as diesel fuel	142	14-B15	15	3/3	-	-	NP	-
PHC as gasoline	66.2	14-B16	20	1/3	-	-	NP	-
unknown extractable hydrocarbon	66 y	14-B02	5	1/15	-	-	NP	-
unknown volatile hydrocarbon	34 z (J2)	14-B02	5	1/15	-	-	NP	-
Volatile Organics								
acetone	0.12 (L)	14-B01	0	4/21	-	-	1,600	0/21
2-butanone (MEK)	0.11 (L)	14-B01	0	3/21	-	-	7,300	0/21
n-butylbenzene	0.869 (M)	14-B16	20	1/3	-	-	140	0/3
sec-butylbenzene	0.602 (M)	14-B16	20	1/3	-	-	110	0/3
tert-butylbenzene	0.0816 (M)	14-B16	20	1/3	-	-	130	0/3
chloroform	0.02	14-S2	50	3/12	-	-	0.24	0/12
1,2-dichloroethane	0.012	14-B02	10	1/21	-	-	0.35	0/21
ethylbenzene	1.16 (M)	14-B16	20	1/21	-	-	230	0/21
2-hexanone	0.013 (L)	14-B01	0	1/21	-	-	NP	-
isopropylbenzene	0.611 (M)	14-B16	20	1/3	-	-	160	0/3
p-isopropyltoluene	0.727 (M)	14-B16	20	1/3	-	-	NP	-
methylene chloride	0.0153 (J)	14-B16	20	7/21	-	-	8.9	0/21
n-propylbenzene	1.22 (M)	14-B16	20	1/3	-	-	140	0/3
toluene	0.68	14-S2	10	5/31	-	-	520	0/31
1,1,2-trichloroethane	0.21	14-S2	10	1/9	-	-	0.84	0/9
trichloroethene (TCE)	0.34	14-B02	5	1/21	-	-	2.8	0/21
1,2,4-trimethylbenzene	3.28 (M)	14-B16	20	1/3	-	-	52	0/3

TABLE 2.6-4. MAXIMUM CONCENTRATIONS OF ORGANIC AND INORGANIC CONSTITUENTS DETECTED IN SOIL COMPARED TO CALCULATED BACKGROUND CONCENTRATIONS AND RESIDENTIAL PRGs - SITE 14
(Page 2 of 3)

Analyte	Maximum Concentration (mg/kg)	Location ID of Maximum Concentration	Sample Depth (ft bgs)	No. Detections/ Total No. Samples	Calculated Background Concentration [a] (mg/kg)	No. Samples Exceeding Background/ Total No. Samples	2000 Residential PRG [b] (mg/kg)	No. Samples Exceeding Residential PRG/Total No. Samples
Volatile Organics *(Continued)*								
1,3,5-trimethylbenzene	2.25 (M)	14-B16	20	1/3	-	-	21	0/3
m- & p-xylene	1.45 (M)	14-B16	20	1/21	-	-	NP	-
o-xylene	0.459 (M)	14-B16	20	1/21	-	-	NP	-
xylenes, total	53	B-1	3	6/34	-	-	210	0/34
Semivolatile Organics								
butyl benzyl phthalate	0.73	14-B03	45	1/10	-	-	12,000	0/10
naphthalene	0.701	14-B16	20	1/13	-	-	56	0/13
Metals and Other Elements								
aluminum	21,900	14-B01	0	15/15	35,900	0/15	76,000	0/15
antimony	6.3	14-B01	0	1/15	6	1/15	31	0/15
arsenic	11.1	14-MW02	45	15/15	22.7	0/15	0.39	15/15
barium	154	14-B03	5	15/15	301	0/15	5,400	0/15
beryllium	0.84	14-B01	0	11/15	1.4	0/15	150	0/15
cadmium	0.72	14-B01	0	1/15	0.5	1/15	9	0/15
calcium	47,200	14-B03	5	15/15	129,000	0/15	NP	-
chromium, total	21.5	14-B01	0	15/15	39.1	0/15	210	0/15
cobalt	9.3	14-B01	0	13/15	18	0/15	4,700	0/15
copper	24.1	14-B01	0	12/15	48.7	0/15	2,900	0/15
iron	23,500	14-B01	0	15/15	36,100	0/15	23,000	1/15
lead	11.8	14-B01	0	15/15	28.2	0/15	400	0/15
magnesium	17,700	14-B01	0	15/15	30,900	0/15	NP	-
manganese	502	14-B01	0	15/15	905	0/15	1,800	0/15
molybdenum	5.1	14-MW01	15	1/15	2	1/15	390	0/15

TABLE 2.6-4. MAXIMUM CONCENTRATIONS OF ORGANIC AND INORGANIC CONSTITUENTS DETECTED IN SOIL COMPARED TO CALCULATED BACKGROUND CONCENTRATIONS AND RESIDENTIAL PRGs - SITE 14
(Page 3 of 3)

Analyte	Maximum Concentration (mg/kg)	Location ID of Maximum Concentration	Sample Depth (ft bgs)	No. Detections/ Total No. Samples	Calculated Background Concentration [a] (mg/kg)	No. Samples Exceeding Background/ Total No. Samples	2000 Residential PRG [b] (mg/kg)	No. Samples Exceeding Residential PRG/Total No. Samples
Metals and Other Elements *(Continued)*								
nickel	19.1	14-B01	0	5/15	16.9	1/15	150	0/15
potassium	6,720	14-B01	0	15/15	10,900	0/15	NP	-
selenium	0.71	14-MW02	10	1/15	0.5	1/15	390	0/15
sodium	3,270	14-MW02	10	11/15	12,500	0/15	NP	-
vanadium	49.5	14-B01	0	15/15	74.5	0/15	550	0/15
zinc	61.8	14-B01	0	15/15	107	0/15	23,000	0/15

Notes:

Data for soil samples collected from mid-1980s through June 2005.
[a] Background level calculated for OU2 (Earth Tech 1995).
[b] USEPA Region IX PRGs (USEPA 2000).

- not applicable
ft bgs feet below ground surface
mg/kg milligrams per kilogram
NP not promulgated
PRG Preliminary Remediation Goal
QC Quality Control
USEPA United States Environmental Protection Agency

Laboratory Data Qualifiers:

y Chromatographic profile is not consistent with pattern(s) exhibited by reference fuel standards. Quantitation of unknown hydrocarbons in sample is based on diesel fuel.
z Chromatographic profile is not consistent with pattern(s) exhibited by reference fuel standards. Quantitation of unknown hydrocarbons in sample is based on gasoline.

Quality Control Data Qualifiers:

(J) Estimated value.
(J2) Estimated value. Calibration range exceeded. Result from a dilution not available or not usable. Indicates low bias.
(L) Estimated value. Recoveries for one or more surrogates are below QC limits. Values may be biased low.
(M) Matrix effect. The concentration is estimated due to a matrix effect.

The estimated volume of floating free product is 71,000 gallons. Based on the specific gravity of JP-4, the estimated residual mass of free product in the plume is 462,000 lbs.

Conceptual Site Model

The conceptual site model illustrating the potential contaminant migration and exposure pathways for the Sites 5/14 Contaminant Plume is shown on Figure 2.6-6. Factors influencing the distribution of contaminants and completed pathways that present risk to human health and biota are described in greater detail below.

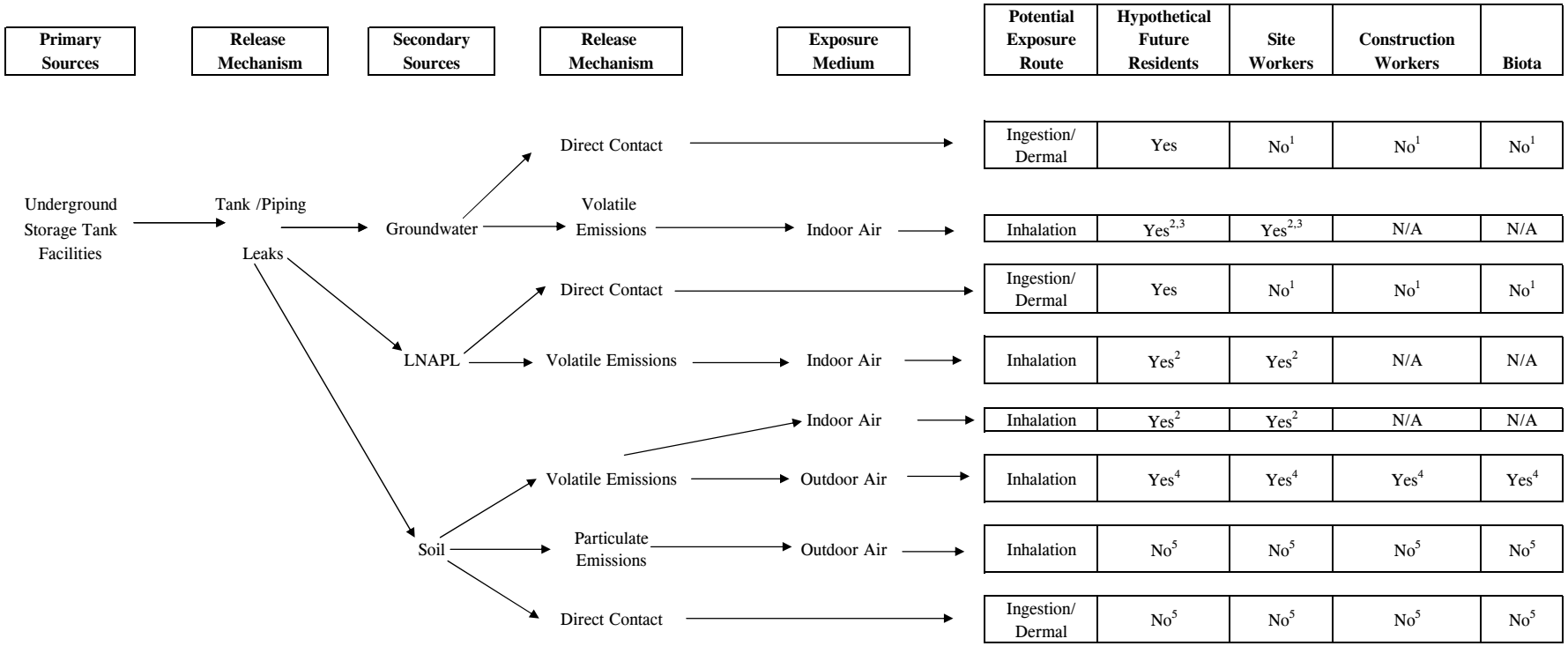
Contaminant Sources

Site investigations indicate that several leaking USTs, located in the southern portion of Site 5 and used to store waste POL between 1972 and 1984, were the source of the groundwater contamination. Based on the contaminants detected in the soils beneath the USTs, and in the floating free product within the plume, it is apparent that waste solvents were commingled with other waste liquids in the USTs.

As indicated in the "Pilot Testing" subsection of Section 2.6.1.2, the free product in the vicinity of the former UST locations has been removed during interim removal actions; however, free product still remains in the middle section of the plume, acting as a continuing source of groundwater contamination. The free product exists as a relatively thin layer (less than one-inch thick) on the potentiometric surface. The presence (or disappearance) of the floating free product in wells is influenced by relatively small changes in the hydrogeologic conditions, and is not believed to be due to contaminant migration.

Laboratory analysis of the free product samples indicates the presence of both fuel-related hydrocarbons and chlorinated solvents (see Table 2.6-2). The concentrations of chlorinated solvents detected in the free product are higher than the concentrations of chlorinated solvents detected in the groundwater. The high concentrations may be due to the enhanced solubility of TCE in other organic solvents, such as those contained in fuels.

FIGURE 2.6-6. CONCEPTUAL SITE MODEL - SITES 5/14 CONTAMINANT PLUME



[1] Depth to groundwater over 12 feet below ground surface; no complete pathway.
[2] Pathway complete only for future buildings; no current buildings impacted.
[3] Pathway potentially complete; however, risk within acceptable limits (see Table 2.6-5).
[4] Pathway potentially complete; however, risk within acceptable limits (pathway included in PRGs for soil [see Table 2.6-5]).
[5] Low levels of residual soil contamination over 12 feet below ground surface; no complete pathway.

LNAPL - Light non-aqueous phase liquid
N/A - Not applicable, not a valid pathway
PRG - Preliminary remediation goal

Based on the data collected during the site investigations, it appears that the majority, if not all, of the groundwater contamination at Site 14 is from the leading edge of the Sites 5/14 Contaminant Plume. The primary groundwater contaminant detected is TCE, although other organic contaminants have been detected sporadically at low concentrations. Hydrocarbon-contaminated soils have been detected at Site 14 but do not extend to the groundwater. Halogenated solvents have also been detected in the soils, but only in one borehole and at a relatively shallow depth (i.e., less than 10 feet bgs).

Factors Controlling the Distribution of Contaminants in Groundwater

Physical, chemical, and biological factors control the horizontal and vertical distribution of the contaminants in the area of the Sites 5/14 Contaminant Plume as discussed below.

Physical Factors

Groundwater contamination is limited to the upper aquifer in the area of the Sites 5/14 contaminant plume. The nearest water supply wells on-Base produce groundwater from water-bearing zones in the middle aquifer at the South Base Well Field located approximately 2.4 miles southwest of Site 14. As shown on a regional cross section developed by Sneed et al. (2005), connectivity between these two aquifers may be retarded by lacustrine deposits (see Figure 2.2-2). In March 2004, groundwater withdrawal rates from these Base water supply wells ranged from approximately 400 gallons per minute (gpm) to approximately 750 gpm from screened intervals in the middle aquifer that range from at least 220 feet bgs to a maximum 690 feet bgs. These yields are in contrast with the yields of approximately 2.5 gpm observed in extraction wells installed in the upper aquifer in the area of Sites 5/14. The cone of depression in the area of the South Base Well Field does not influence the direction of groundwater flow in the vicinity of Sites 5/14 (Earth Tech 2005).

Based on the results of a step-drawdown pump test performed at Site 5, the calculated groundwater velocity is 42 feet per year. Based on velocity, contaminated groundwater at Site 5 would migrate downgradient (east-southeast) an estimated 1,260 feet during a 30-year period (assuming a homogeneous subsurface lithology). However, based on the mapped areal extent of the fuel (benzene) and TCE contamination, and assuming that the initial contaminant release occurred in 1972, the fuel component of the contaminant plume has migrated downgradient approximately 3,600 feet in

approximately 30 years, and the TCE component of the contaminant plume has migrated downgradient approximately 5,600 feet.

Pilot testing (Earth Tech 2008e) has indicated that the heterogeneous nature of the upper aquifer in the area of Sites 5/14 creates preferential flow paths for injection chemicals. Based on the estimated time for the permanganate to reach wells, the calculated groundwater velocities in the treatment area ranged from less than 20 feet per year to 320 feet per year across the width of the plume.

The vertical extent of the contamination in the groundwater is largely limited to the upper 10 feet to 15 feet of the saturated zone. The limited vertical extent may be due to the presence of fine-grained sediments (i.e., silts and clays) impeding the vertical transport in the aquifer (see Figures 2.6-2 and 2.6-3).

Biological/Chemical Factors

The floating free product acts as a continuing source of dissolved phase fuel and chlorinated hydrocarbon contamination to the groundwater. Natural attenuation of fuel-related contaminants appears to be occurring. Fuel-related hydrocarbons degrade very rapidly at OU2 once leached from the free product and dissolved in the aquifer due to aerobic conditions within the plume outside of areas with free product (Earth Tech 2008a). For this reason, the vertical and horizontal extent of fuel-related hydrocarbons is limited at Sites 5/14.

Based on an evaluation of natural attenuation parameters, including an evaluation of the presence of chlorinated hydrocarbon degradation products, there is no evidence that natural attenuation of chlorinated hydrocarbons is occurring. The lack of reductive dechlorination may be related to the largely aerobic conditions within the plume boundary. Fate and transport modeling indicates that if uncontrolled, the chlorinated hydrocarbon portion of the plume will continue to migrate (Earth Tech 2005c).

Exposure Pathways

There are two potentially complete exposure pathways that may cause risk to future receptors: (1) if hypothetical future residents are exposed to untreated (i.e., contaminated) groundwater through

ingestion or dermal contact, and (2) if hypothetical future residents or industrial users are exposed to vapors released from free product at Sites 5/14 or soil at Site 14 and impacting indoor air.

The pre-scoping ecological risk assessments conducted at Sites 5 and 14 indicate there is no current threat to biota (USGS 2004). The analytical results for the soil samples collected during the remediation status borehole drilling in March 2004 indicate the soils pose minimal risk to current (or future) site or construction workers. The only complete exposure pathway would be if future site workers or future area residents were exposed to untreated groundwater.

2.6.1.3 Current and Potential Future Land and Resource Uses

According to the *General Plan* (HB&A 2001), the Sites 5/14 Contaminant Plume is located within the Developed Area of the Base, and the existing land uses within the limits of the plume boundary are categorized as Airfield Pavements, Engineering Test, Industrial, and Buffer Zone. The Airfield Pavements land use category includes South Base Runway 06/24. The Engineering Test land use category includes the southwestern corner of the BFTF. The land used for Industrial purposes is the Current Fire Fighting Training Area. Future land uses at the Sites 5/14 Contaminant Plume are expected to be similar to the existing land uses. All these land use categories are considered industrial for risk assessment purposes. According to the *General Plan*, which indicates future land use out for a period of five years, land use at OU2, including Sites 5/14, is expected to be similar to current use. No residential uses of any portion of OU2 are anticipated.

Although groundwater in the Sites 5 and 14 areas, including the groundwater in the contaminant plume, is not currently used for drinking water, historic (inactive) Base supply wells are located within the boundaries of the sites. Active Base supply wells are located approximately two miles south of the sites (see Figure 2.1-2). The Cal/EPA DTSC and the Water Board have designated the groundwater at these sites as a potential source of drinking water.

2.6.1.4 Summary of Site Risks

Human Health Risk

A comprehensive discussion of the risk assessment is presented in the *South Base HHRA* (Earth Tech 2003b). However, after the *South Base HHRA* was completed, interim removal actions

and additional soil vapor, soil, and groundwater sampling were performed at the Sites 5/14 Contaminant Plume. Consequently, the risk assessment values in the *South Base HHRA* were updated using the more recent sampling results (Earth Tech 2008d) and are summarized in Table 2.6-5.

As shown in Table 2.6-5, the calculated cancer risks and noncancer HIs at Sites 5 and 14 are considered acceptable for the following pathways:

- The calculated cancer risk and noncancer HI to future residents and industrial users through dermal contact with soil at Sites 5 and 14.
- The calculated cancer risk and noncancer HI to future residents and industrial users from the potential volatilization of VOC contaminants off contaminated groundwater from the Sites 5/14 plume.

The calculated cancer risks and noncancer HIs at Sites 5/14 are considered unacceptable for the following pathways:

- The calculated cancer risk and noncancer HI to future residents through the ingestion of contaminated groundwater in the Sites 5/14 Contaminant Plume.
- The calculated indoor air noncancer HIs to future residents or industrial users from the potential volatilization of the VOC contaminants in soil to indoor air at Site 14.
- The indoor air risk from the vaporization of free product present in the middle section of the Sites 5/14 Contaminant Plume was not assessed. The available data for the light non-aqueous phase liquid (LNAPL) is not amenable for use with the conventionally used models because capillary fringe soil contaminant concentration data were not collected. For this reason, the cancer and noncancer indoor air risks are assumed to be unacceptable.

It should be noted that the risk from indoor air at Site 5 (volatilization off soil) also estimates the risk from volatilization off free product. The data used to assess the potential risks associated with the vapor intrusion pathway to indoor air were collected from the network of soil vapor extraction wells also associated with the remediation of the product by the Site 5 DES.

The risk from direct contact with free product under a residential groundwater use scenario was not assessed because toxicity values for contaminants dissolved in non-aqueous media have not been promulgated. For this reason, the cancer risk from contact with contaminated groundwater is underestimated.

TABLE 2.6-5. SUMMARY OF HUMAN HEALTH RISK ASSESSMENT RESULTS – SITES 5/14 CONTAMINANT PLUME
(Page 1 of 2)

Potential Exposure Scenario	Exposure Medium	Cancer Risk[a]	Primary Risk Drivers[b]	Noncancer Hazard Index[c]	Primary Risk Drivers[b]
Residential (Hypothetical future)	Site 5 Soil	$2x10^{-7}$	None	0.62	None
	Site 14 Soil	$1x10^{-7}$	None	0.24	None
	Sites 5/14 Groundwater[d]	**$1x10^{-3}$**	EDB (78%) TCE (14%)	**5.6**	Naphthalene (41%) 1,2,4-TMB (33%)
	Site 5 Indoor Air[e] (volatilization from soil)	$2x10^{-7}$	None	0.09	None
	Site 14 Indoor Air (volatilization from soil)	$3x10^{-5}$	None	**6.8**	Total xylenes (97%)
	Sites 5/14 Indoor Air[d] (volatilization from groundwater)	$6x10^{-6}$	None	0.08	None
Industrial	Site 5 Soil	$9x10^{-8}$	None	0.22	None
	Site 14 Soil	$6x10^{-8}$	None	0.10	None
	Site 5/14 Groundwater[d]	NA	NA	NA	NA
	Site 5 Indoor Air[e] (volatilization from soil)	$6x10^{-9}$	None	0.01	None
	Site 14 Indoor Air (volatilization from soil)	$2x10^{-6}$	None	**1.1**	Total xylenes (97%)
	Sites 5/14 Indoor Air[d] (volatilization from groundwater)	$1x10^{-7}$	None	0.001	None
Construction Worker	Site 5 Soil	$1x10^{-09}$	None	0.08	None
	Site 14 Soil	$9x10^{-10}$	None	0.04	None
	Site 5/14 Groundwater[d]	NA	NA	NA	NA
	Site 5 Indoor Air[e] (volatilization from soil)	NA	NA	NA	NA
	Site 14 Indoor Air (volatilization from soil)	NA	NA	NA	NA
	Sites 5/14 Indoor Air[d] (volatilization from groundwater)	NA	NA	NA	NA

TABLE 2.6-5. SUMMARY OF HUMAN HEALTH RISK ASSESSMENT RESULTS – SITES 5/14 CONTAMINANT PLUME

(Page 2 of 2)

Notes:

Values in bold exceed USEPA 1991 generally acceptable criteria for cancer and noncancer risks.

Results for indoor air using Air Force-recommended toxicity criteria are presented. Results using USEPA provisional TCE toxicity criteria are presented in the indoor air pathway tables for each site.

(a) To manage risks from known or suspected carcinogens, the United States Environmental Protection Agency (USEPA 1980) has developed the following exposure range: more than one additional cancer case for 10,000 people is unacceptable (i.e., greater than $1x10^{-4}$); one additional cancer case for 10,000 to one million people is considered generally acceptable (i.e., between $1x10^{-4}$ and $1x10^{-6}$); and one additional cancer case for one million or more people is considered acceptable (i.e., less than $1x10^{-6}$). However, if multiple contaminants are present and multiple pathways of exposure exist, the more stringent end of the range should be used to establish cleanup goals.

(b) "None" indicates that there are no primary risk drivers because the total risk is characterized as acceptable or generally acceptable according to the USEPA (1980) exposure range. If a constituent is shown as a primary risk driver, the number in parentheses is the percentage of the risk accounted for by the constituent.

(c) A Hazard Index less than 1 is considered generally acceptable (USEPA 1991).

(d) Results are for the entire Sites 5/14 Contaminant Plume.

(e) Results are for a building the size of Building 120, which is within the footprint of the plume. Results for soil impact were calculated using soil vapor data, see text.

1,1,2-TCA	1,1,2-trichloroethane
1,2,4-TMB	1,2,4-trimethylbenzene
EDB	ethylene dibromide
NA	Not applicable; no exposure pathway identified.
TCE	trichloroethene

Ecological Risk

No complete exposure pathways to ecological receptors were found at Sites 5 and 14 during the *Pre-scoping Assessment, OUs 1, 2, 3, and 6, Ecological Risk Assessment* (USGS 2004). The assessment results indicated that the contamination is too deep to pose a risk to wildlife or habitat. In addition, the industrial nature of these sites makes for poor wildlife habitat, and no threatened or endangered plants or animals live at these sites.

Threat to Groundwater or Surface Water

The USEPA's VLEACH Model, Version 2.2 was used to evaluate the leaching potential of contaminants in soil at Sites 5 and 14 that are unlikely to degrade by natural attenuation. These include the chlorinated hydrocarbons TCE and PCE for Site 5 and TCE for Site 14. Fuel hydrocarbons, including benzene and naphthalene, are present in small quantities in the soil; however, because they would be readily degraded by the aerobic conditions in the Sites 5/14 groundwater, they were not modeled.

Model results are contained in *Evaluation of the Potential Impact to Groundwater due to the Mobilization and Migration of Organic Contaminants in Soil at Operable Unit 2 Using the Vadose Zone Leaching Model (VLEACH)* (USAF 2008). For TCE and PCE in soil at Site 5, the model predicted a mass flux of 1.32×10^{-5} g/yr/ft^2 and 1.84×10^{-5} g/yr/ft^2, respectively, impacting the groundwater at a simulation time of 500 years. Using the predicted TCE and PCE mass flux in a mixing model (USAF 2008), the predicted TCE and PCE concentrations in groundwater at a simulation time of 500 years are 5.57×10^{-2} μg/L and 7.75×10^{-2} μg/L per unit volume of groundwater, respectively, which are below the MCLs for TCE and PCE (5 μg/L).

For TCE in soil at Site 14, the model predicted a mass flux of 6.76×10^{-7} g/yr/ft^2 impacting the groundwater at a simulation time of 500 years. Using the predicted TCE mass flux in a mixing model (USAF 2008), the predicted TCE concentration in groundwater at a simulation time of 500 years is 2.84×10^{-3} μg/L per unit volume of groundwater, which is below the MCL for TCE (5 μg/L).

Based on these results, there is no threat to groundwater from constituents remaining in soil at Sites 5/14 because all constituents were evaluated and determined to be either naturally occurring, readily degradable, or at concentrations unlikely to impact groundwater. There is no surface water

present at Sites 5/14. The nearest water supply wells are located at the South Base Well Field in the Landfill/Evaporation Ponds Area, which is approximately two miles south (cross-gradient) of the plume (see Figure 2.1-2).

2.6.1.5 Remedial Action Objectives

Cleanup Standards for Soil

Because human health risks from direct soil exposure are in the acceptable range, and there are no complete pathways for ecological risk, the RPMs agreed that no further action is required for soils at Sites 5/14 (Earth Tech 2005c and 2006a). However, because the noncancer HIs from soil vapors are not acceptable to residential or industrial receptors at Site 14, land use controls will be required at the site. Engineering controls must be put in place if future residential or industrial buildings are constructed at the site. The land use controls will be required until soil contaminant concentrations drop below the risk-based cleanup standards listed in Table 2.6-6.

Cleanup Standards for Groundwater

Although the groundwater at Sites 5 and 14 is currently not a drinking water source, it is classified as a "potential drinking water source" by Cal/EPA DTSC and the Water Board, which means that the contamination must be cleaned up. Cleanup standards for contaminants of concern (COCs) in groundwater and constituents in free product are listed in Table 2.6-7.

The Sites 5/14 Remedial Action Objectives (RAOs) are to:

1. Prevent migration of COCs listed in Table 2.6-7 that are present in the groundwater at concentrations above the more stringent of Federal or State Primary MCLs;

2. Restore levels of COCs in groundwater listed in Table 2.6-7 to safe drinking water standards, which are defined by the more stringent of Federal or State Primary MCLs;

3. Protect human health by preventing ingestion of, or dermal contact with, groundwater or free-product contaminated with the COCs listed in Table 2.6-7 at concentrations greater than the more stringent of Federal or State Primary MCLs; and

4. Protect human health by preventing future exposure to vapor-phase COCs at levels exceeding those listed in Table 2.6-8 for indoor air that could volatilize off LNAPL in the middle section of the Sites 5/14 groundwater contaminant plume, or volatilize off soil at Site 14.

TABLE 2.6-6. CLEANUP STANDARDS FOR CONTAMINANTS OF CONCERN IN SOIL WHICH PRESENT AN UNACCEPTABLE RISK TO INDOOR AIR – SITE 14

Contaminants of Concern	Maximum Detected Concentration (μg/kg)	95% UCL Concentration [a] (μg/kg)	Current Residential Cancer Risk/Noncancer Hazard Index	Basis for Listing as a Chemical of Concern	Selected Cleanup Standard [b] (μg/kg)	Cancer Risk/ Noncancer Hazard Index at Cleanup Standard
chloroform	20	4.8	2.20×10^{-5}/NA	Exceeds the risk-based cleanup level	0.22	1.00×10^{-6}/NA
1,1,2-trichloroethane	210	22	1.24×10^{-5}/NA	Exceeds the risk-based cleanup level	1.7	9.74×10^{-7}/NA
total xylenes	53,000	6,806	NA/**6.7**	Noncancer Hazard Index exceeds the threshold criteria of 1.	1,022	NA/1

Notes:

[a] Source: *Environmental Restoration Program, Addendum to the Human Health Risk Assessment, South Base, Operable Unit 2, Edwards AFB, CA* (Earth Tech 2008c). The 95% UCLs for soil samples collected at Site 14 were used to calculate the residential cancer risk/noncancer Hazard Index.

[b] Risk-based indoor exposure soil concentration in the Johnson and Ettinger (J&E) model for the evaluation of the indoor air risk (Earth Tech 2008c).

Values shown in **bold** exceed the threshold carcinogenic risk criteria of 1×10^{-4} or noncancer Hazard Index of 1.

μg/kg	micrograms per kilogram
95% UCL	95 percent upper confidence limit of the mean
NA	not applicable; there is either no cancer risk or noncancer Hazard Index for the contaminant of concern
OU2	Operable Unit 2

TABLE 2.6-7. CLEANUP STANDARDS FOR CONTAMINANTS OF CONCERN IN GROUNDWATER AND FREE PRODUCT – SITES 5/14 CONTAMINANT PLUME

Contaminants of Concern	Maximum Concentration Detected in 2006/2007 [a] (μg/L)	95% UCL Concentration [b] (μg/L)	Current Residential Cancer Risk/Noncancer Hazard Index [b]	Basis for Listing as a Chemical of Concern	Selected Cleanup Standard [c][d] (μg/L)	Cancer Risk/ Noncancer Hazard Index at Cleanup Standard
Contaminants Detected in Groundwater (Dissolved Phase)						
benzene	2.6	7.0	1.99×10^{-5}/NA	Exceeds the MCL.	1	2.86×10^{-6}/NA
carbon tetrachloride	22	1.0	6.01×10^{-6}/NA	Exceeds the MCL.	0.5	2.94×10^{-6}/NA
tetrachloroethene (PCE)	6.9	1.6	1.48×10^{-6}/NA	Exceeds the MCL.	5	4.55×10^{-6}/NA
trichloroethene (TCE)	270	217	**1.35×10^{-4}**/NA	Exceeds the MCL and the cancer risk exceeds the threshold carcinogenic risk criteria of 1×10^{-4}.	5	3.13×10^{-6}/NA
Contaminants Detected in Free Product						
ethylbenzene	510,000	NC	[e]	Exceeds the MCL.	300	NA/ < 1
trichloroethene (TCE)	220,000	NC	[e]	Exceeds the MCL.	5	3.13×10^{-6}/NA
o-xylene	400,000	NC	[e]	Exceeds the MCL.	1,750 [f]	NA/ < 1
m- & p-xylene	550,000	NC	[e]	Exceeds the MCL.	1,750 [f]	NA/ < 1

Notes:

[a] The last two years of groundwater samples for Sites 5 and 14 were chosen to maximize spatial coverage of the plumes. The maximum contaminant concentrations included in this table are greater than the MCLs.

[b] Source: *Environmental Restoration Program, Addendum to the Human Health Risk Assessment, South Base, Operable Unit 2, Edwards AFB, CA* (Earth Tech 2008c). The 95% UCLs for groundwater samples collected through December 2005 were used to calculate the residential cancer risk.

[c] The more stringent of the Federal or State Primary MCLs (CDHS 2003).

[d] Concentration also defines extent of land use control compliance boundary for groundwater use.

[e] An evaluation of risk from the contaminants in free product in middle section of the Sites 5/14 Contaminant Plume was not assessed in the Environmental Restoration Program, Addendum to the Human Health Risk Assessment, South Base, Operable Unit 2, Edwards AFB, CA (Earth Tech 2008c). Available data for the free product is not amenable for use in the NAPL-SCREEN model because the model requires capillary fringe soil contaminant concentrations as a data input and these data were not collected.

[f] The MCL is for either a single isomer or the sum of the isomers (CDHS 2003).

Values shown in **bold** exceed the threshold carcinogenic risk criteria of 1×10^{-4}.

μg/L	micrograms per liter
95% UCL	95 percent upper confidence limit of the mean
MCL	Maximum Contaminant Level
NA	not applicable; there is no noncancer Hazard Index for the contaminant of concern
NC	not calculated due to insufficient number of samples
OU2	Operable Unit 2

TABLE 2.6-8. INDOOR AIR VAPOR COMPLIANCE STANDARDS

Chemical	Indoor Air[a] Human Health Screening Levels ($\mu g/m^3$)	
	Residential Land Use	Commercial/Industrial Land Use Only
Benzene	8.40E-02	1.41E-01
Carbon Tetrachloride	5.79E-02	9.73E-02
1,2-Dichloroethane	1.16E-01	1.95E-01
cis-1,2-Dichloroethylene	3.65E+01	5.11E+01
trans-1,2-Dichloroethylene	7.30E+01	1.02E+02
Ethylbenzene	Postponed[b]	Postponed[b]
Mercury, elemental	9.40E-02	1.31E-01
Methyl tert-Butyl Ether	9.35E+00	1.57E+01
Naphthalene	7.20E-02	1.20E-01
Tetrachloroethylene	4.12E-01	6.93E-01
Tetraethyl Lead	3.65E-04	5.11E-04
Toluene	3.13E+02	4.38E+02
1,1,1-Trichloroethane	2.29E+03	3.21E+03
Trichloroethylene	1.22E+00	2.04E+00
Vinyl Chloride	3.11E-02	5.24E-02
m-Xylene	7.30E+02	1.02E+03
o-Xylene	7.30E+02	1.02E+03
p-Xylene	7.30E+02	1.02E+03

Notes:

Source: *Use of California Human Health Screening Levels in Evaluation of Contaminated Properties* (Cal/EPA 2005).

[a] "Residential Land Use" screening levels generally considered adequate for other sensitive uses (e.g., day-care centers, hospitals, etc.). Commercial/industrial properties should be evaluated using both residential and commercial/industrial CHHSLs. A deed restriction that prohibits use of the property for sensitive purposes may be required at sites that are evaluated and/or remediated under a commercial/industrial land use scenario only.

Calculation of cumulative risk may be required at sites where multiple contaminants with similar health effects are present.

Carcinogens: CHHSLS based on target cancer risk of 10-6. Cal/EPA cancer slope factors used when available.

Noncarcinogens: CHHSLS based on target hazard quotient of 1.0.

[b] Calculation of a screening number for the chemical has been postponed until the toxicity criterion currently being developed by OEHHA is published as a final document.

$\mu g/m^3$ micrograms per cubic meter
Cal/EPA California Environmental Protection Agency
CHHSL California Human Health Screening Level
OEHHA Office of Environmental Health Hazard Assessment

2.6.1.6 Description of Alternatives

The USAF evaluated four alternatives to manage and clean up the contaminated groundwater. A more comprehensive discussion of the different alternatives is presented in the *OU2 FS* (Earth Tech 2005c).

The four alternatives considered are:

1. **No Action**. The NCP and USEPA guidance requires the consideration of a no action alternative as a "baseline case" against which all other alternatives are compared. This alternative assumes that the Site 5 DES would remain shut down, the currently operating Site 14 GETS would be shut down, and no additional actions would be taken. As a result, the only reduction in contaminants that would occur would be due to natural attenuation. No monitoring of groundwater would be conducted; therefore, the potential attenuation of contaminant levels would remain unknown, as would the rate of any attenuation. It is assumed that no monetary costs are incurred for this alternative.

2. **Containment**. This alternative consists of the continued operation of the Site 14 GETS (i.e., a barrier well system) to prevent further migration of the plume. The Site 5 DES would remain shut down. Groundwater monitoring would be implemented to ensure the Site 14 GETS continues to prevent the plume from migrating, and to evaluate how fast the contaminants degrade. LUCs (see Section 2.8.1) would be put in place to (1) prevent people from using the groundwater; and (2) require engineering controls on structures designed for residential (unlikely scenario) or industrial use in areas with floating free product or vapor-contaminated soil to protect building inhabitants from vapor intrusion into indoor air. Procedures to maintain LUCs and the areas requiring LUCs would be documented in the General Plan (HB&A 2001). Based on computer modeling, the Site 14 GETS would need to be operated for an estimated 100 years and was estimated to cost $30 million in the *OU2 FS* (Earth Tech 2005c) (Table 2.6-9). However, in all likelihood the system would need to be operated for much longer, resulting in significantly increased costs. The risk during this period is that land use, groundwater use, or the hydrogeologic regime may change significantly over time, potentially requiring major modifications to this alternative.

3. **Free Product Removal and Plume Containment.** For this alternative, the continued operation of the existing Site 14 GETS to contain the Sites 5/14 Contaminant Plume would be supplemented by the installation and operation of a DES to remove floating free product in the middle section of the plume (see Figure 2.6-1). The new system would be of a much larger scale than the Site 5 DES; based on the areal extent of free product contamination, 61 DEWs would be installed and approximately 9,000 feet of branch and header lines would be required to connect the DEWs to the DES treatment plant. Following source contamination removal, the dissolved-phase petroleum hydrocarbon plume would be allowed to degrade naturally. Groundwater monitoring, identical to that in Alternative 2, would be implemented to evaluate how fast the contaminants degrade.

TABLE 2.6-9. COSTS OF THE SITES 5/14 ALTERNATIVES

Cost in 2007 dollars	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Timeframe	NA	100 years	30 years	12 years
Capital	$0	$33,700	$4,900,000	$3,910,000
LUCs/LTM	NA	$3,810,000	$1,740,000	$697,000
O&M (Total)	NA	$8,850,000	$7,980,000	$2,040,000
O&M (Annual)		$88,500	$26,600	$170,000
Escalated Cost[1]	$0	$29,500,000	$17,600,000	$7,280,000
Present Value Cost[2]	$0	$3,050,000	$11,600,000	$6,040,000

Notes:

[1] Escalated cost is the inflationary adjustment from current dollars to the future estimated cost when the work is performed.

[2] Present value is the amount of money that would need to be invested in the present to cover the total cost of the project, assuming an interest rate of 7 percent.

NA not applicable
LUCs land use controls
LTM long-term management
O&M Operations and Maintenance
OU2 Operable Unit 2
USEPA United States Environmental Protection Agency

LUCs, identical to those in Alternative 2, would also be put in place during cleanup. Based on the performance of the Site 5 DES, it is estimated that this alternative would be effective in remediating the source area of the plume in seven years (i.e., removing floating free product). In addition, this alternative would be effective in containing the plume and preventing exposure to site contaminants. It was assumed that operation and maintenance (O&M) of the Site 14 GETS, groundwater monitoring, and maintaining institutional controls would be performed for 30 years.

This alternative was estimated to cost $18 million over 30 years in the *OU2 FS* (Earth Tech 2005c) (see Table 2.6-9). However, although Alternative 3 was costed for 30 years, computer modeling indicates that contaminants could persist after source removal in excess of 50 years, resulting in significantly increased costs. The risk during this period is that land use, groundwater use, or the hydrogeologic regime may change significantly over time, potentially requiring major modifications to this alternative.

4. **In Situ Aerobic Biological Degradation of the Source Area and In Situ Chemical Oxidation (ISCO) of the Dissolved-phase Chlorinated Plume (Selected Alternative).** This alternative combines in situ aerobic biological degradation using gaseous-phase nutrient injection for the remediation of the floating free product in the middle section of the plume and chemical reagent injection for the remediation of the dissolved-phase TCE plume. For the implementation of the gaseous-phase nutrient injection, an estimated 60 vertical injection wells would be installed within the area of floating free product. One mobile (i.e., trailer-mounted) system containing an air compressor and nutrient handling equipment would be deployed. At any one time, 20 wells would be ganged together to the mobile system using temporary aboveground hose/piping. The total time required to remediate the free product area of the plume is estimated to be 10 years. This estimation assumes that each of the three gangs of 20 wells would be operated for a total of three years (although not continuously) and that some wells would need one additional year of treatment. For the dissolved-phase chlorinated plume, ten horizontal wells would be installed at approximately 400-foot spacing. The use of horizontal wells allows for the injection of chemical oxidant across the entire width of the plume (i.e., southwest to northeast) without disruption of flightline operations or existing infrastructure. A chemical reagent solution would be injected into the aquifer once per year for a period of 10 years to remediate the dissolved TCE plume.

   O&M of the Site 14 GETS, groundwater monitoring, and maintenance of institutional controls would be identical to those in Alternative 3. It was assumed these phases would be performed for 11 years; one year during design and installation of the horizontal well and vertical well systems, and 10 years concurrent with operation of the gaseous-phase nutrient and chemical reagent injections. LUCs, identical to those in Alternative 2, would also be put in place during cleanup. Assuming implementation would begin in 2007, the estimated total cost for this alternative was $7 million over 12 years in the *OU2 FS* (Earth Tech 2005c) (see Table 2.6-9).

2.6.1.7 Comparative Analysis of Alternatives

The comparative analysis of the alternatives for the Sites 5/14 Contaminant Plume is presented in Table 2.6-10. All of the active alternatives would provide adequate protection of human health and the environment by making use of LUCs to prevent/limit exposure to groundwater and floating free product. Alternative 2 prevents further migration of the contaminated groundwater plume with an existing GETS, but does not aggressively remediate the source area, thereby extending the period it would take for the plume to naturally attenuate. Alternative 3, which is a more aggressive approach than Alternative 2, would remove the source of the groundwater contamination (i.e., floating free product) using dual extraction, which has proven effective during the IRA at Site 5, while also preventing further migration of the plume using an existing GETS. Alternative 4 would actively remediate the entire contaminant plume using technologies that have been validated at a pilot scale at Sites 5/14 (Earth Tech 2007a, 2008b, and 2008e) after the completion of the *OU2 FS* (Earth Tech 2005c), while also preventing further migration of the plume using an existing GETS. Although the injection of oxidant temporarily increases the dissolution of metals in the aquifer, creating a short-term impact, once the oxidant is no longer active, metal concentrations decrease to levels below the MCL (Earth Tech 2008e).

As shown in Table 2.6-9, Alternative 2 has the lowest present value cost to implement, but the highest estimated escalated cost. Alternative 4 has a higher present value cost to implement, but the lowest estimated escalated cost to implement. However, it should be noted that the Air Force is not allowed to create a trust fund that would bear interest over the estimated 100 years that LUCs/LTM would need to be in place; therefore the escalated cost is the best indicator of the true life-cycle cost of the alternative.

Based on the evaluation of alternatives, the implementation of Alternative 4 is selected.

2.6.1.8 Principal Threat Wastes

Principal threat wastes are source materials that are considered to be highly toxic or highly mobile that generally cannot be reliably contained, or would present an unacceptable risk to human health or the environment should exposure occur. Source materials are materials that contain hazardous substances, pollutants, or contaminants that act as the starting point of contaminant migration to groundwater and

TABLE 2.6-10. COMPARATIVE ANALYSIS OF ALTERNATIVES – SITES 5/14 CONTAMINANT PLUME

(Page 1 of 2)

CERCLA Criteria [a]	ALTERNATIVE 1 No Action	ALTERNATIVE 2 Containment and LUCs	ALTERNATIVE 3 Source Removal, Containment, and LUCs	ALTERNATIVE 4 In Situ Treatment (Entire Plume) (Selected Alternative)
Overall Protection of Human Health and the Environment	Does not eliminate potential for future exposure to contaminated groundwater. ○	Protects water supply wells by preventing migration of plume. ●	Protects water supply wells by preventing migration of plume. ●	Will restore groundwater to drinking water standards within 12 years. ●
Compliance with ARARs	Does not comply with chemical-specific ARARs for groundwater. ○	Attains MCLs downgradient of the containment wellfield, but not upgradient. May not restore entire aquifer to MCLs within 100 years. ◒	Attains MCLs downgradient of the containment wellfield. May not restore entire aquifer to MCLs within 30 years. ◒	Will treat groundwater to MCLs within 12 years. ●
Long-Term Effectiveness and Permanence	Does not eliminate potential for future exposure to contaminated groundwater. ○	Reduces risk to water supply wells to acceptable levels. Free product and dissolved-phase chlorinated solvents may remain for over 100 years. ◒	Reduces risk to water supply wells to acceptable levels. Reduces risk from use of groundwater within the contaminant plume, but not to acceptable levels within 30 years. ◒	Reduces risk from future exposure to groundwater to acceptable levels within 12 years. ●
Reduction of Toxicity, Mobility, and Volume through Treatment	No effect on the toxicity, volume, or mobility of contaminants. ○	Reduces the mobility of contaminants: little reduction of volume or toxicity of contaminants. ◒	Reduces toxicity, mobility, and volume of contaminants. Dissolved-phase chlorinated solvents are expected to remain for more than 30 years. ●	Will reduce toxicity, mobility, and volume of contaminants to acceptable levels within 12 years. ●
Short-Term Effectiveness	May reduce risk to remediation workers by shutting down active remediation systems (Site 5 DES and Site 14 GETS). ●	May reduce risk to remediation workers by shutting down the Site 5 DES. Minimal risks remain from LTM and O&M of the Site 14 GETS. These risks can easily be dealt with through use of personal protective equipment (PPE) and work practices. ●	May increase risk to remediation workers due to increase in air emissions from oxidizer and size of area to be treated. These risks can easily be dealt with through use of personal protective equipment (PPE) and work practices. ◒	May increase risk to remediation workers slightly due to on-site chemical mixing and handling. These risks can easily be dealt with through use of personal protective equipment (PPE) and work practices. ◒

TABLE 2.6-10. COMPARATIVE ANALYSIS OF ALTERNATIVES – SITES 5/14 CONTAMINANT PLUME

(Page 2 of 2)

CERCLA Criteria [a]	ALTERNATIVE 1 No Action	ALTERNATIVE 2 Containment and LUCs	ALTERNATIVE 3 Source Removal, Containment, and LUCs	ALTERNATIVE 4 In Situ Treatment (Entire Plume) (Selected Alternative)
Implementability	Not applicable, no activities proposed. ●	Required components (Site 14 GETS and LTM) are already in place and operational. ●	Some required components (Site 14 GETS and LTM) are already in place and operational. Difficult to implement due to the number of wells and trenches needed in the area of the taxiway and South Base Runway and treatment system siting issues. ◒	Some required components (Site 14 GETS and LTM) are already in place and operational. Difficult to implement due to the number of required injection wells. Added complexities are involved in the installation of horizontal wells. ◒
Cost	●	○	◒	●
Escalated Cost [b]	None	$29,500,000	$17,600,000	$7,280,000
Present Value Cost [c]	None	$ +3,050,000	$11,600,000	$6,040,000
Regulatory Agency Acceptance	Not acceptable. ○	Not acceptable. ○	Acceptable. ●	Acceptable. ●
Community Acceptance	No public comments specific to this alternative. ◒	No public comments specific to this alternative. ◒	No public comments specific to this alternative ◒	Acceptable. ●

Notes:

[a] Source: USEPA (1999).
[b] Escalated cost is in 2007 dollars.
[c] Present value cost is in 2007 dollars (assumes a 7 percent discount factor).
○ Does not meet criteria
◒ Partially meets criteria
● Meets criteria

ARARs applicable or relevant and appropriate requirements
CERCLA Comprehensive Environmental Response, Compensation, and Liability Act
DES dual extraction system
GETS groundwater extraction and treatment system
LUC land use control
MCL maximum contaminant level
O&M operation and maintenance

may be highly toxic and not readily contained. Floating free product would be considered a principal threat waste at Sites 5/14.

2.6.1.9 Selected Remedy

The USAF and USEPA, with concurrence from Cal/EPA DTSC and the Water Board, selected Alternative 4 for Sites 5/14. The USAF, USEPA, and Cal/EPA DTSC concur with the selected remedy because it is the lowest cost alternative that will clean up the COCs, reduce the risk to human health, protect the environment, and accomplish these goals within a reasonable timeframe. The Water Board concurs with the selected remedy because it meets the technical requirements of California water quality law, plans, and policies.

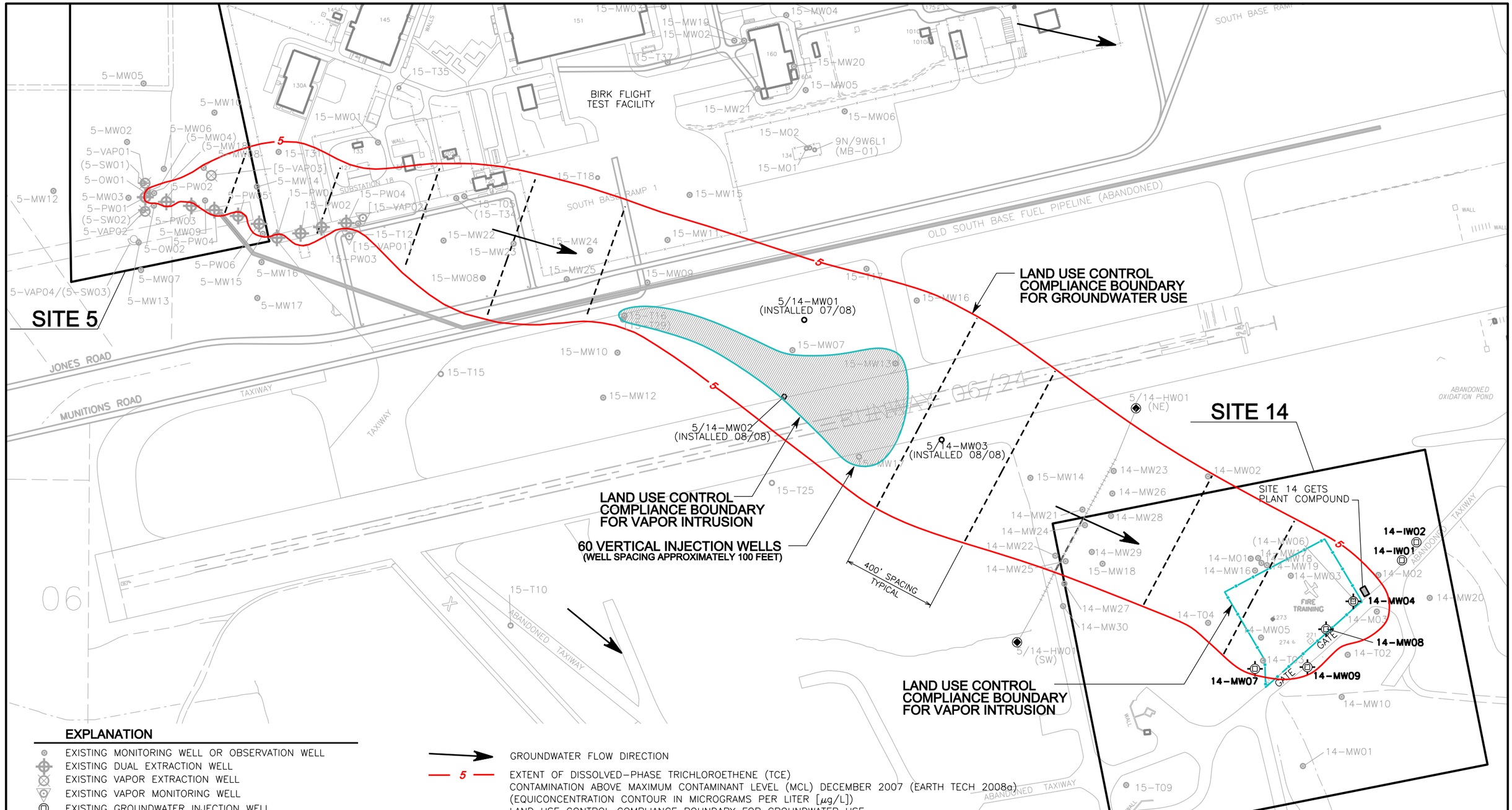
The selected remedy utilizes in situ treatment by aerobic biological degradation of the floating free product and ISCO of the dissolved chlorinated plume. Until the remediation is complete, LUCs will be maintained to prevent exposure by potential future residential and industrial users to contaminated groundwater and volatile emissions using administrative procedures described in Section 2.8.1.2. Details regarding the design and layout of injection wells and the type, quantity, and frequency of injected chemical reagent and gaseous-phase nutrients will be specified during the Remedial Design phase. Figure 2.6-7 shows the conceptual layout for the selected remedy.

The Selected Remedy consists of the following components:

a. **Aerobic biological degradation to treat the middle section of the plume contaminated with floating free product:** Inject air and gaseous nutrients through vertical wells to destroy floating free product (addresses RAOs #2 and #4);

b. **Chemical reagent injection to treat groundwater contaminated by chlorinated solvents (primarily TCE):** Inject chemical reagent using horizontal wells to treat contaminated groundwater (addresses RAO #2);

c. **Site 14 GETS operation to prevent further downgradient migration of the Sites 5/14 groundwater contaminant plume:** Operate the Site 14 GETS to prevent further downgradient migration of the groundwater contaminant plume or elevated metals while needed for plume containment during remediation. The GETS is required to treat extracted groundwater to meet the enforceable levels of half the respective MCLs for the constituents listed in Table 2.6-11 on a median basis with a maximum discharge level of the respective MCLs, as measured at the effluent sampling port of the Site 14 GETS (addresses RAO #1);



EXPLANATION

- EXISTING MONITORING WELL OR OBSERVATION WELL
- EXISTING DUAL EXTRACTION WELL
- EXISTING VAPOR EXTRACTION WELL
- EXISTING VAPOR MONITORING WELL
- EXISTING GROUNDWATER INJECTION WELL
- EXISTING GROUNDWATER EXTRACTION WELL
- EXISTING AIR SPARGING WELL
- EXISTING NESTED AIR SPARGING/VAPOR EXTRACTION WELL
- ( ) WELL SCREEN BELOW WATER TABLE
- [ ] WELL SCREEN ABOVE WATER TABLE
- HORIZONTAL WELL SURFACE COMPLETION
- HORIZONTAL WELL CASING
- HORIZONTAL WELL SCREEN

- GROUNDWATER FLOW DIRECTION
- 5 — EXTENT OF DISSOLVED-PHASE TRICHLOROETHENE (TCE) CONTAMINATION ABOVE MAXIMUM CONTAMINANT LEVEL (MCL) DECEMBER 2007 (EARTH TECH 2008a) (EQUICONCENTRATION CONTOUR IN MICROGRAMS PER LITER [$\mu g/L$]) LAND USE CONTROL COMPLIANCE BOUNDARY FOR GROUNDWATER USE
- LAND USE CONTROL COMPLIANCE BOUNDARY FOR VAPOR INTRUSION
- CONCEPTUAL HORIZONTAL WELL LOCATION
- EXTENT OF FLOATING FREE-PRODUCT (DECEMBER 2005)
- GETS — GROUNDWATER EXTRACTION AND TREATMENT SYSTEM

NORTH

0 200 400 FEET

SCALE: 1"= 400'

OU2 ROD

Conceptual Layout of the Selected Remedy Sites 5/14 Contaminant Plume

Date 3-09	South Base Edwards AFB	Figure
Project No. 77194		2.6-7

EDWARDS\ 77194\B5837FGA.A01

TABLE 2.6-11. STANDARDS FOR CONTAMINANTS OF CONCERN IN SITE 14 GROUNDWATER EXTRACTION AND TREATMENT SYSTEM EFFLUENT INJECTED DOWNGRADIENT OF THE SITES 5/14 GROUNDWATER CONTAMINANT PLUME

Contaminant [a]	MCL [b] (μg/L)	Injection Standard [c] (μg/L)
1,2-dichloroethane	0.5	0.25
cis-1,2-dichloroethene	6	3
trans-1,2-dichloroethene	10	5
tetrachloroethene (PCE)	5	2.5
trichloroethene (TCE)	5	2.5

Notes:

[a] The list of Site 14 GETS influent contaminants was used as the basis of the injection standards list. The last four years of groundwater samples were chosen to account for temporal variation in plant influent.

[b] Value is the Primary MCL from the California Department of Health Services (2003).

[c] The enforceable levels of half the respective MCLs for the constituents listed on a median basis with a maximum discharge level of the respective MCLs, as measured at the effluent sampling port of the Site 14 GETS.

μg/L micrograms per liter
GETS Groundwater Extraction and Treatment System
MCL Maximum Contaminant Level

d. **Groundwater monitoring:** Perform groundwater monitoring in accordance with the Remedial Action Work Plan (RAWP) for Sites 5/14 to verify that the groundwater contaminant plume or elevated metals are not migrating downgradient and to determine the status of remediation to groundwater cleanup standards (addresses RAOs #1, #2, and #3);

e. **Treatment of elevated metals resulting from injection of chemical reagent:** Baseline concentrations (concentrations prior to the first injection of chemical reagent) of manganese and total chromium will be documented during development of the RAWP for Sites 5/14. If manganese and total chromium do not return to baseline conditions within 2 years after ISCO reagent injections cease, the Air Force will institute measures to return the metals to those baseline conditions;

f. **Institutional controls to prevent ingestion of, or dermal contact with, contaminated groundwater:** During the remedial action, implement and maintain institutional controls at Sites 5/14 to prevent ingestion of, or dermal contact with, contaminated groundwater within the boundary shown on Figure 2.6-7. The footprints of areas impacted with COCs will be periodically updated in the GIS from ERP documents (see Section 2.8.1.2) (addresses RAO #3);

g. **Institutional controls to protect human health from vapors impacting indoor air:** Due to the presence of free product in the middle section of the Sites 5/14 groundwater contaminant plume (0.01 inches or greater thickness) and soil contamination at Site 14 (see Figure 2.6-7), future residential and industrial construction will be restricted within these areas by institutional controls unless engineering controls are instituted and maintained to ensure indoor air vapor levels are below those listed in Table 2.6 8. These engineering controls may include, but are not limited to, actions such as sub-slab depressurization; installation of vapor barriers; foundation ventilation systems; and protective heating, ventilation, and air conditioning (HVAC) designs. The footprints of areas impacted with COCs will be periodically updated in the GIS from ERP documents (see Section 2.8.1.2). The LUCs required due to the presence of free product in the middle section of the plume may be removed if it can be demonstrated by field instrumentation that no measurable free product (less than 0.01 inches thick) remains at the site. The LUC boundary for Site 14 is drawn at the fence line of Site 14 for convenience of administration; the extent of impacted soil is shown on Figure 2.6-5. The LUC required due to the presence of soil contamination at Site 14 can be removed if future soil sampling results indicate that soil contaminant concentrations are less than the standards listed in Table 2.6-6 (addresses RAO #4);

h. **Institutional controls to restrict installation of groundwater extraction wells:** The installation of groundwater extraction wells that include the Sites 5/14 groundwater contaminant plume boundary within the radius of influence of the wells is prohibited by institutional controls, with the exception of wells related to the Sites 5/14 remedy, until the groundwater is approved for unrestricted use and unlimited exposure (addresses RAO #3);

i. **Institutional controls to protect infrastructure:** Until the groundwater at Sites 5/14 is acceptable for unrestricted use and unlimited exposure, infrastructure related to the remedies as presented in Components a, b, and c, including, but not limited to, injection,

extraction, and monitoring wells, and treatment plants and piping systems will be protected by institutional controls from activities that may negatively impact their ongoing maintenance, effectiveness, and safety (addresses RAOs #1 and #2);

j. **Re-evaluation of the OU2 Technical and Economic Feasibility Analysis (TEFA):** When TCE approaches its MCL of 5 μg/L in the groundwater contaminant plume at Sites 5/14, the Air Force, in collaboration with the USEPA, Cal/EPA DTSC, and Water Board, will re-evaluate the lowest concentrations technically and economically achievable for all constituents listed in Table 2.6-7 and other contaminants remaining at the site, and determine the need to reach those lower concentrations; and

k. **LUC and IC Components:** All LUC and IC components described and listed above will be implemented and administered according to requirements and procedures described and listed in Section 2.8.1. Site-specific LUC and IC requirements will be included in the Air Force's routinely-updated *General Plan* (addresses RAOs #3 and #4).

The selected remedy is designed to return the groundwater to unrestricted use within 12 years. No further action is required to return the soils to unrestricted use, except for the soils at Site 14, which might pose an indoor air vapor intrusion risk to residential and industrial receptors. LUCs designed to protect human health from this indoor air vapor intrusion risk are contained in Selected Remedy Component g. The selected remedy will cost an estimated $7 million over 12 years.

2.6.1.10 Statutory Determinations

Under CERCLA Section 121 and the NCP, the lead agency must select remedies that are protective of human health and the environment, comply with ARARs (unless a statutory waiver is justified), are cost effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.

In addition, CERCLA asserts a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element, and a bias against off-site disposal of untreated wastes. The following sections discuss how the selected remedy meets these statutory requirements.

Protection of Human Health and the Environment

The selected remedy will protect human health and the environment by cleaning up groundwater to drinking water standards (i.e., the more stringent of the Federal or State Primary MCLs). LUCs will prevent exposure to contaminated groundwater during the remedial action.

Compliance with ARARs

The selected remedy will comply with the technical requirements of all Federal and State ARARs identified for the remedial action (see Section 2.8 and Appendix B) as follows:

Chemical-Specific ARARs

- Primary Drinking Water Standards (Table B-1, Item No. 1) - The NCP states that primary drinking water standards are legally applicable only to drinking water at the tap, but are relevant and appropriate as cleanup standards for groundwater and surface water that have been determined to be current or future drinking water sources. The selected remedy uses Primary MCLs as cleanup standards for the Sites 5/14 Plume.

- Water Quality Control Plan, South Lahontan Basin (Basin Plan) (Table B-1, Item No. 2) - The beneficial uses of groundwater listed in Section 2 of the Basin Plan are relevant and appropriate to groundwater at Sites 5/14.

Location-Specific ARARs

- Wildlife Species/Habitats (Table B-1, Item No. 4) – State protected species will be protected when practicable during construction and operations activities and the appropriate State authority will be contacted if conflicts arise.

Action-Specific ARARs

- Standards Applicable to Generators of Hazardous Waste (Table B-1, Item No. 5) – Although applicable to wastes generated during remedial activities (soil cuttings, purge water, and spent carbon), historically, these wastes have not been designated as hazardous under California Code of Regulations (CCR), Title 22 at Sites 5/14. However, the selected remedial action will comply with these standards in handling waste materials when and if they are applicable.

- Underground Injection Control Program (Table B-1, Item No. 6) – Injection of treatment chemicals and treated groundwater is planned for Site 5/14. The selected remedy will not degrade groundwater through injection of chemicals that will cause concentrations of COCs to exceed Primary MCLs.

- Statement of Policy with Respect to Maintaining High Quality of Waters in California (Non-degradation Policy) (Table B-1, Item No. 7) – Chemicals or treated groundwater injected during the selected remedy will not degrade the beneficial uses of the aquifer.

- Sources of Drinking Water Policy (Table B-1, Item No. 8) – The Air Force agrees with the designation of the current and potential use of the groundwater at Sites 5/14 as drinking/domestic use.

- Definition of and Criteria for Identifying Hazardous Wastes (Table B-1, Item No. 9) – The criteria contained in this ARAR will be used to define if waste generated by the selected remedy is hazardous.

- Hazardous Waste Land Disposal Restrictions (LDRs) (Table B-1, Item No. 10) – The criteria contained in this ARAR will be used to define if waste generated by the selected remedy is subject to LDRs.

- Land Use Controls (Table B-1, Item No. 11) – LUCs will be administered during the implementation of the selected remedy as indicated in Section 2.8 of this document and the Basewide LUC Implementation Plan.

Cost Effectiveness

The selected remedy is the lowest cost remedy that will remediate the groundwater to MCLs.

Utilization of Permanent Solutions and Alternative Treatment Technologies

The selected remedy is designed to permanently destroy contaminants in the groundwater, eliminate the floating free product, and return groundwater to its designated beneficial use. As an in situ technology, it treats the contaminated groundwater in place, rather than extracting contaminated groundwater from the aquifer.

Preference for Treatment as a Principal Element

The selected remedy has the treatment of the entire Sites 5/14 Contaminant Plume as its principal element.

Five-Year Review Requirements

Five-year reviews will be conducted until site contaminants have been reduced to concentration levels which allow for unrestricted use and unlimited exposure.

2.6.1.11 Documentation of Significant Changes from the OU2 Proposed Plan

No further action for soil was recommended in the *OU2 Proposed Plan*. However, at the request of the USEPA, a supplemental HHRA (Earth Tech 2008c) was conducted to evaluate the impact to indoor air from volatilization of contaminants off soil. As a result of this evaluation, it was determined that there could be an unacceptable noncancer HI to future residential receptors at Site 14. Even though Site 14 is an active Fire Fighting Training Area and there are no plans for residential development, it was agreed that LUCs requiring engineering controls on future residential construction be implemented that would control vapor intrusion to acceptable risk levels. Because there are no plans to use Site 14 for residential development, and LUCs will be maintained for other sites at Edwards AFB, there is no incremental cost associated with this change.

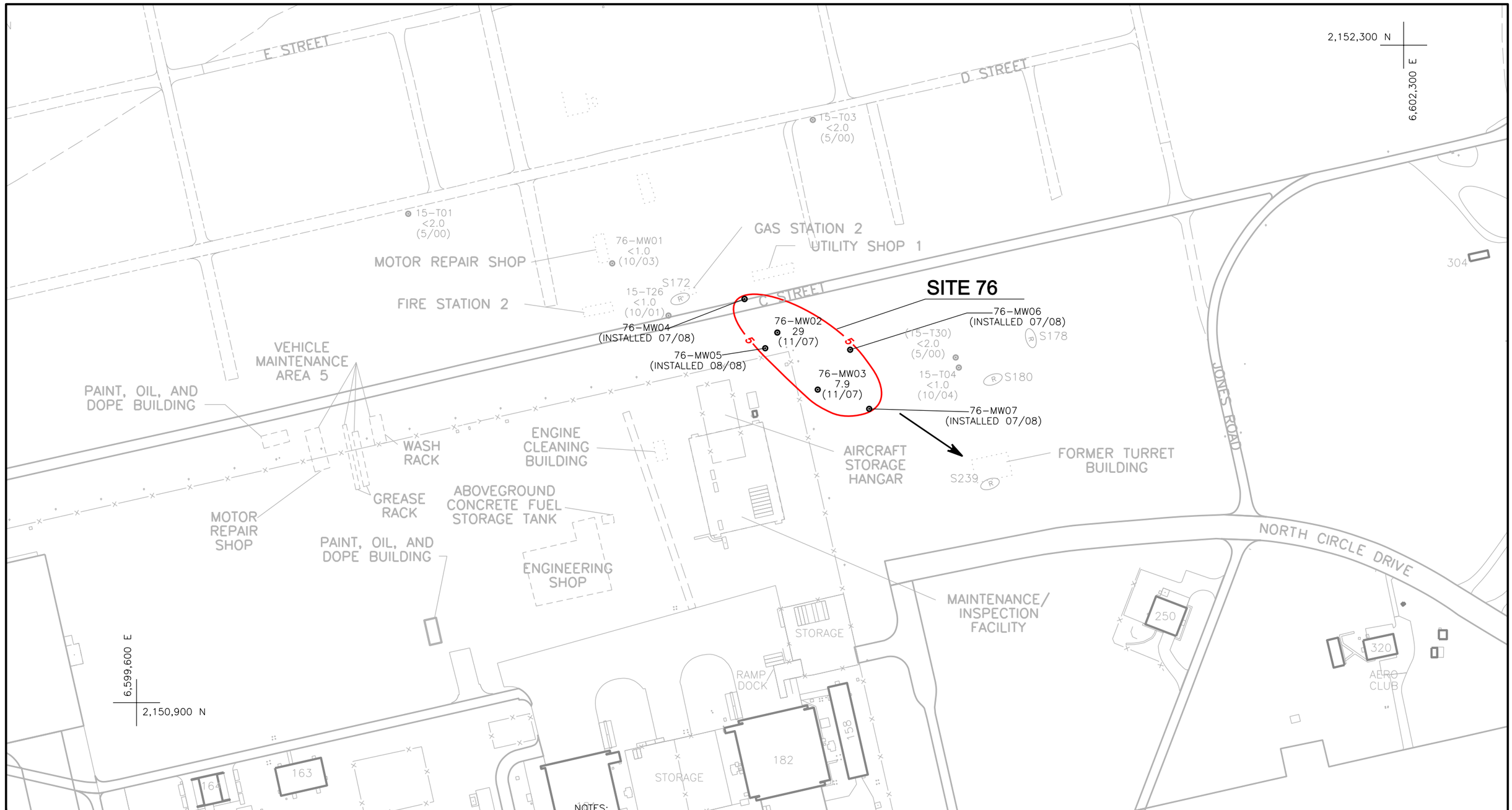
2.6.2 SITES 76 AND 86

2.6.2.1 Site Name, Location, and Brief Description

Sites 76 and 86 are located north of South Base Active Runway 06/24 (see Figure 2.1-2).

Site 76, Old South Base Assorted Facilities, is located northeast of the BFTF and includes part of that facility (Figure 2.6-8). The site consists of remnants of a Vehicle Maintenance Area; a Motor Repair Shop; an Engineering Shop; a Maintenance/Inspection Facility; a Utility Shop; a Gas Station; a Fire Station; Paint, Oil, and Dope Buildings; a Turret Building; and two 55-gallon drums used as USTs that were active during World War II. Fuels, solvents, waste oils, and lubricants may have been used or disposed at these facilities. Although no infrastructure that could convey contaminants, such as storm drains or sewers, is known to exist at the site, chemicals may have been disposed on the ground surface in the vicinity of these facilities and then leached to groundwater.

Site 86, Building 300 Engine Test Cell, is located southeast of Building 300 and consists of a former engine test cell that was constructed in the 1940s (Figure 2.6-9). Only concrete foundations of the former facilities remain. Fuels, solvents, and waste oils and lubricants would have been used and disposed at this facility. Several unlined surface drainage channels lead away from the test cell. Cooling water contaminated with petroleum products and solvents (primarily TCE) would have been flushed through the engines and discharged to the surrounding soil via the drainage channels.



EXPLANATION

76-MW02 ●	MONITORING WELL
20	TCE CONCENTRATION IN $\mu g/L$
(12/05)	DATE SAMPLED
(R)	REMOVED UNDERGROUND STORAGE TANK
(15-T30)	WELL SCREENED BELOW WATER TABLE
5	EXTENT OF DISSOLVED-PHASE TCE CONTAMINATION ABOVE THE MAXIMUM CONTAMINANT LEVEL IN GROUNDWATER (EQUICONCENTRATION CONTOUR IN $\mu g/L$)
→	GROUNDWATER FLOW DIRECTION
	FORMER BUILDING/FACILITY (CONCRETE PAD EVIDENT)
	FORMER BUILDING/FACILITY (NO REMAINS EVIDENT)
	PAVED ROAD
	FORMER ROAD
	FENCE

NOTES:

1. WELLS IN GRAY NOT SAMPLED IN DECEMBER 2007 (EARTH TECH 2008a)
2. LOCATION OF WELLS 15-T01, 15-T03, 15-T04, 15-T26, AND 15-T30 BASED ON GLOBAL POSITIONING SYSTEM SURVEY.
3. STATE PLANE COORDINATES ARE NORTH AMERICAN DATUM 1983 IN FEET.

ABBREVIATIONS:

<	LESS THAN
$\mu g/L$	MICROGRAMS PER LITER
TCE	TRICHLOROETHENE

NORTH

0 100 200 FEET

SCALE: 1"= 200'

OU2 ROD

Location Map
Site 76 Contaminant Plume

Date 3-09	South Base Edwards AFB	Figure
Project No. 77194		2.6-8

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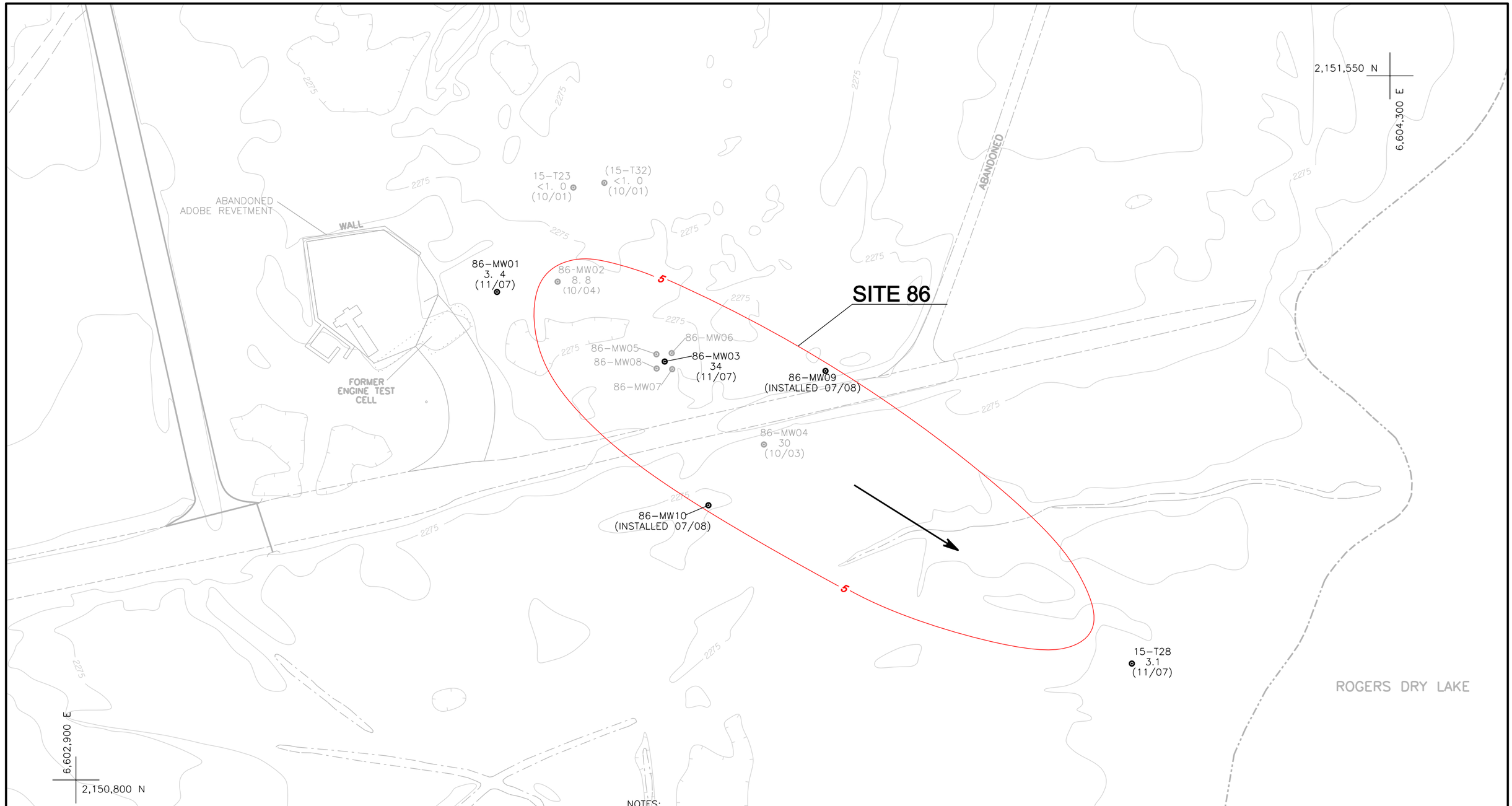


EXPLANATION

86-MW03 ⊙	MONITORING WELL
200	TCE CONCENTRATION IN $\mu g/L$
(12/05)	DATE SAMPLED
(15-T32)	WELL SCREENED BELOW WATER TABLE
5	EXTENT OF DISSOLVED-PHASE TCE CONTAMINATION ABOVE THE MAXIMUM CONTAMINANT LEVEL IN GROUNDWATER (EQUICONCENTRATION CONTOUR IN $\mu g/L$)
→	GROUNDWATER FLOW DIRECTION
	PAVED ROAD
	FORMER ROAD
	LAKE BED BOUNDARY

NOTES:

1. WELLS IN GRAY NOT SAMPLED IN DECEMBER 2007 (EARTH TECH 2008a)
2. LOCATION OF WELLS 15-T23, 15-T28, AND 15-T32 BASED ON GLOBAL POSITIONING SYSTEM SURVEY.
3. STATE PLANE COORDINATES ARE NORTH AMERICAN DATUM 1983 IN FEET.

ABBREVIATIONS:

<	LESS THAN
$\mu g/L$	MICROGRAMS PER LITER
TCE	TRICHLOROETHENE

NORTH

0 50 100 FEET

SCALE: 1"= 100'

OU2 ROD

Location Map
Site 86 Contaminant Plume

Date 3-09	South Base Edwards AFB	Figure 2.6-9
Project No. 77194		

EDWARDS\ 77194\B5839FGA.A01

2.6.2.2 Site History and Enforcement Activities

Site History

Sites 76 and 86 were identified as areas requiring further investigation in the *RI/FS WP/SAP* (Earth Technology 1993a) and the *ESI/RFA Technical Report* (Earth Technology 1993b).

Remedial Investigations

RI activities performed at Sites 76 and 86 from the mid-1980s through 1999 included geophysical surveys, investigation and removal of three USTs at Site 76, soil gas sampling at 68 sample locations (56 at Site 76 and 12 at Site 86), soil sampling, installation of 14 groundwater monitoring wells (eight at Site 76 and six at Site 86) to depths ranging from 53 feet bgs to 150 feet bgs, and groundwater sampling. Long-term groundwater monitoring programs began at Site 76 in 1999 and Site 86 in 2000. A more comprehensive discussion of the RI activities at these sites is presented in the *OU2 RI Summary Report* (Earth Tech 2004b).

At Sites 76 and 86, no organic constituents were detected at concentrations above residential PRGs, and no inorganic constituents were detected at concentrations above either the calculated background concentrations or residential PRGs (Tables 2.6-12 and 2.6-13). However, it was found that organic contaminants (mostly TCE) reached groundwater, which occurs at depths of approximately 50 feet bgs. The groundwater contamination occurs in the unconsolidated alluvial sediments of the upper aquifer of the Lancaster Subbasin.

Groundwater Monitoring

As part the RI program, groundwater samples were collected during several sampling events from wells at Site 76 from 1986 through 1995 and Site 86 from 1988 through 1998. Long-term groundwater monitoring began at Site 76 in 1999, and groundwater samples were collected from selected wells at the site once in 1999 and 2000, semiannually from 2001 through 2004, and annually from 2005 through 2007. Long-term groundwater monitoring began at Site 86 in 2000, and groundwater samples were collected from selected wells at the site semiannually from 2000 through 2004, and annually from 2005 through 2007.

TABLE 2.6-12. MAXIMUM CONCENTRATIONS OF ORGANIC AND INORGANIC CONSTITUENTS DETECTED IN SOIL COMPARED TO CALCULATED BACKGROUND CONCENTRATIONS AND RESIDENTIAL PRGs - SITE 76

Analyte	Maximum Concentration (mg/kg)	Location ID of Maximum Concentration	Sample Depth (ft bgs)	No. Detections/ Total No. Samples	Calculated Background Concentration [a] (mg/kg)	No. Samples Exceeding Background/ Total No. Samples	2000 Residential PRG [b] (mg/kg)	No. Samples Exceeding Residential PRG/Total No. Samples
Petroleum Hydrocarbons								
unknown extractable hydrocarbon	12 y	76-MW01	25	1/7	-	-	NP	-
Volatile Organics								
acetone	0.017	76-B01	5	1/13	-	-	1,600	0/13
Metals and Other Elements								
aluminum	16,000	76-B02	40	13/13	35,900	0/13	76,000	0/13
arsenic	14.4	76-B02	40	13/13	22.7	0/13	0.39	13/13
barium	75.1	76-B02	40	13/13	301	0/13	5,400	0/13
beryllium	0.77	76-B02	40	9/13	1.4	0/13	150	0/13
calcium	42,100	76-B01	50	13/13	129,000	0/13	NP	-
chromium, total	12.6	76-B02	40	11/13	39.1	0/13	210	0/13
cobalt	4.8	76-B02	40	9/13	18	0/13	4,700	0/13
copper	8.6	76-B01	50	9/13	48.7	0/13	2,900	0/13
iron	16,300	76-B02	40	13/13	36,100	0/13	23,000	0/13
lead	8.0	76-B02	40	8/13	28.2	0/13	400	0/13
magnesium	5,350	76-B02	40	13/13	30,900	0/13	NP	-
manganese	253	76-B02	40	13/13	905	0/13	1,800	0/13
mercury	0.28	76-B02	10	1/13	0.1	1/13	23	0/13
nickel	8.0	76-B02	40	2/13	16.9	0/13	150	0/13
potassium	3,350	76-B02	40	13/13	10,900	0/13	NP	-
sodium	1,850	76-B02	10	7/13	12,500	0/13	NP	-
vanadium	30.5	76-B02	40	13/13	74.5	0/13	550	0/13
zinc	37.0	76-B01	50	13/13	107	0/13	23,000	0/13

Notes:

Data for soil samples collected from October 1993 through February 1995.

[a] Background level calculated for OU2 (Earth Tech 1995).

[b] USEPA Region IX PRGs (USEPA 2000)

- not applicable
ft bgs feet below ground surface
mg/kg milligrams per kilogram
NP not promulgated
PRG Preliminary Remediation Goal
USEPA United States Environmental Protection Agency

Laboratory Data Qualifier:

Y Chromatographic profile is not consistent with pattern(s) exhibited by reference fuel standards. Quantitation of unknown hydrocarbons in sample is based on diesel fuel.

TABLE 2.6-13. MAXIMUM CONCENTRATIONS OF ORGANIC AND INORGANIC CONSTITUENTS DETECTED IN SOIL COMPARED TO CALCULATED BACKGROUND CONCENTRATIONS AND RESIDENTIAL PRGs - SITE 86

Analyte	Maximum Concentration (mg/kg)	Location ID of Maximum Concentration	Sample Depth (ft bgs)	No. Detections/ Total No. Samples	Calculated Background Concentration [a] (mg/kg)	No. Samples Exceeding Background/ Total No. Samples	2000 Residential PRG [b] (mg/kg)	No. Samples Exceeding Residential PRG/Total No. Samples
Petroleum Hydrocarbons								
petroleum hydrocarbons, total recoverable	27	86-B01	0	2/10	-	-	NP	-
Volatile Organics								
trichloroethene (TCE)	0.18	86-B02	30	3/13	-	-	2.8	0/13
Metals and Other Elements								
aluminum	15,100	86-B01	0	10/10	35,900	0/10	76,000	0/10
arsenic	7.0	86-B01	0	10/10	22.7	0/10	0.39	10/10
barium	105	86-B01	0	10/10	301	0/10	5,400	0/10
beryllium	0.61	86-B01	0	8/10	1.4	0/10	150	0/10
calcium	60,500	86-B03	10	10/10	129,000	0/10	NP	-
chromium, total	15.8	86-B01	0	10/10	39.1	0/10	210	0/10
cobalt	7.0	86-B01	0	9/10	18	0/10	4,700	0/10
copper	19.3	86-B01	0	8/10	48.7	0/10	2,900	0/10
iron	17,300	86-B01	0	10/10	36,100	0/10	23,000	0/10
lead	21.0	86-B01	0	10/10	28.2	0/10	400	0/10
magnesium	10,700	86-B01	0	10/10	30,900	0/10	NP	-
manganese	493	86-B01	0	10/10	905	0/10	1,800	0/10
mercury	0.12	86-B01	0	1/10	0.1	1/10	23	0/10
nickel	13.9	86-B01	0	3/10	16.9	0/10	150	0/10
potassium	4,600	86-B01	0	10/10	10,900	0/10	NP	-
sodium	1,370	86-B03	10	9/10	12,500	0/10	NP	-
vanadium	38.5	86-B01	0	10/10	74.5	0/10	550	0/10
zinc	54.0	86-B01	0	10/10	107	0/10	23,000	0/10

Notes:

Data for soil samples collected from May 1994 through August 1997.

[a] Background level calculated for OU2 (Earth Tech 1995).

[b] USEPA Region IX PRGs (USEPA 2000).

- not applicable
ft bgs feet below ground surface
mg/kg milligrams per kilogram
NP not promulgated
PRG Preliminary Remediation Goal
USEPA United States Environmental Protection Agency

The maximum concentrations of organic constituents detected in groundwater samples collected at Sites 76 and 86 in 2006 and 2007, and the maximum concentrations of filtered metals and other elements and general inorganics detected in all groundwater samples collected at the sites (Earth Tech 2004b, 2007d, and 2008a) are shown in Tables 2.6-14 and 2.6-15, respectively. Of the organic constituents, only the maximum concentration of TCE detected was above its Primary MCL. No inorganic constituent was detected above either its background concentration or its Primary MCL at Site 76. At Site 86, only zinc was detected above it background concentration, however, no Primary MCL has been promulgated for zinc, and it was detected below its secondary MCL.

Figures 2.6-10 and 2.6-11 show the estimated horizontal extent of groundwater contamination for the Sites 76 and 86 plumes. Figures 2.6-12 and 2.6-13 show the estimated vertical extent of groundwater contamination. Note that no contaminants have been detected in any of the deep wells.

Pilot Testing

In 2006, a pilot test was performed at Site 86 to evaluate the effectiveness of a commercial bioremediation project, CL-Out, in remediating TCE in the groundwater (FPM 2007a). CL-Out was injected into a treatment well at the site on a monthly basis for three months (from February through April 2006). Because the TCE concentrations did not change, a calcium peroxide solution was added on a monthly basis for the next three months (May through July 2006) to try to increase dissolved oxygen levels. This was followed by a final injection of CL-Out in July 2006. The Pilot Study results show that CL-Out is not an effective remedy for the site.

Interim Removal Actions

At Site 76 in May 1995, as part of the USTI program administered by Kern County, two 55 gallon drums connected by a pipe that were being used as an underground storage tank for fuel oil were removed. The drums were decontaminated and the rinsate was taken of an off-Base recycling facility. The drums were then shipped to an off-Base recycling facility. No USTs remain in the ground at the site.

TABLE 2.6-14. MAXIMUM CONCENTRATIONS OF ORGANIC AND INORGANIC CONSTITUENTS DETECTED IN GROUNDWATER COMPARED TO CALCULATED BACKGROUND CONCENTRATIONS AND PRIMARY MCLs - SITE 76

Analyte	Unit	Maximum Concentration	Location ID of Maximum Concentration	No. Detections/ Total No. Samples	Calculated Background Concentration [a]	No. Samples Exceeding Background/ Total No. Samples	Maximum Contaminant Level [b] (MCL)	No. Samples Exceeding MCL/Total No. Samples
Volatile Organics								
acetone	µg/L	3.0 J	76-MW02	2/6	-	-	NP	-
chloroform	µg/L	1.6	76-MW02	6/6	-	-	NP	-
cis-1,2-dichloroethene	µg/L	0.39 J	76-MW02	2/6	-	-	6	0/6
toluene	µg/L	0.37 J	76-MW03	1/6	-	-	150	0/6
trichloroethene (TCE)	µg/L	29	76-MW02	6/6	-	-	5	6/6
trihalomethanes, total	µg/L	1.6	76-MW02	6/6	-	-	80	0/6
Metals and Other Elements (filtered)								
barium	mg/L	0.095	15-T03	1/1	0.49	0/1	1	0/1
calcium	mg/L	111	15-T03	1/1	586	0/1	NP	-
magnesium	mg/L	25.9	15-T03	1/1	407	0/1	NP	-
potassium	mg/L	1.5	15-T03	1/1	13.23	0/1	NP	-
sodium	mg/L	120	15-T03	1/1	513	0/1	NP	-
zinc	mg/L	0.023	15-T03	1/1	0.025	0/1	5[c]	0/1
General Inorganics								
alkalinity, bicarb. (as CaCO3)	mg/L	164	15-T30	7/7	428	0/7	NP	-
chloride	mg/L	148	15-T04	7/7	2,332	0/7	250	0/7
fluoride	mg/L	0.81	15-T30	7/7	2.6	0/7	2	0/7
hardness (as CaCO3)	mg/L	326	15-T04	7/7	-	-	NP	-
sulfate	mg/L	129	15-T04	7/7	314	0/7	250	0/7
total dissolved solids	mg/L	594	15-T04	7/7	-	-	500	3/7

Notes:

Data for volatile organics were from groundwater samples collected in 2006 and 2007. Data for filtered metals and other elements and general inorganics were from all groundwater samples collected at the site.

[a] Background level calculated for OU2 (Earth Tech 1996). Background levels for metals and other elements were calculated from analytical results from filtered groundwater samples.

[b] Federal (USEPA) and Title 22 California Code of Regulations (CDHS) - MCLs (10/18/2007).

[c] California Secondary MCL (10/18/2007).

- not applicable
CDHS California Department of Health Services
MCL Maximum Contaminant Level
mg/L milligrams per liter
NP not promulgated
USEPA United States Environmental Protection Agency

Laboratory Data Qualifier:

J Estimated result. Result is below the reporting limit.

TABLE 2.6-15. MAXIMUM CONCENTRATIONS OF ORGANIC AND INORGANIC CONSTITUENTS DETECTED IN GROUNDWATER COMPARED TO CALCULATED BACKGROUND CONCENTRATIONS AND PRIMARY MCLs - SITE 86

(Page 1 of 2)

Analyte	Unit	Maximum Concentration	Location ID of Maximum Concentration	No. Detections/ Total No. Samples	Calculated Background Concentration [a]	No. Samples Exceeding Background/ Total No. Samples	Maximum Contaminant Level [b] (MCL)	No. Samples Exceeding MCL/Total No. Samples
Volatile Organics								
acetone	µg/L	3,100	86-MW03	2/5	-	-	NP	-
2-butanone (MEK)	µg/L	2,300	86-MW03	1/5	-	-	NP	-
carbon tetrachloride	µg/L	0.48 J	15-T28	2/5	-	-	0.5	0/5
cis-1,2-dichloroethene	µg/L	2.9	86-MW03	1/5	-	-	6	0/5
methylene chloride	µg/L	2.4 J	86-MW03	1/5	-	-	5	0/5
toluene	µg/L	0.45 J	86-MW03	1/5	-	-	150	0/5
trichloroethene (TCE)	µg/L	83	86-MW03	5/5	-	-	5	2/5
Metals and Other Elements (filtered)								
barium	mg/L	0.055	86-MW03	3/3	0.49	0/3	1	0/3
calcium	mg/L	100	86-MW03	3/3	586	0/3	NP	-
magnesium	mg/L	21.7	86-MW03	3/3	407	0/3	NP	-
manganese	mg/L	0.012	86-MW03	1/3	0.043	0/3	0.05[c]	0/3
potassium	mg/L	4.2	86-MW03	3/3	13.23	0/3	NP	-
sodium	mg/L	129	86-MW03	3/3	513	0/3	NP	-
vanadium	mg/L	0.015	15-T28	2/3	0.027	0/3	NP	-
zinc	mg/L	0.61	86-MW03	1/3	0.025	1/3	5[c]	0/3
General Inorganics								
alkalinity, bicarb. (as CaCO3)	mg/L	214	15-T23	52/52	428	0/52	NP	-
alkalinity, total (as CaCO3)	mg/L	122	15-T32	46/46	-	-	NP	-
chloride	mg/L	471	86-MW02	55/55	2,332	0/55	250	22/55
cyanide	mg/L	0.015	15-T28	2/11	-	-	0.15	0/11
fluoride	mg/L	1.9	15-T23	6/6	2.6	0/6	2	0/6
hardness (as CaCO3)	mg/L	626	86-MW02	9/9	-	-	NP	-
nitrogen, nitrate (as N)	mg/L	2.1	86-MW03	55/55	-	-	10	0/55
sulfate	mg/L	252	86-MW03	55/55	314	0/55	250	1/55
total dissolved solids	mg/L	962	15-T23	6/6	-	-	500	6/6

TABLE 2.6-15. MAXIMUM CONCENTRATIONS OF ORGANIC AND INORGANIC CONSTITUENTS DETECTED IN GROUNDWATER COMPARED TO CALCULATED BACKGROUND CONCENTRATIONS AND PRIMARY MCLs - SITE 86

(Page 2 of 2)

Notes:

Data for volatile organics were from groundwater samples collected in 2006 and 2007. Data for filtered metals and other elements and general inorganics were from all groundwater samples collected at the site.

(a) Background level calculated for OU2 (Earth Tech 1996). Background levels for metals and other elements were calculated from analytical results from filtered groundwater samples.

(b) Federal (USEPA) and Title 22 California Code of Regulations (CDHS) - MCLs (10/18/2007).

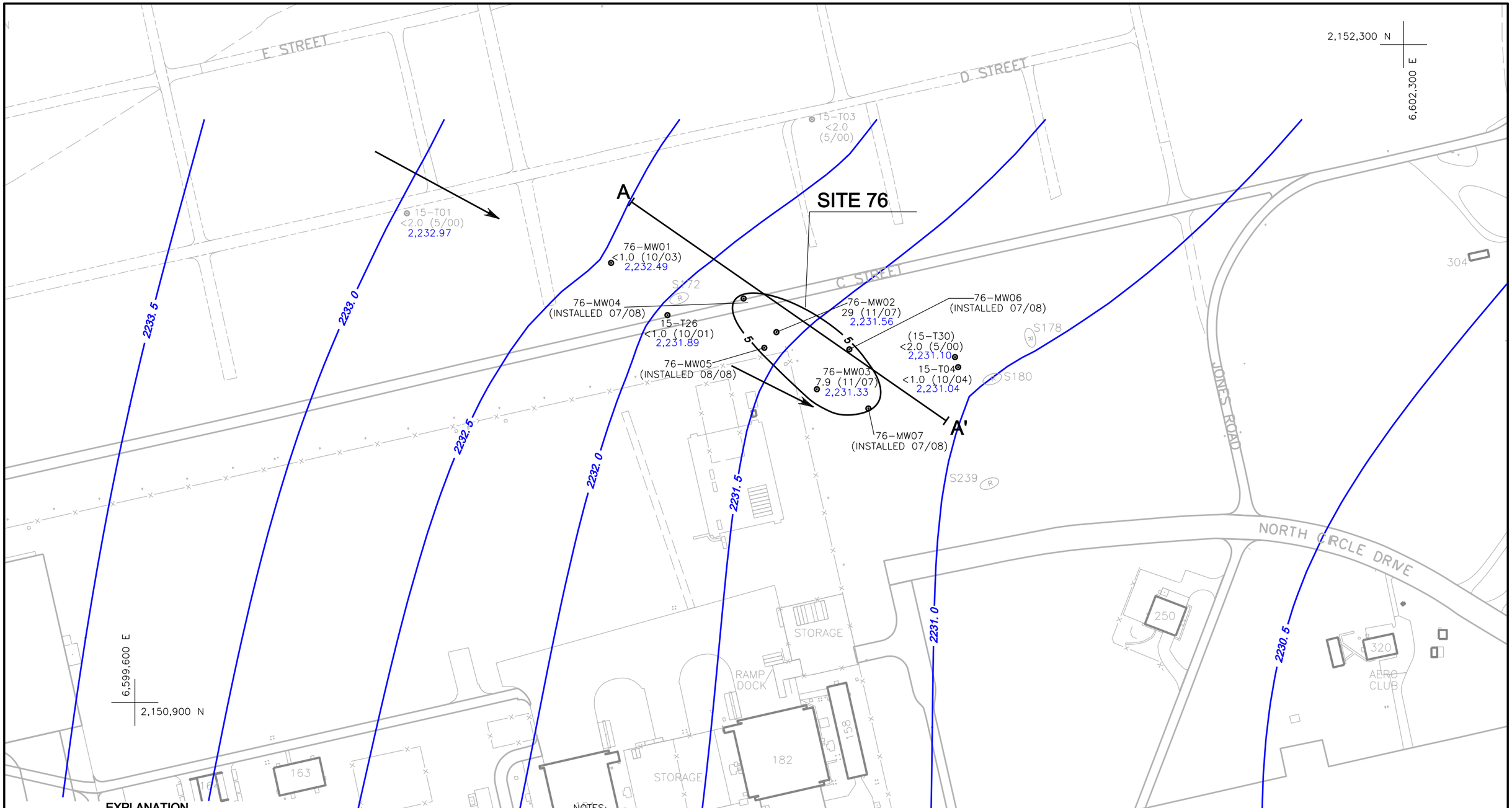
(c) California Secondary MCL (10/18/2007).

- not applicable

CDHS California Department of Health Services
MCL Maximum Contaminant Level
mg/L milligrams per liter
NP not promulgated
USEPA United States Environmental Protection Agency

Laboratory Data Qualifier:

J Estimated result. Result is below the reporting limit.



EXPLANATION

76-MW02 ⊙ 29 (11/07) 2,231.56	MONITORING WELL TCE CONCENTRATION IN $\mu g/L$ (DATE SAMPLED) GROUNDWATER ELEVATION
(R)	REMOVED UNDERGROUND STORAGE TANK
(15-T30)	WELL SCREENED BELOW WATER TABLE (NOT USED IN CONTOURING)
2,232.5	GROUNDWATER ELEVATION CONTOUR
→	GROUNDWATER FLOW DIRECTION
5	EXTENT OF DISSOLVED PHASE TCE CONCENTRATION (EQUICONCENTRATION CONTOUR IN $\mu g/L$)
A⊢⊣A'	CROSS SECTION
	PAVED ROAD
	FORMER ROAD
	FENCE

NOTES:

1. WELLS IN GRAY NOT SAMPLED IN NOVEMBER 2007.
2. LOCATION OF WELLS 15-T01 AND 15-T03 BASED ON GLOBAL POSITIONING SYSTEM SURVEY.
3. STATE PLANE COORDINATES ARE NORTH AMERICAN DATUM 1983 IN FEET.

ABBREVIATIONS:

<	LESS THAN
$\mu g/L$	MICROGRAMS PER LITER
TCE	TRICHLOROETHENE

NORTH

0 100 200 FEET

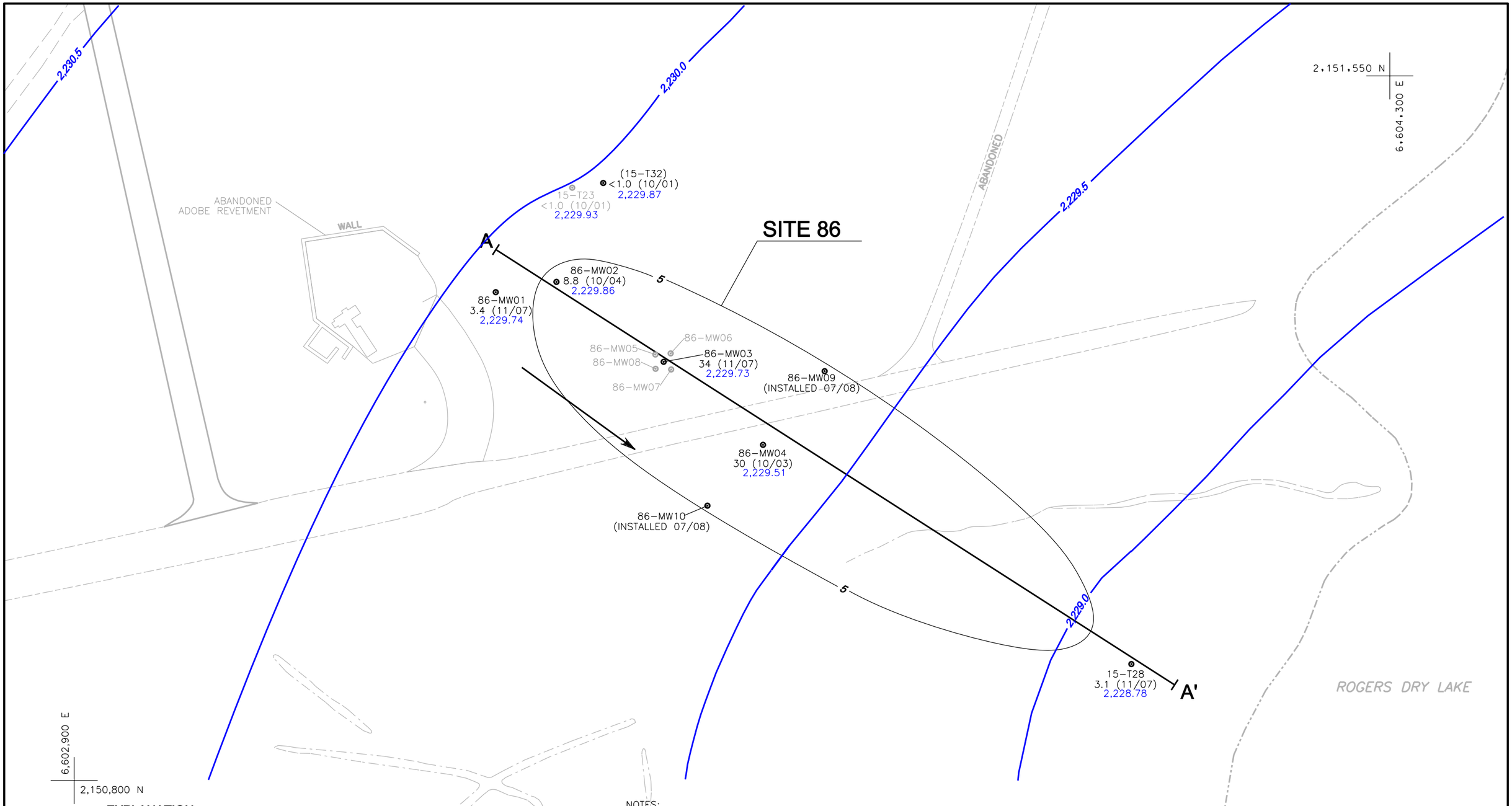
SCALE: 1"= 200'

OU2 ROD

Extent of TCE Contamination in Groundwater (November 2007) Site 76

Date 3-09	South Base Edwards AFB	Figure
Project No. 102133		2.6-10

EDWARDS\ 101302\B6984FGA.A01



EXPLANATION

86-MW03 ⊙	MONITORING WELL
34 (11/07)	TCE CONCENTRATION IN $\mu g/L$ (DATE SAMPLED)
2,229.73	GROUNDWATER ELEVATION
(15-T32)	WELL SCREENED BELOW WATER TABLE (NOT USED IN CONTOURING)
5	EXTENT OF DISSOLVED PHASE TCE CONCENTRATION (EQUICONCENTRATION CONTOUR IN $\mu g/L$)
2230.0	GROUNDWATER ELEVATION CONTOUR
→	GROUNDWATER FLOW DIRECTION
A A'	CROSS SECTION
	PAVED ROAD
	FORMER ROAD
	LAKE BED BOUNDARY

NOTES:

1. WELLS IN GRAY NOT SAMPLED IN NOVEMBER 2007.
2. LOCATION OF WELLS 15-T23, 15-T28, AND 15-T32 BASED ON GLOBAL POSITIONING SYSTEM SURVEY.
3. STATE PLANE COORDINATES ARE NORTH AMERICAN DATUM 1983 IN FEET.

ABBREVIATIONS:

<	LESS THAN
$\mu g/L$	MICROGRAMS PER LITER
TCE	TRICHLOROETHENE

NORTH

0 50 100 FEET

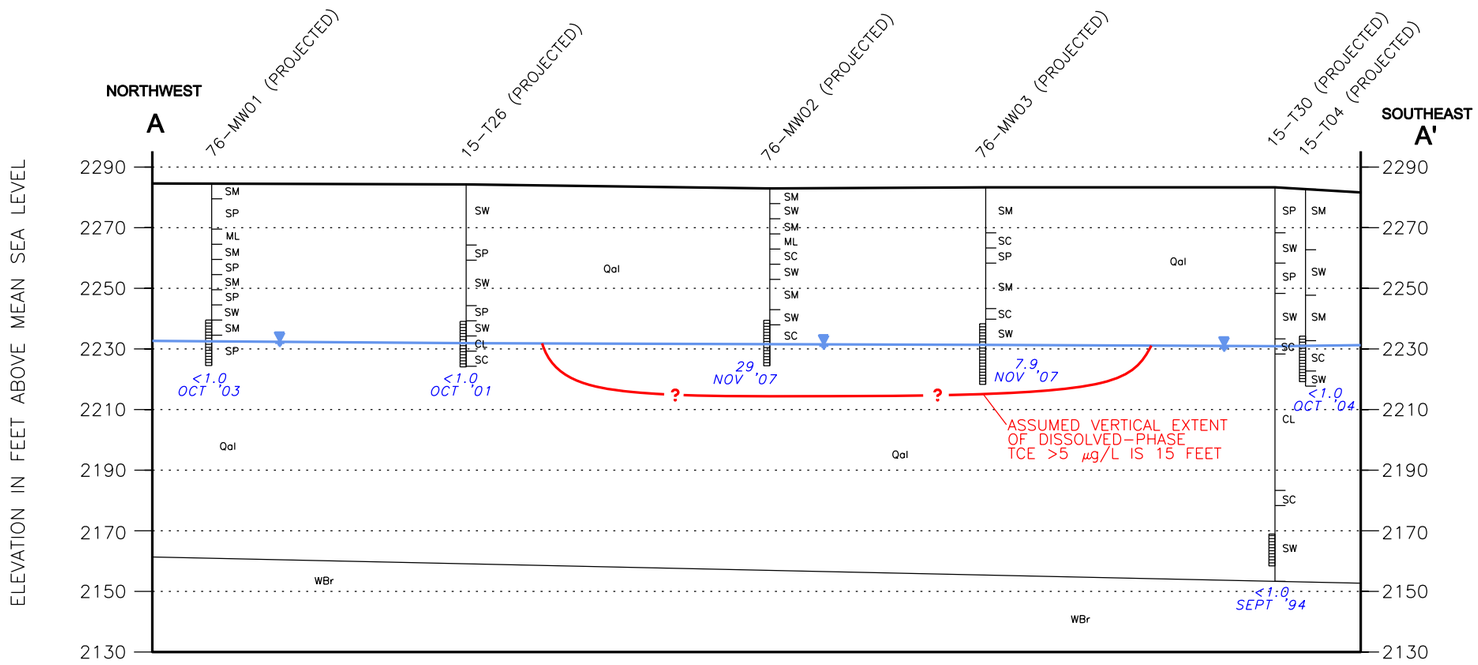
SCALE: 1"= 100'

OU2 ROD

Extent of TCE Contamination in Groundwater (November 2007) Site 86

Date 2-09	South Base Edwards AFB	Figure
Project No. 102133		2.6-11

EDWARDS\ 101302\B6983FGA.A01



EXPLANATION

- SCREEN INTERVAL
- POTENTIOMETRIC SURFACE
- 5.4 NOV '07 — TCE CONCENTRATION IN µg/L, DATE SAMPLED
- * — WELL CONTAINS FLOATING PRODUCT (THICKNESS EVALUATED TO BE LESS THAN TWO INCHES)
- > — GREATER THAN
- µg/L — MICROGRAMS PER LITER
- TCE — TRICHLOROETHENE

SW	WELL GRADED SAND
SC	CLAYEY SAND, SILTY CLAYEY SAND
SM	SILTY SAND
SP	POORLY GRADED SAND
ML	SILT, SANDY SILT
CL	CLAY, SANDY CLAY, SILTY CLAY
Qal	QUATERNARY ALLUVIUM
WBr	WEATHERED BEDROCK

NOTES:

1. REFER TO FIGURE 2.6-10 FOR THE LOCATION OF CROSS SECTION A-A'.

0 50 100 FEET

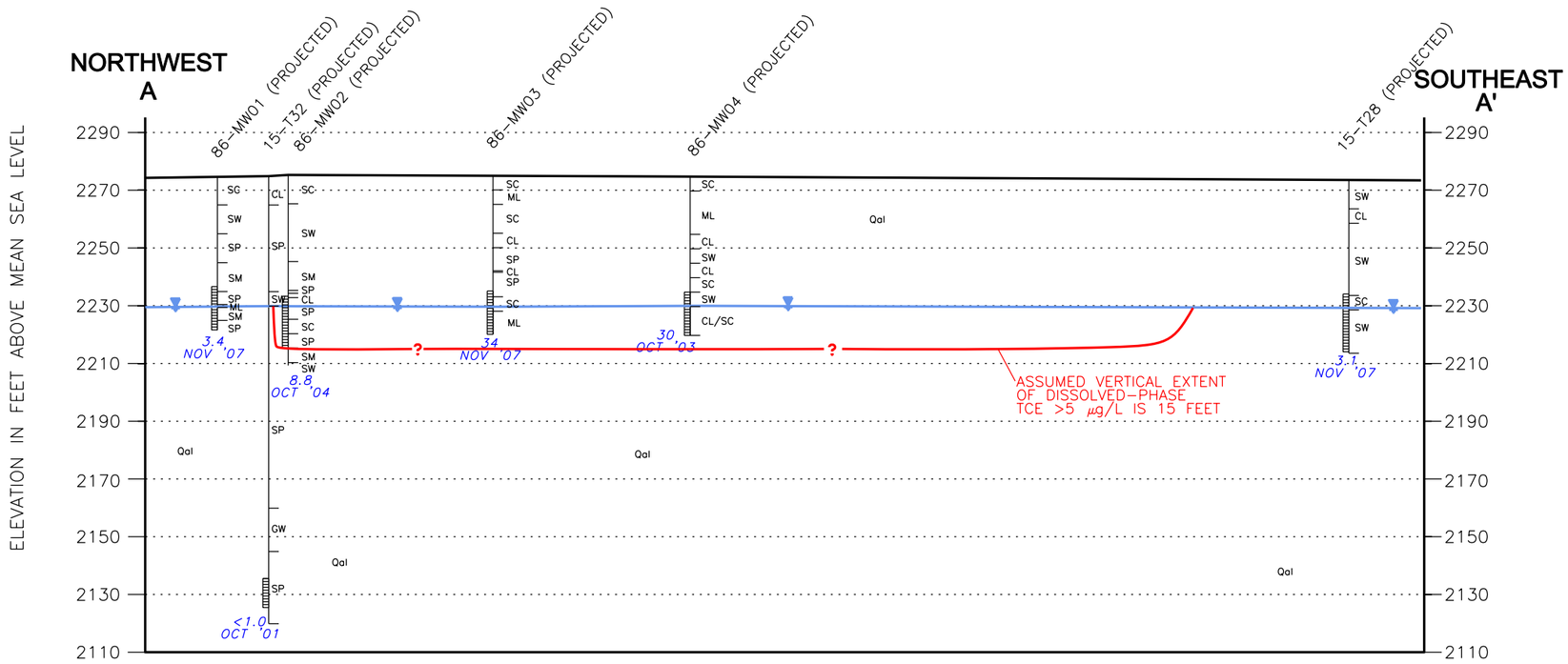
HORIZONTAL SCALE: 1"= 100'
VERTICAL SCALE: 1"= 50'
VERTICAL EXAGERATION = 1:2

OU2 ROD

Site 76
Geologic Cross Section A-A'

Date 3-09	South Base Edwards AFB	Figure 2.6-12
Project No. 101302		

EDWARDS\101302\B6980XSA.A01



EXPLANATION

- SCREEN INTERVAL
- POTENTIOMETRIC SURFACE
- 5.4 NOV '07 — TCE CONCENTRATION IN µg/L, DATE SAMPLED
- * — WELL CONTAINS FLOATING PRODUCT (THICKNESS EVALUATED TO BE LESS THAN TWO INCHES)
- > — GREATER THAN
- µg/L — MICROGRAMS PER LITER
- TCE — TRICHLOROETHENE

GW	WELL GRADED GRAVEL
SW	WELL GRADED SAND
SC	CLAYEY SAND, SILTY CLAYEY SAND
SM	SILTY SAND
SP	POORLY GRADED SAND
ML	SILT, SANDY SILT
CL	CLAY, SANDY CLAY, SILTY CLAY
Qal	QUATERNARY ALLUVIUM

NOTES:

1. REFER TO FIGURE 2.6-11 FOR THE LOCATION OF CROSS SECTION A-A'.

0 50 100 FEET

HORIZONTAL SCALE: 1"= 100'
VERTICAL SCALE: 1"= 50'
VERTICAL EXAGERATION = 1:2

OU2 ROD

Site 86
Geologic Cross Section A-A'

Date 3-09	South Base Edwards AFB	Figure 2.6-13
Project No. 101302		

EDWARDS\ 101302\B6981XSA.A01

Due to the low risk to human health and the environment from the groundwater contamination at Sites 76 and 86, only groundwater monitoring and LUCs have been instituted to date. These LUCs consist of requiring digging permits for intrusive work, and prohibiting the installation of drinking water wells.

Nature and Extent of Residual Site Contamination

Based on available data, contamination is limited to the upper 10 feet to 15 feet of the groundwater. Although not currently used for drinking water, the groundwater is classified as a potential drinking water source. At Site 76, TCE concentrations exceeding the MCL are localized in an area approximately 140 feet wide by 360 feet long (see Figure 2.6-8). The plume covers approximately one acre, and contains an estimated 996,000 gallons of contaminated groundwater. The estimated remaining mass of TCE in the plume is 0.1 lbs. At Site 86, TCE concentrations exceeding the MCL are localized in an area approximately 200 feet wide by 670 feet long (see Figure 2.6-9). The plume covers approximately 2.6 acres, and contains an estimated 2.5 million gallons of contaminated groundwater. The estimated remaining mass of TCE in the plume is 0.2 lbs.

Conceptual Site Model

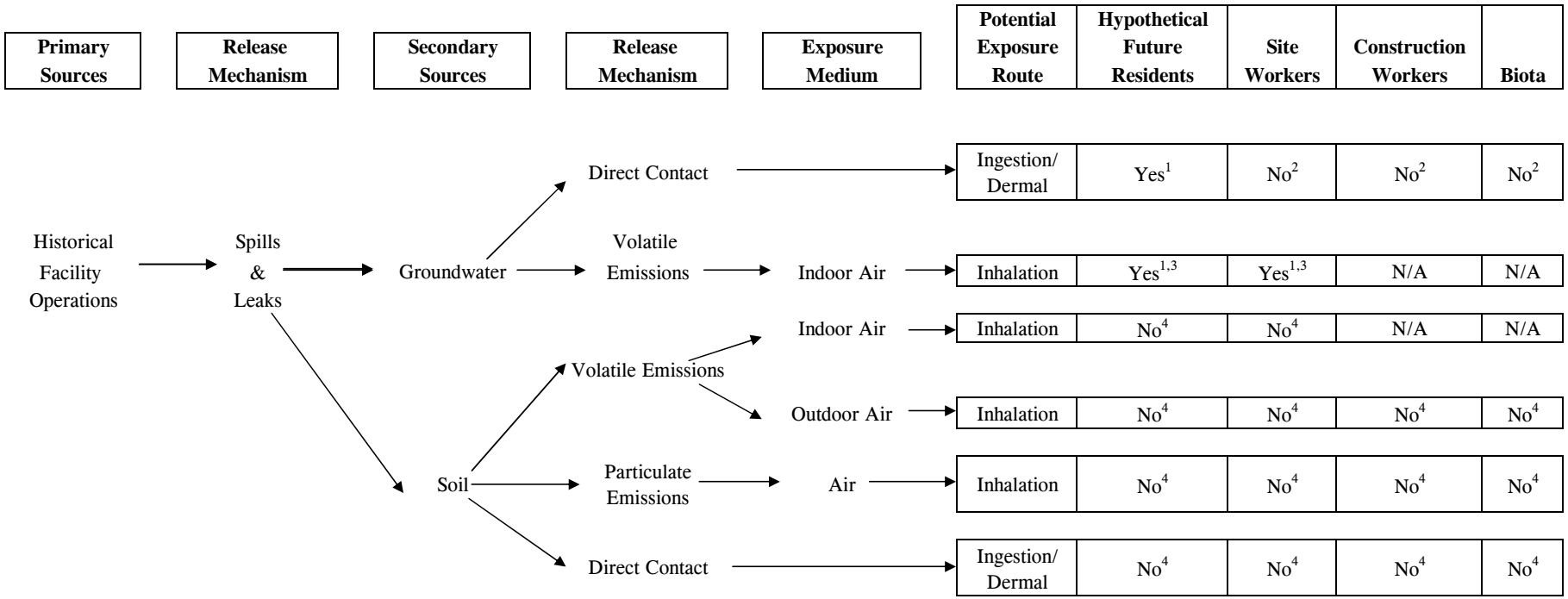
The conceptual site models illustrating the potential contaminant migration and exposure pathways for Sites 76 and 86 are shown on Figures 2.6-14 and 2-6-15, respectively. Factors influencing the distribution of contaminants and completed pathways that present risk to human health and biota are described in greater detail below:

<u>Contaminant Sources</u>

TCE is the primary contaminant in the groundwater at Sites 76 and 86. At Site 76, the lateral extent of the TCE-contaminated groundwater is primarily downgradient of a motor repair shop and gas station that were active during the 1940s. Solvents (primarily TCE) were commonly used as degreasers at repair shops and gas stations at that time. The source of the TCE in the groundwater at the site may have been the result of the ground disposal of waste solvents, which then seeped to the water table.

At Site 86, the source of the TCE may have been solvents used to flush engines at the engine test cell, which was located at an adobe revetment that was active until the 1950s. TCE-contaminated purge

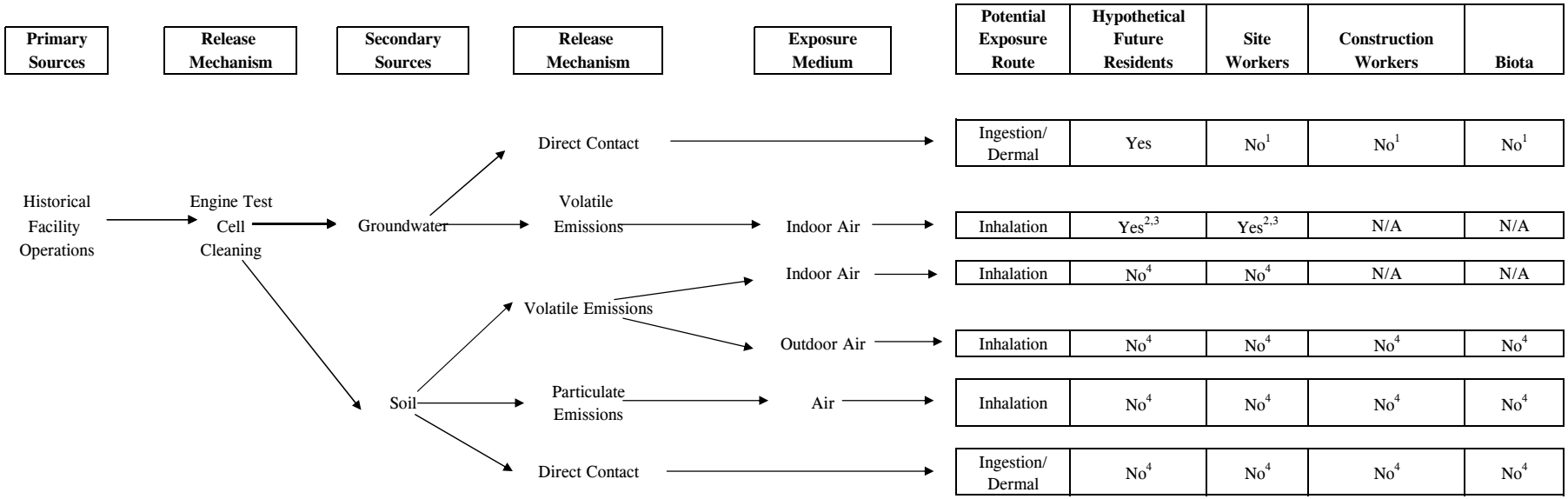
FIGURE 2.6-14. CONCEPTUAL SITE MODEL - SITE 76



[1] Pathway potentially complete; however, risk within acceptable limits (see Table 2.6-16).
[2] Depth to groundwater over 12 feet below ground surface; no complete pathway.
[3] Pathway complete only for future buildings; no current buildings impacted.
[4] Contaminants of concern not present in soil; no complete pathway.

N/A - Not applicable, not a valid pathway

FIGURE 2.6-15. CONCEPTUAL SITE MODEL - SITE 86



[1] Depth to groundwater over 12 feet below ground surface; no complete pathway.
[2] Pathway complete only for future buildings; no current buildings impacted.
[3] Pathway potentially complete; however, risk within acceptable limits (see Table 2.6-17).
[4] Contaminants of concern only sporadically detected in soil; no complete pathway.

N/A - Not applicable, not a valid pathway

water may have leaked or been discharged to unlined drainage channels that lead away from the engine test cell, where it then seeped to the water table.

At Sites 76 and 86, TCE is not persistent in the soil, but instead migrated vertically to the groundwater. The concentrations of TCE were not sufficient to form a dense non-aqueous phase liquid plume.

Factors Controlling the Distribution of Contaminants in Groundwater

Physical, chemical, and biological factors control the vertical and horizontal distribution of the contaminants at Sites 76 and 86 as discussed below.

Physical Factors

Groundwater contamination is limited to the upper aquifer in the area of Sites 76 and 86. The nearest water supply wells on-Base produce groundwater from water-bearing zones in the middle aquifer at the South Base Well Field located approximately 3.4 miles southwest of Site 76 and approximately 3.5 miles southwest of Site 86. As shown on a regional cross section developed by Sneed et al. (2005), connectivity between these two aquifers may be retarded by lacustrine deposits (see Figure 2.2-2). The cone of depression in the area of the South Base Well Field does not influence the direction of groundwater flow in the vicinity of Sites 76 and 86 (Earth Tech 2005).

The vertical extent of the TCE contamination in groundwater at Sites 76 and 86 is primarily limited to the upper 10 feet to 15 feet of the saturated zone. The limited vertical extent may be due to the presence of fine-grained sediments (i.e., silts and clays), which may impede the vertical migration of the TCE in the aquifer.

The contaminant plume at Site 76 has migrated approximately 525 feet during the past 60 years, assuming the release occurred in the early 1940s. The contaminant plume at Site 86 has migrated approximately 800 feet during the past 50 years, assuming the release occurred in the early 1950s. The analytical results for the groundwater samples collected at the sites during the long-term groundwater monitoring and sampling program (Earth Tech 2008a) indicate that the plumes continue to migrate.

However, based on the analytical data, the contaminant plumes at Sites 76 and 86 apparently either migrate at a slower rate than the Sites 5/14 Contaminant Plume, or the leading edges of the plumes are attenuating due to dispersion, dilution, adsorption, or biodegradation.

Biological/Chemical Factors

At Site 76, trace concentrations of cis-1,2-DCE are present in groundwater, indicating that limited reductive dechlorination is occurring. However, TCE concentrations have not been decreasing over time. At Site 86, although low concentrations of cis-1,2-DCE have occurred in past sampling rounds, since 2006, concentrations of cis-1,2-DCE have increased, and concentrations of TCE have decreased due to the injection of CL-Out during a pilot test conducted at the site. However, the lack of a carbon source (such as fuel hydrocarbons) and the high dissolved oxygen concentrations in the groundwater may be impeding reductive dechlorination at both sites.

Exposure Pathways

For both sites, the only potentially complete exposure pathways would be if hypothetical future residents were exposed to untreated (i.e., contaminated) groundwater through dermal contact, ingestion or inhalation during bathing.

The pre-scoping ecological risk assessments conducted at Sites 76 and 86 indicate there is no current threat to biota (USGS 2004). The analytical results for the soil samples collected during the site investigations indicate the soils pose minimal risk to current (or future) site or construction workers. The only complete exposure pathway would be if future site workers or future area residents were exposed to untreated groundwater.

2.6.2.3 Current and Potential Future Land and Resource Uses

According to the *General Plan* (HB&A 2001), Sites 76 and 86 are located within the Developed Area of the Base. The existing land uses at Site 76 are categorized as Engineering Test and Buffer Zone. The existing land use at Site 86 is categorized as Buffer Zone. The Engineering Test land use category at Site 76 includes the northeastern corner of the BFTF. The Buffer Zone at Sites 76 and 86 includes areas that are undeveloped and may be uneconomical to develop due to the ERP

sites or nearby flood-prone areas. All these categories are considered industrial for risk assessment purposes.

According to the *General Plan*, which indicates future land use out for a period of five years, land use at OU2 is expected to be similar to current use. No residential uses of any portion of OU2, including Sites 76 and 86, are anticipated.

2.6.2.4 Summary of Site Risks

Human Health Risk

The results of the HHRAs for Sites 76 and 86 are summarized in Tables 2.6-16 and 2.6-17, respectively. A more comprehensive discussion of the HHRAs for these sites is presented in the *South Base HHRA* (Earth Tech 2003b and 2008c).

The calculated cancer risks and noncancer HIs to both future residents and industrial workers exposed to the soils at Site 76 and Site 86 are considered acceptable. The cancer risk to future residents exposed to the groundwater at Site 76 is considered acceptable, whereas the cancer risk to future residents exposed to the groundwater at Site 86 is considered unacceptable. The noncancer HIs to future residents exposed to the groundwater at Sites 76 and 86 are considered acceptable. There is no cancer risk or noncancer HI to industrial workers from the groundwater at Sites 76 and 86 because the groundwater is not used for any purpose and workers are unlikely to be exposed to groundwater through ingestion, inhalation, or dermal contact. The cancer and noncancer indoor air risks to future residential and industrial users from the potential volatilization of contaminants in groundwater to indoor air at both sites are acceptable.

Ecological Risk

No complete exposure pathways to ecological receptors were identified in the *Pre-scoping Assessment, OUs 1, 2, 3, and 6, Ecological Risk Assessment* (USGS 2004). The assessment results indicated that the groundwater contamination is too deep to be accessed by wildlife and that there was no risk from soils. The industrial nature of these sites makes for poor wildlife habitat and no threatened or endangered plants or animals live at these sites.

TABLE 2.6-16. SUMMARY OF HUMAN HEALTH RISK ASSESSMENT RESULTS – SITE 76

Potential Exposure Scenario	Exposure Medium	Cancer Risk[a]	Primary Risk Drivers[b]	Noncancer Hazard Index[c]	Primary Risk Drivers[b]
Residential (Hypothetical future)	Soil	*	None	0.012	None
	Groundwater	$5x10^{-5}$	None	0.05	None
	Indoor Air	$6x10^{-7}$	None	<0.01	None
Industrial	Soil	*	None	<0.001	None
	Groundwater	NA	NA	NA	NA
	Indoor Air	$3x10^{-8}$	None	<0.01	None
Construction Worker	Soil	*	None	<0.001	None
	Groundwater	NA	NA	NA	NA
	Indoor Air	NA	NA	NA	NA

Notes:

Values in bold exceed USEPA 1991 generally acceptable criteria for cancer and noncancer risks.

Results for indoor air using Air Force-recommended toxicity criteria are presented. Results using USEPA provisional TCE toxicity criteria are presented in the indoor air pathway tables for each site.

[a] To manage risks from known or suspected carcinogens, the United States Environmental Protection Agency (USEPA 1980) has developed the following exposure range: more than one additional cancer case for 10,000 people is unacceptable (i.e., greater than $1x10^{-4}$); one additional cancer case for 10,000 to one million people is considered generally acceptable (i.e., between $1x10^{-4}$ and $1x10^{-6}$); and one additional cancer case for one million or more people is considered acceptable (i.e., less than $1x10^{-6}$). However, if multiple contaminants are present and multiple pathways of exposure exist, the more stringent end of the range should be used to establish cleanup goals.

[b] "None" indicates that there are no primary risk drivers because the total risk is characterized as generally acceptable or acceptable according to the USEPA (1980) exposure range.

[c] A Hazard Index less than 1 is considered generally acceptable (USEPA 1991).

* No analytes were carried forward in the risk assessment process

NA Not applicable; no exposure pathway identified during the risk assessment

TABLE 2.6-17. SUMMARY OF HUMAN HEALTH RISK ASSESSMENT RESULTS – SITE 86

Potential Exposure Scenario	Exposure Medium	Cancer Risk[a]	Primary Risk Drivers[b]	Noncancer Hazard Index[c]	Primary Risk Drivers[b]
Residential (Hypothetical future)	Soil	$7x10^{-8}$	None	0.005	None
	Groundwater	**$1x10^{-4}$**	TCE (98%)	0.69	None
	Indoor Air	$4x10^{-6}$	None	<0.01	None
Industrial	Soil	$3x10^{-8}$	None	<0.001	None
	Groundwater	NA	NA	NA	NA
	Indoor Air	$3x10^{-7}$	None	<0.01	None
Construction Worker	Soil	$5x10^{-10}$	None	<0.001	None
	Groundwater	NA	NA	NA	NA
	Indoor Air	NA	NA	NA	NA

Notes:

Values in bold exceed USEPA 1991 generally acceptable criteria for cancer and noncancer risks.

Results for indoor air using Air Force-recommended toxicity criteria are presented. Results using USEPA provisional TCE toxicity criteria are presented in the indoor air pathway tables for each site.

[a] To manage risks from known or suspected carcinogens, the United States Environmental Protection Agency (USEPA 1980) has developed the following exposure range: more than one additional cancer case for 10,000 people is unacceptable (i.e., greater than $1x10^{-4}$); one additional cancer case for 10,000 to one million people is considered generally acceptable (i.e., between $1x10^{-4}$ and $1x10^{-6}$); and one additional cancer case for one million or more people is considered acceptable (i.e., less than $1x10^{-6}$). However, if multiple contaminants are present and multiple pathways of exposure exist, the more stringent end of the range should be used to establish cleanup goals.

[b] "None" indicates that there are no primary risk drivers because the total risk is characterized as generally acceptable or acceptable according to the USEPA (1980) exposure range. If a constituent is shown as a primary risk driver, the number in parentheses is the percentage of the risk accounted for by the constituent.

[c] A Hazard Index less than 1 is considered generally acceptable (USEPA 1991).

% percent
NA Not applicable; no exposure pathway identified during the risk assessment.
TCE trichloroethene

Threat to Groundwater or Surface Water

The USEPA's VLEACH Model, Version 2.2 was used to evaluate the leaching potential of TCE at Site 86, the only organic contaminant in soil detected at the site. A single detection of acetone occurred at Site 76, however, because acetone would be readily degraded by the aerobic conditions present at Site 76, it was not modeled.

Model results are contained in *Evaluation of the Potential Impact to Groundwater due to the Mobilization and Migration of Organic Contaminants in Soil at Operable Unit 2 Using the Vadose Zone Leaching Model (VLEACH)* (USAF 2008). For TCE in soil at Site 86, the model predicted a mass flux of 9.64×10^{-7} g/yr/ft^2 impacting the groundwater at a simulation time of 500 years. Using the predicted TCE mass flux in a mixing model (USAF 2008), the predicted TCE concentration in groundwater at a simulation time of 500 years is 4.05×10^{-3} μg/L per unit volume of groundwater, which is below the MCL for TCE (5 μg/L).

Based on these results, there is no threat to groundwater from constituents remaining in soil at Sites 76 and 86 because all constituents were evaluated and determined to be either naturally occurring, readily degradable, or at concentrations unlikely to impact groundwater. The nearest water supply wells are located at the South Base Well Field in the Landfill/Evaporation Ponds Area, which is approximately two miles south (cross-gradient) of the plumes (see Figure 2.1-2). There is no surface water present at Sites 76 and 86.

2.6.2.5 Remedial Action Objectives

Cleanup Standards for Soil

The USAF, USEPA, Cal/EPA DTSC, and the Water Board agreed that no further action is required for the soil at Sites 76 and 86 because the cancer and noncancer risks to humans are acceptable for both residential and industrial uses, and there is no risk to wildlife and habitat.

Cleanup Standards for Groundwater

Although the groundwater at Sites 76 and 86 is currently not a source of drinking water, it is classified as a "potential drinking water source" by Cal/EPA DTSC and the Water Board, which means that the

contamination must be cleaned up. Cleanup standards for COCs in groundwater are listed in Table 2.6-18.

The Sites 76 and 86 RAOs are to:

1. Restore levels of COCs in groundwater listed in Table 2.6-18 to safe drinking water standards, which are defined by the more stringent of Federal or State Primary MCLs;

2. Prevent migration of COCs listed in Table 2.6-18 that are present in the groundwater at concentrations above the more stringent of Federal or State Primary MCLs; and

3. Protect human health by preventing ingestion of, or dermal contact with, groundwater contaminated with the COCs listed in Table 2.6-18 at concentrations greater than the more stringent of Federal or State Primary MCLs.

2.6.2.6 Description of Alternatives

Four remedial alternatives were developed for groundwater at each of these two sites. A more comprehensive discussion of the alternatives is presented in the *OU2 FS* (Earth Tech 2005c).

The four alternatives considered are:

1. **No Action.** This alternative is only listed to compare to others. Nothing would be done, and the contamination would remain in place. Bacteria present in the groundwater may slowly degrade some of the contaminants. This alternative would cost nothing.

2. **Land Use Controls and Long-term Monitoring.** This alternative consists of sampling and analyzing the groundwater at each site to make sure that the plumes are not moving and to determine if the contaminants are degrading. The USAF would maintain LUCs to make sure people do not use the groundwater. Procedures to maintain LUCs would be documented in the *General Plan*. The alternative assumes that sampling would occur at two monitoring wells at each site annually for more than 100 years. The sampling would need to continue over this long period of time because the contaminants do not appear to be degrading naturally. This alternative was estimated to cost $9.9 million over 100 years at each site in the *OU2 FS* (Earth Tech 2005c) (Table 2.6-19).

3. **Active Groundwater Restoration (Ex Situ Treatment).** The groundwater in this alternative would be pumped to the surface, treated with carbon, and then re-injected into the aquifer. The USAF would conduct groundwater monitoring and maintain LUCs during treatment. At Site 76, this alternative would require four extraction and two injection wells, and five years to clean the groundwater to MCLs, and was estimated to cost $1.3 million in the *OU2 FS* (Earth Tech 2005c) (see Table 2.6-19). At Site 86, this

TABLE 2.6-18. CLEANUP STANDARDS FOR CONTAMINANTS OF CONCERN IN GROUNDWATER – SITES 76 AND 86

Contaminants of Concern	Maximum Concentration Detected in 2006/2007 [a] (μg/L)	95% UCL Concentration [b] (μg/L)	Current Residential Cancer Risk/Noncancer Hazard Index [b]	Basis for Listing as a Chemical of Concern	Selected Cleanup Standard [c] (μg/L)	Cancer Risk/ Noncancer Hazard Index at Cleanup Standard
Site 76						
trichloroethene (TCE)	29	17	1.06×10^{-5}/NA	Exceeds the MCL.	5	3.13×10^{-6}/NA
Site 86						
trichloroethene (TCE)	83	200 [d]	**1.25×10^{-4}**/NA	Exceeds the MCL and the cancer risk exceeds the threshold carcinogenic risk criteria of 1×10^{-4}.	5	3.13×10^{-6}/NA

Notes:

[a] The last two years of groundwater samples for each site were chosen to maximize spatial coverage of the plumes. Contaminant concentration levels included in this table are greater than the MCLs.

[b] Source: *Environmental Restoration Program, Addendum to the Human Health Risk Assessment, South Base, Operable Unit 2, Edwards AFB, CA* (Earth Tech 2008c). The 95% UCL for groundwater samples collected through December 2005 was used to calculate the residential cancer risk.

[c] The more stringent of the Federal or State Primary MCLs (CDHS 2003).

[d] The maximum concentration for groundwater samples collected through December 2005 was used to calculate the residential cancer risk because there were too few samples to calculate a 95% UCL concentration.

Values shown in **bold** exceed the threshold carcinogenic risk criteria of 1×10^{-4}.

μg/L	micrograms per liter
95% UCL	95 percent upper confidence limit of the mean
MCL	Maximum Contaminant Level
NA	not applicable; there is no noncancer Hazard Index for the contaminant of concern
OU2	Operable Unit 2

TABLE 2.6-19. COSTS OF THE SITES 76 AND 86 ALTERNATIVES

Cost in 2007 dollars	Alternative 1[a]	Alternative 2[a]	Alternative 3[a]	Alternative 4[b]
Timeframe	NA	100 years	5 years	5 years
Site 76				
Capital	$0	$33,700	$848,000	$249,000
LUCs/LTM	NA	$4,120,000	$182,000	$139,000
O&M (Total)	NA	NA	$214,000	$166,000
O&M (Annual)			$42,800	$33,200
Escalated Cost[c]	$0	$9,940,000	$1,300,000	$554,000
Present Value Cost[d]	$0	$908,000	$1,250,000	$518,000
Site 86				
Capital	$0	$33,700	$1,480,000	$636.000
LUCs/LTM	NA	$4,120,000	$396,000	$256,000
O&M (Total)	NA	NA	$280,000	$379.000
O&M (Annual)			$56,000	$75,800
Escalated Cost[c]	$0	$9,940,000	$2,250,000	$1,350,000
Present Value Cost[d]	$0	$908,000	$2,170,000	$1,270,000

Notes:

[a] The complete cost estimates can be found in the OU2 Feasibility Study (Earth Tech 2005c).

[b] The complete cost estimates can be found in the OU2 Technical and Economic Feasibility Analysis (United States Air Force [in preparation]).

[c] Escalated cost is the inflationary adjustment from current dollars to the future estimated cost when the work is performed

[d] Present value is the amount of money that would need to be invested in the present to cover the total cost of the project, assuming an interest rate of 7 percent.

LTM long-term management
LUCs land use controls
NA not applicable
OU2 Operable Unit 2
USEPA United States Environmental Protection Agency

As recommended by the USEPA (2000), cost estimates for each alternative are to be within an accuracy range of –30 to +50 percent

alternative would require 16 extraction and eight injection wells, and five years to clean the groundwater to MCLs, and was estimated to cost $2.3 million in the *OU2 FS* (Earth Tech 2005c) (see Table 2.6-19).

4. **Active Groundwater Restoration (In Situ Treatment) (Selected Alternative).** This alternative includes ISCO of the dissolved chlorinated plume at Site 76 by the injection of chemical reagent through vertical wells, and in situ aerobic biological degradation of the contaminants in the plume at Site 86 by the injection of air and gaseous nutrients through vertical wells. ISCO was considered for Site 76 because it had a lower overall cost for this smaller plume than in situ aerobic biological treatment. At Site 76, a chemical reagent solution would be injected into the aquifer once per year for a period of four years to remediate the dissolved TCE plume (plus one year of rebound monitoring). At Site 86, a mobile (i.e., trailer-mounted) system containing an air compressor and nutrient handling equipment would be deployed for the injection of air and gaseous nutrients for a period of three years to remediate the dissolved TCE plume (plus two years of rebound monitoring). At Site 86, wells would be connected to the mobile system using underground and temporary aboveground hose/piping. The USAF would conduct groundwater monitoring and maintain LUCs to make sure that people do not use the groundwater before it is cleaned. At Site 76, this alternative would require an estimated five injection wells when the system is installed to contain the plume and to clean the plume to MCLs within an estimated 5 years, and was estimated to cost $0.55 million in the *Operable Unit 2 Technical and Economic Feasibility Analysis (TEFA)* (USAF 2009). At Site 86, this alternative would require an estimated 16 injection wells to contain the plume when the system is installed and clean the plume to MCLs within an estimated five years, and was estimated to cost $1.35 million in the *OU2 TEFA* (see Table 2.6-19).

2.6.2.7 Comparative Analysis of Alternatives

The comparative analysis of the alternatives for Sites 76 and 86 is presented in Table 2.6-20. All of the active alternatives provide adequate protection of human health and the environment by making use of institutional controls to prevent contact with contaminated groundwater. Alternative 2 would prevent residential use of the groundwater, but does not actively remediate the contaminated groundwater. Alternatives 3 and 4 are both protective of human health and the environment because they have the potential to remediate groundwater contaminant levels to concentrations below drinking water standards. Alternative 4 would actively remediate the contaminant plumes at Sites 76 and 86 using technologies that have been validated on a pilot scale at Sites 5/14 (Earth Tech 2007a and 2008d) after the completion of the *OU2 FS* (Earth Tech 2005c). Alternative 3 would achieve containment of the Site 76 and 86 plumes within one year of system startup by creating a hydraulic capture zone.

TABLE 2.6-20. COMPARATIVE ANALYSIS OF ALTERNATIVES – SITES 76 AND 86
(Page 1 of 2)

CERCLA Criteria [a]	ALTERNATIVE 1 No Action	ALTERNATIVE 2 LUCs and LTM	ALTERNATIVE 3 Active Groundwater Restoration (Ex Situ Treatment)	ALTERNATIVE 4[d] Active Groundwater Restoration (In Situ Treatment) (Selected Alternative)
Overall Protection of Human Health and the Environment	Does not eliminate potential for future exposure to contaminated groundwater. ○	Reduces exposure to contaminated groundwater through land use controls, but does not prevent plume migration. ◒	Protects downgradient water supply wells by restoring groundwater aquifer. ●	Protects downgradient water supply wells by restoring groundwater aquifer. ●
Compliance with ARARs	Does not comply with chemical-specific ARARs for groundwater. ○	Does not comply with chemical-specific ARARs for groundwater. ○	Will treat groundwater to MCLs within 5 years. ●	Will treat groundwater to MCLs within 5 years. ●
Long-Term Effectiveness and Permanence	Does not eliminate potential for future exposure to contaminated groundwater. ○	Reduces, but does not eliminate potential for future exposure to contaminated groundwater. ◒	Reduces risk from future exposure to groundwater to acceptable levels within 5 years. ●	Reduces risk from future exposure to groundwater to acceptable levels within 5 years. ●
Reduction of Toxicity, Mobility, and Volume through Treatment	No effect on the toxicity, volume, or mobility of contaminants. ○	No effect on the toxicity, volume, or mobility of contaminants. ○	Will reduce toxicity, mobility, and volume of contaminants to acceptable levels within 5 years. ●	Will reduce toxicity, mobility, and volume of contaminants to acceptable levels within 5 years. ●
Short-Term Effectiveness	Not applicable, no activities proposed. ●	Short-term risks would increase marginally to remediation workers due to LTM activities. Precautions to ensure safe handling of contaminated groundwater would reduce these risks to acceptable levels. ◒	Short-term risks would increase marginally to remediation workers due to construction, operation, and maintenance activities. Implementation of safe construction practices would reduce these risks to acceptable levels. ◒	Short-term risks would increase marginally to remediation workers due to construction, operation, and maintenance activities. Implementation of safe construction practices would reduce these risks to acceptable levels. ◒
Implementability	Not applicable, no activities proposed. ●	An LTM program is currently in place. ●	Similar systems have already been constructed at Edwards AFB. ●	A pilot test using the technology has already been completed at Edwards AFB. ◒

TABLE 2.6-20. COMPARATIVE ANALYSIS OF ALTERNATIVES – SITES 76 AND 86
(Page 2 of 2)

CERCLA Criteria [a]	ALTERNATIVE 1 No Action	ALTERNATIVE 2 LUCs and LTM	ALTERNATIVE 3 Active Groundwater Restoration (Ex Situ Treatment)	ALTERNATIVE 4[d] Active Groundwater Restoration (In Situ Treatment) (Selected Alternative)
Cost – Site 76	●	◒	◒	●
Escalated Cost [b]	None	$9,935,000	$1,298,000	$554,000
Present Value Cost [c]	None	$908,000	$1,252,000	$518,000
Cost – Site 86	●	◒	◒	●
Escalated Cost [b]	None	$9,935,000	$2,251,000	$1,350,000
Present Value Cost [c]	None	$908,000	$2,170,000	$$1,270,000
Regulatory Agency Acceptance	Not acceptable. ○	Not acceptable. ○	Acceptable. ●	Acceptable. ●
Community Acceptance	No public comments specific to this alternative. ◒	No public comments specific to this alternative. ◒	No public comments specific to this alternative. ◒	Acceptable. ●

Notes:

[a] Source: USEPA (1999)
[b] Escalated cost is in 2007 dollars
[c] Present value cost is in 2007 dollars (assumes a 7 percent discount factor)

○ Does not meet criteria
◒ Partially meets criteria
● Meets criteria

AFB Air Force Base
ARARs applicable or relevant and appropriate requirements
CERLA Comprehensive Environmental Response, Compensation, and Liability Ac
LTM long-term monitoring
LUC land use control
MCL maximum contaminant level

Movement of the plumes would likely be less than 50 feet from their positions at the time of system startup. If placement of sparging and injection wells is optimized, Alternative 4 also has the capability of containing the plumes within one year of startup, and preventing plume migration beyond 50 feet of their current positions. However, oxidants injected at the leading edge of the Site 76 plume may migrate as much as 300 feet downgradient, causing temporary dissolution of metals from the aquifer matrix. Baseline oxidation conditions are expected to be restored within two years after injections cease and the oxidant degrades, after which time metals would precipitate out of the groundwater, and dissolved metals concentrations would revert to baseline conditions. Both Alternatives 3 and 4 would be expected to clean the groundwater plumes to below drinking water standards within five years. As shown on Table 2.6-19, Alternative 2 has the lowest present value cost of all alternatives to implement, but the highest estimated escalated cost. However, it should be noted that the Air Force is not allowed to create a trust fund that would bear interest over the estimated 100 years that LUCs/LTM would need to be in place; therefore the escalated cost is the best indicator of the true life-cycle cost of the alternative. Both the present value and escalated costs for the implementation of Alternative 3 are higher than those for Alternative 4.

Based on the evaluation of alternatives, the implementation of Alternative 4 is selected.

2.6.2.8 Principal Threat Wastes

No principal threat wastes have been identified at Sites 76 and 86.

2.6.2.9 Selected Remedy

The USAF and USEPA, with concurrence from Cal/EPA DTSC and the Water Board, selected Alternative 4 for Sites 76 and 86. The USAF, USEPA, and Cal/EPA DTSC concur with the Selected Remedy because it is the lowest cost alternative that will clean up the COCs, reduce the risk to human health, protect the environment, and accomplish these goals within a reasonable timeframe. The Water Board concurs with the Selected Remedy because it meets the technical requirements of California water quality law, plans, and policies.

The Selected Remedy utilizes ISCO for Site 76 and in situ treatment by aerobic biological degradation for Site 86. Details regarding the design and layout of injection wells and the type, quantity, and frequency of injected chemical reagent and gaseous-phase nutrients will be specified during the

Remedial Design phase. Figures 2.6-16 and 2.6-17 show the conceptual layouts for the Selected Remedy for Sites 76 and 86, respectively.

The Selected Remedy consists of the following components:

a. **Chemical reagent injection to treat groundwater contaminated by chlorinated solvents (primarily TCE):** Inject chemical reagent using vertical wells to treat contaminated groundwater at Site 76. Reagents will be injected in wells upgradient of the plume to address contaminants within the current plume boundary and at other appropriate locations to prevent further migration of contaminants above the MCL for TCE (5 μg/L) (see Figure 2.6-16). The chemical reagent will be injected at a concentration and frequency to maximize contaminant treatment while minimizing the production of elevated metals (addresses RAOs #1 and #2);

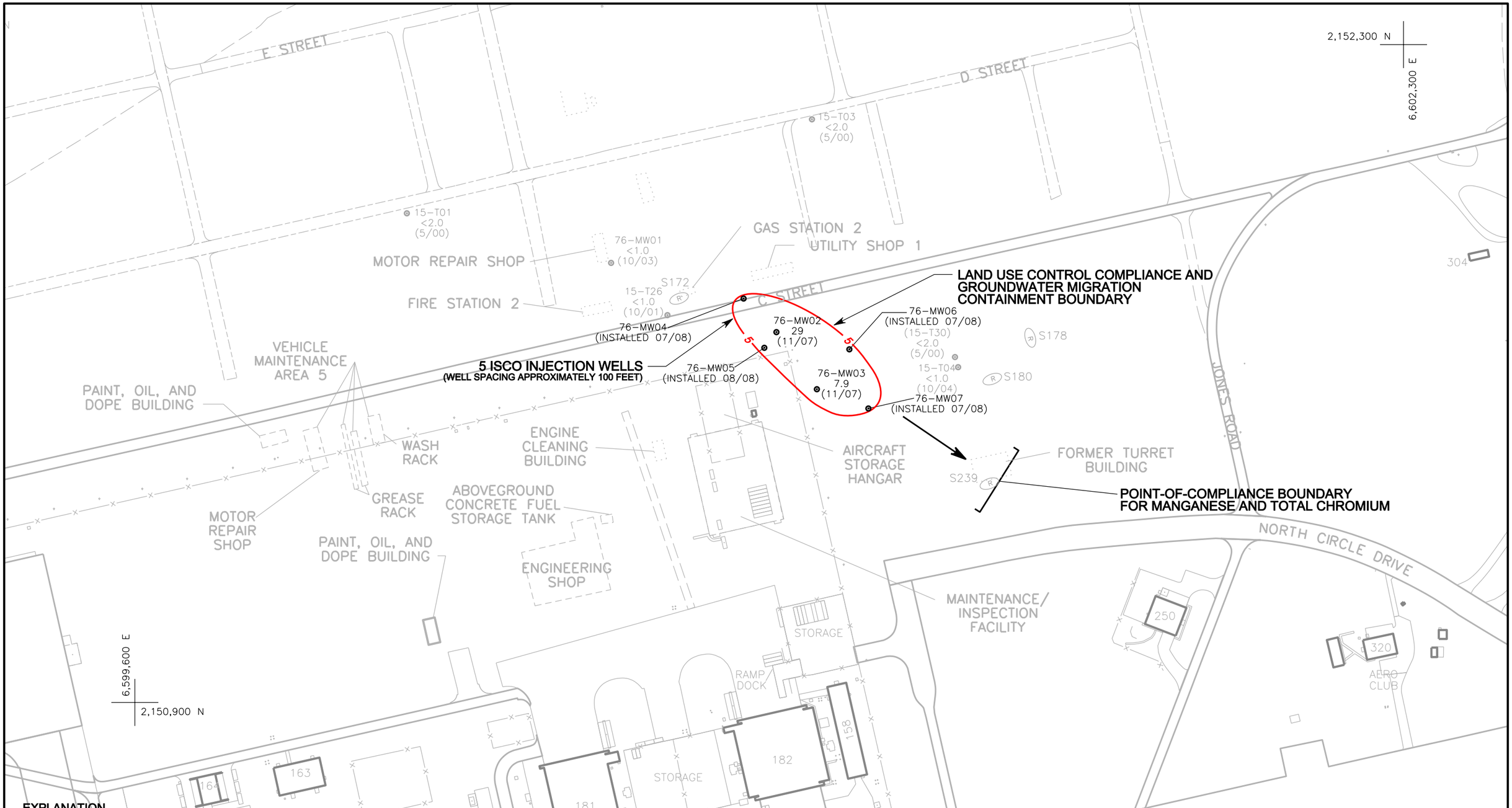
b. **Aerobic biological degradation to treat groundwater contaminated by chlorinated solvents (primarily TCE):** Inject air and gaseous nutrients through vertical wells to treat contaminated groundwater at Site 86. Wells will be distributed throughout the plume to address contaminants within the plume and to prevent further migration of contaminants above the MCL for TCE (5 μg/L) (see Figure 2.6-17) (addresses RAOs #1 and #2);

c. **Groundwater monitoring to determine the status of the remediation:** Perform groundwater monitoring in accordance with the RAWP for Sites 76 and 86 to determine the status of remediation to groundwater cleanup standards (addresses RAOs #1, #2, and #3);

d. **Treatment of elevated metals resulting from injection of chemical reagent at Site 76:** Baseline concentrations (concentrations prior to the first injection of chemical reagent) of manganese and total chromium will be documented during development of the RAWP for Site 76. If manganese and total chromium do not return to baseline conditions at Site 76 within 2 years after ISCO reagent injections cease, the Air Force will institute measures to return the metals to those baseline conditions;

e. **Institutional controls to prevent ingestion of, or dermal contact with, contaminated groundwater:** During the remedial action, implement and maintain institutional controls at Sites 76 and 86 to prevent ingestion of, or dermal contact with, contaminated groundwater within the boundaries shown on Figures 2.6-16 and 2.6-17. The footprints of areas impacted with COCs will be periodically updated in the GIS from ERP documents (see Section 2.8.1.2) (addresses RAO #3);

f. **Institutional controls to restrict installation of groundwater extraction wells:** The installation of groundwater extraction wells that include the Sites 76 or 86 groundwater contaminant plume boundaries within the radius of influence of the wells is prohibited by institutional controls, with the exception of wells related to the Sites 76 and 86 remedies, until the groundwater is acceptable for unrestricted use and unlimited exposure (addresses RAO #3);



EXPLANATION

76-MW02 ⊙	MONITORING WELL
20	TCE CONCENTRATION IN $\mu g/L$
(12/05)	DATE SAMPLED
(R)	REMOVED UNDERGROUND STORAGE TANK
(15-T30)	WELL SCREENED BELOW WATER TABLE
→	GROUNDWATER FLOW DIRECTION
5	EXTENT OF DISSOLVED-PHASE TCE CONTAMINATION ABOVE THE MAXIMUM CONTAMINANT LEVEL IN GROUNDWATER (EQUICONCENTRATION CONTOUR IN $\mu g/L$)
	LAND USE CONTROL COMPLIANCE AND GROUNDWATER MIGRATION CONTAINMENT BOUNDARY
	FORMER BUILDING/FACILITY (CONCRETE PAD EVIDENT)
	FORMER BUILDING/FACILITY (NO REMAINS EVIDENT)
	PAVED ROAD
	FORMER ROAD
	FENCE

NOTES:

1. WELLS IN GRAY NOT SAMPLED IN DECEMBER 2007 (EARTH TECH 2008a)
2. LOCATION OF WELLS 15-T01, 15-T03, 15-T04, 15-T26, AND 15-T30 BASED ON GLOBAL POSITIONING SYSTEM SURVEY.
3. STATE PLANE COORDINATES ARE NORTH AMERICAN DATUM 1983 IN FEET.

ABBREVIATIONS:

<	LESS THAN
$\mu g/L$	MICROGRAMS PER LITER
TCE	TRICHLOROETHENE
ISCO	IN SITU CHEMICAL OXIDATION

NORTH

0 100 200 FEET

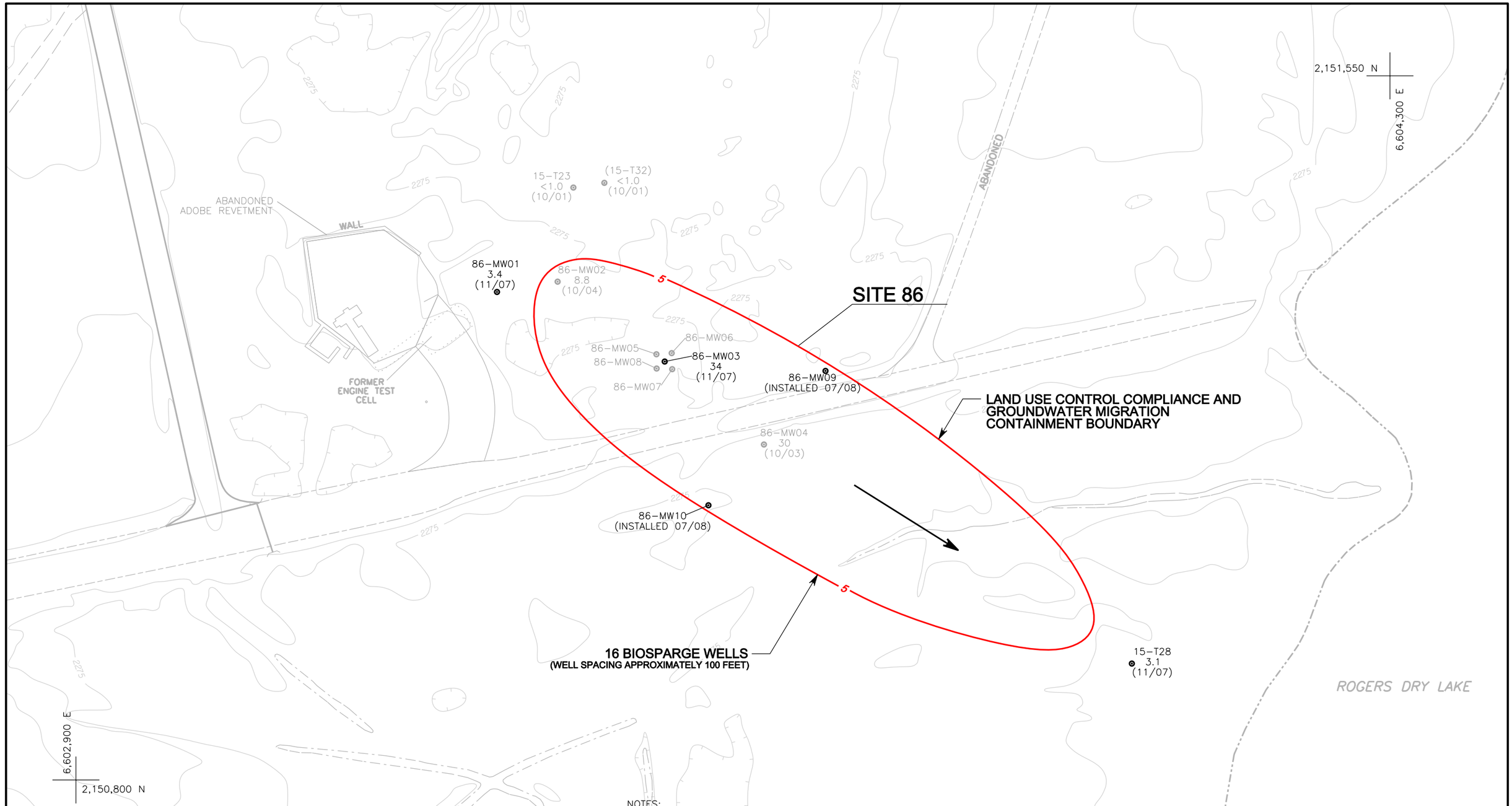
SCALE: 1"= 200'

OU2 ROD

Conceptual Layout of the Selected Remedy Site 76 Contaminant Plume

Date 3-09	South Base Edwards AFB	Figure 2.6-16
Project No. 77194		

EDWARDS\ 77194\B5838FGA.A02



EXPLANATION

86-MW03 ⊙ 200 (12/05)	MONITORING WELL TCE CONCENTRATION IN $\mu g/L$ DATE SAMPLED
(15-T32)	WELL SCREENED BELOW WATER TABLE
5	EXTENT OF DISSOLVED-PHASE TCE CONTAMINATION ABOVE THE MAXIMUM CONTAMINANT LEVEL IN GROUNDWATER (EQUICONCENTRATION CONTOUR IN $\mu g/L$)
	LAND USE CONTROL COMPLIANCE AND GROUNDWATER MIGRATION CONTAINMENT BOUNDARY
→	GROUNDWATER FLOW DIRECTION
	PAVED ROAD
	FORMER ROAD
	LAKE BED BOUNDARY

NOTES:

1. WELLS IN GRAY NOT SAMPLED IN DECEMBER 2007 (EARTH TECH 2008a)
2. LOCATION OF WELLS 15-T23, 15-T28, AND 15-T32 BASED ON GLOBAL POSITIONING SYSTEM SURVEY.
3. STATE PLANE COORDINATES ARE NORTH AMERICAN DATUM 1983 IN FEET.

ABBREVIATIONS:

<	LESS THAN
$\mu g/L$	MICROGRAMS PER LITER
TCE	TRICHLOROETHENE

NORTH

0 50 100 FEET

SCALE: 1"= 100'

OU2 ROD

Conceptual Layout of the Selected Remedy Site 86 Contaminant Plume

Date 3-09	South Base Edwards AFB	Figure 2.6-17
Project No. 77194		

EDWARDS\ 77194\B5839FGA.A03

g. **Institutional controls to protect infrastructure:** Until the groundwater at Sites 76 and 86 is acceptable for unrestricted use and unlimited exposure, infrastructure related to the remedies as presented in Components a, b, and c, including, but not limited to, injection and monitoring wells, will be protected by institutional controls from activities that may negatively impact their ongoing maintenance, effectiveness, and safety (addresses RAOs #1, #2, and #3);

h. **Contain the elevated metals resulting from injection of chemical reagent at Site 76:** Elevated concentrations of manganese and total chromium resulting from the injection of chemical reagent at Site 76 will be treated using a reducing agent if they migrate to a point-of-compliance boundary 300 feet downgradient of the 5 μg/L TCE contour line established just prior to the first injection of chemical reagent as shown on Figure 2.6-16;

i. **Re-evaluation of the OU2 TEFA:** When TCE approaches its MCL of 5 μg/L in the groundwater contaminant plume at Sites 76 and 86, the Air Force, in collaboration with the USEPA, Cal/EPA DTSC, and Water Board, will re-evaluate the lowest concentrations technically and economically achievable for all constituents listed in Table 2.6-18 and other contaminants remaining at the site, and determine the need to reach those lower concentrations; and

j. **LUC and IC Components:** All LUC and IC components described and listed above will be implemented and administered according to requirements and procedures described and listed in Section 2.8.1. Site-specific LUC and IC requirements will be included in the Air Force's routinely-updated *General Plan* (addresses RAO #3).

The Selected Remedies are designed to return the groundwater to unrestricted use within five years. No further action is required to return the soils to unrestricted use at these sites. The Selected Remedy for Site 76 is estimated to cost $0.55 million over 5 years, and the Selected Remedy for Site 86 is estimated to cost $1.35 million over 5 years.

2.6.2.10 Statutory Determinations

The following sections discuss how the selected remedy meets the statutory requirements.

Protection of Human Health and the Environment

The selected remedy will protect human health and the environment by cleaning up groundwater to drinking water standards (i.e., the more stringent of the Federal or State Primary MCLs). LUCs will prevent exposure to contaminated groundwater during the remedial action.

Compliance with ARARs

The selected remedy will comply with the technical requirements of all Federal and State ARARs identified for the remedial action (see Section 2.8 and Appendix B) as follows:

Chemical-Specific ARARs

- Primary Drinking Water Standards (Table B-1, Item No. 1) – The NCP states that primary drinking water standards are legally applicable only to drinking water at the tap, but are relevant and appropriate as cleanup standards for groundwater and surface water that have been determined to be current or future drinking water sources. The selected remedy uses Primary MCLs as cleanup standards for the Sites 76 and 86 plumes.

- Water Quality Control Plan, South Lahontan Basin (Basin Plan) (Table B-1, Item No. 2) – The beneficial uses of groundwater listed in Section 2 of the Basin Plan are relevant and appropriate to groundwater at Sites 76 and 86.

Location-Specific ARARs

- Wildlife Species/Habitats (Table B-1, Item No. 4) – State protected species will be protected when practicable during construction and operations activities and the appropriate State authority will be contacted if conflicts arise.

Action-Specific ARARs

- Standards Applicable to Generators of Hazardous Waste (Table B-1, Item No. 5) – Although applicable to wastes generated during remedial activities (soil cuttings and purge water), historically, these wastes have not been designated as hazardous under CCR, Title 22 at Sites 76 and 86. However, the selected remedial action will comply with these standards in handling waste materials when and if they are applicable.

- Underground Injection Control Program (Table B-1, Item No. 6) – Injection of treatment chemicals and treated groundwater is planned for Site 5/14. The selected remedy will not degrade groundwater through injection of chemicals that will cause concentrations of COCs to exceed Primary MCLs.

- Statement of Policy with Respect to Maintaining High Quality of Waters in California (Non-degradation Policy) (Table B-1, Item No. 7) – Chemicals or treated groundwater injected during the selected remedy will not degrade the beneficial uses of the aquifer.

- Sources of Drinking Water Policy (Table B-1, Item No. 8) – The Air Force agrees with the designation of the current and potential use of the groundwater at Sites 76 and 86 as drinking/domestic use.

- Definition of and Criteria for Identifying Hazardous Wastes (Table B-1, Item No. 9) – The criteria contained in this ARAR will be used to define if waste generated by the selected remedy is hazardous.
- Hazardous Waste Land Disposal Restrictions (LDRs) (Table B-1, Item No. 10) – The criteria contained in this ARAR will be used to define if waste generated by the selected remedy is subject to LDRs.
- Land Use Controls (Table B-1, Item No. 11) – LUCs will be administered during the implementation of the selected remedy as indicated in Section 2.8 of this document and the Basewide LUC Implementation Plan.

Cost Effectiveness

The selected remedy is the lowest cost remedy that will remediate the groundwater plumes to MCLs.

Utilization of Permanent Solutions and Alternative Treatment Technologies

The selected remedy is designed to permanently destroy contaminants in the groundwater, and return groundwater to its designated beneficial use. As an in situ technology, it treats the contaminated groundwater in place, rather than extracting contaminated groundwater from the aquifer.

Preference for Treatment as a Principal Element

The selected remedy has the treatment of the entire Sites 76 and 86 contaminant plumes as its principal element.

Five-Year Review Requirements

Five-year reviews will be conducted until site contaminants have been reduced to concentration levels which allow for unrestricted use and unlimited exposure.

2.6.2.11 Documentation of Significant Changes from the OU2 Proposed Plan

There are no significant changes from the *OU2 Proposed Plan*.

2.7 DECISION SUMMARY - SITE WITH DEBRIS

2.7.1 SITE 29

2.7.1.1 Site Name, Location, and Brief Description

Site 29, South Base Abandoned Sanitary Landfill, is located near the sewage treatment plant evaporation ponds at the southwest corner of Rogers Dry Lake. The site covers approximately 35 acres and consists of two former landfills, which cover approximately 23 acres (Figure 2.7-1).

2.7.1.2 Site History and Enforcement Activities

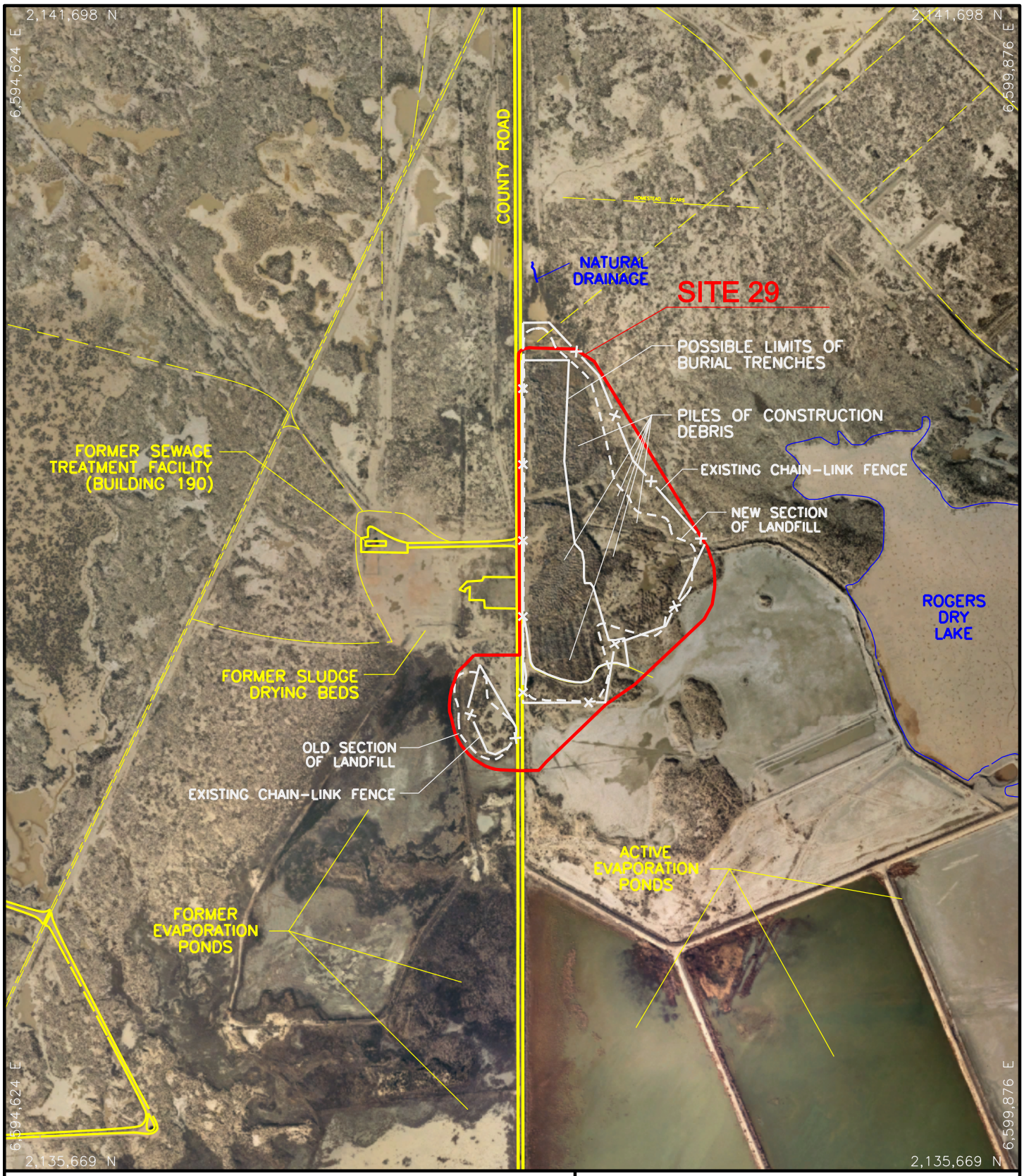
Site History

The older, western landfill area encompasses approximately three acres and was active in the late 1930s. The eastern landfill area encompasses approximately 20 acres and was opened in the mid-1950s. Waste was deposited in the eastern landfill until the 1970s. Household and industrial wastes, construction rubble (mainly concrete and asphalt), and asbestos-containing material (ACM) were deposited in the eastern landfill. During its operation, the eastern landfill served as the primary area for waste disposal. The cut-and-cover method of waste disposal was used, and trenches (cells) were dug to contain the waste (BSK & Associates 1990). At the end of each operating day, the waste was covered with a 6-inch soil layer. As many as seven cells, ranging in thickness from 10 feet to 15 feet, were designated to receive various types of waste. There are anecdotal reports that the eastern landfill may contain UXO.

The total area of subsurface debris is 25.2 acres. The total volume of subsurface debris is not known; however, based on an assumed refuse depth of 15 feet bgs, is approximately 490,000 cubic yards.

In 1985, construction rubble from the demolition of parts of South Base was placed on the surface of the eastern landfill. The aerial extent of surface debris at the landfill is 20.8 acres. The total volume of surface debris at the landfill is estimated to be 60,000 cubic yards.

Site 29 was identified as an area requiring further investigation in the *RI/FS WP/SAP* (Earth Technology 1993a) and the *ESI/RFA Technical Report* (Earth Technology 1993b).



NORTH

0 350 700 FEET

SCALE: 1"= 700'

OU2 ROD

Site 29
Aerial Photograph
December 2002

Date 3-09	South Base Edwards AFB	Figure 2.7-1
Project No. 81001		

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Remedial Investigation

This section presents a brief description of the RI activities conducted at Site 29. A more comprehensive discussion of the RI activities is presented in the *OU2 RI Summary Report* (Earth Tech 2004b). The RI activities conducted to date include the following (presented in chronological order):

- In January 1990, three gas migration monitoring wells were installed in the eastern section of the landfill as part of an air Solid Waste Assessment Test (SWAT) to evaluate the potential for landfill gas migration (BSK & Associates 1990).
- In February 1992, a geophysical survey was conducted at Site 29 using magnetic and electromagnetic induction (EMI) methods to delineate the boundaries of the two former landfills (Earth Technology 1992).
- In May 1992, 40 soil gas points were installed around the perimeter of the landfill to evaluate contamination in soil and groundwater in or beneath the landfill (Tracer Research Corporation 1992).
- In July and August 1992, seven groundwater monitoring wells were installed around the perimeter of Site 29 in order to evaluate possible groundwater contamination from the landfill (Earth Technology 1992). In September 1992, groundwater samples were collected from the monitoring wells, and two surface soil samples were collected at the southern perimeter of the landfill.
- In June 1994, three additional groundwater monitoring wells were installed at Site 29 (Earth Tech 1996e). Soil samples were collected during the installation of the wells.
- In August and September 1994, groundwater samples were collected from the 10 monitoring wells. In February and March 1995, a second round of groundwater samples was collected from three monitoring wells. Groundwater samples were also collected from the 10 monitoring wells in June 1997.
- In August 1996, 35 hand-augered boreholes were sampled to evaluate the potential risk due to contact with the surface soil. Soil samples were collected at the surface, one foot bgs, and two feet bgs or auger refusal.
- In June 1997, rising-head permeability tests were performed on three deep monitoring wells and one shallow monitoring well. Hydraulic conductivities ranged from 0.5 foot to 6.9 feet per day.

Groundwater Monitoring

Long-term groundwater monitoring at Site 29 began in January 1999, and occurred semiannually from 1999 through 2003 (Earth Tech 2001, 2002, 2003a, and 2004a). In 2004, one groundwater monitoring and sampling event was conducted (Earth Tech 2005b). The next groundwater monitoring and sampling event at Site 29 was conducted in 2006 (Earth Tech 2007d).

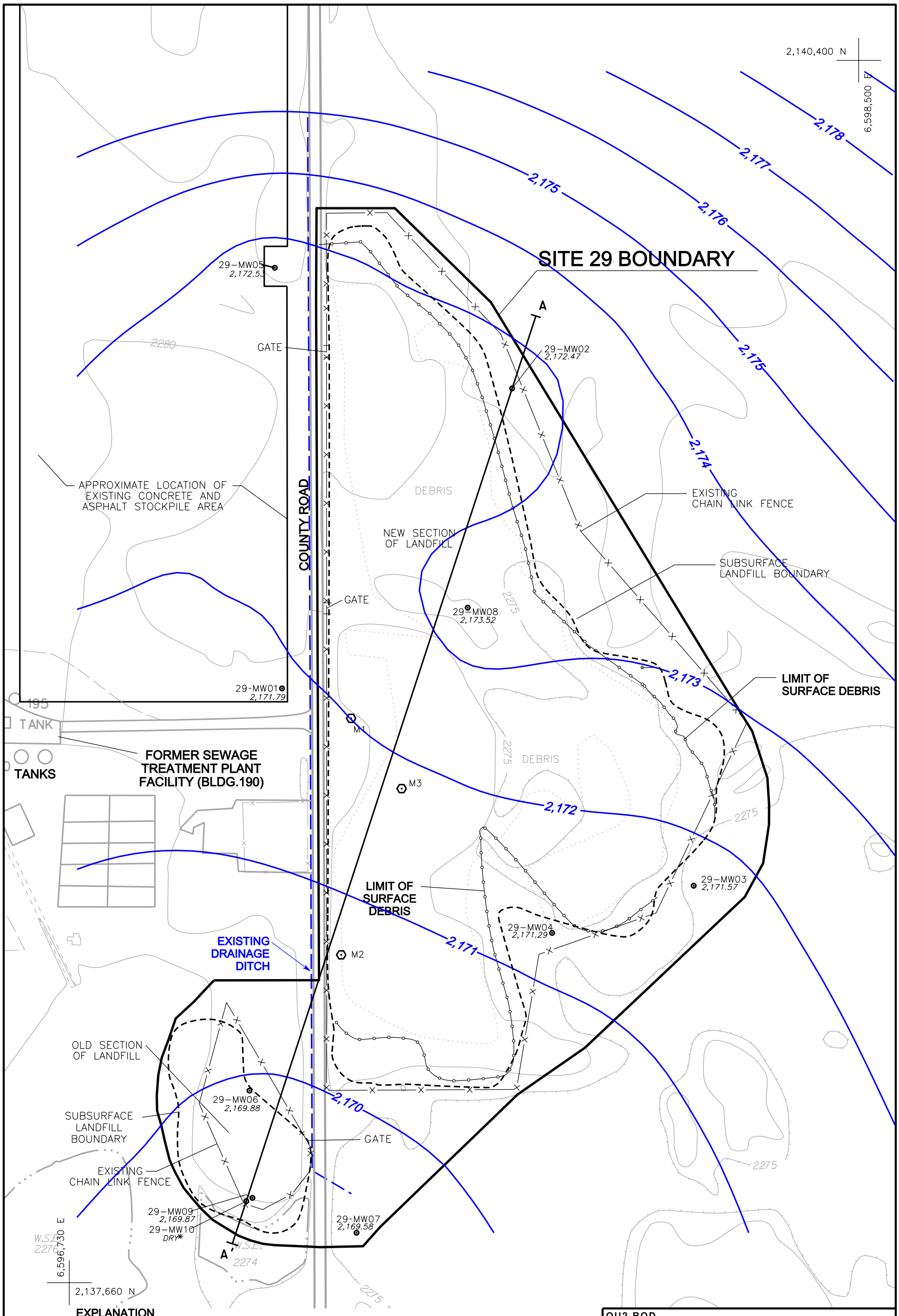
Figure 2.7-2 shows the location of the monitoring wells in plan view. Wells are located both around and within the perimeter of the landfill. A cross section depicting site geology and groundwater levels for 2006 is presented on Figure 2.7-3. Note that the monitoring well which sampled the shallow perched groundwater is now dry. All of the remaining nine monitoring wells are screened across the top of the middle aquifer of the Lancaster Subbasin, and are therefore likely to intercept any contaminants leaching from the landfill. In addition, site geology is comprised of silty and clayey sands, which would impede the downward migration of contaminants from the landfill. There is approximately 85 feet between the bottom of the refuse and the top of the middle aquifer.

Sampling results for the last two sampling rounds in 2004 and 2006 (Earth Tech 2005b and 2007d) are shown in Table 2.7-1. Sampling results from the 2004 round from Well 29-MW10 are not included because that well is now dry. No VOCs or SVOCs were detected in the groundwater above primary MCLs, and no metals or other elements were detected above background concentrations at any of the wells.

Interim Removal Actions

Interim remedial alternatives were evaluated in an EE/CA in 1997. Based on the results of this analysis, the recommended interim removal actions were to conduct groundwater monitoring to provide early warning of a chemical release to groundwater, and to install an eight-foot high chain-link fence along the boundaries of the landfill to prevent unauthorized dumping and to limit site access. Additionally, it was determined that ACM should be removed from the landfill surface for proper disposal.

The fence was installed in 1998, and the groundwater monitoring program was instituted. Additionally, a total of 645 cubic yards of non-friable ACM and 15 cubic yards of friable ACM were removed from the site. The ACM was transported to a land disposal facility and disposed according to the requirements in CCR, Title 14, Division 7, Chapter 3.5.



OU2 ROD

Groundwater Potentiometric Surface and Flow Direction (October 2006) Site 29

Date 3-09	South Base Edwards AFB	Figure 2.7-2
Project No. 101302		

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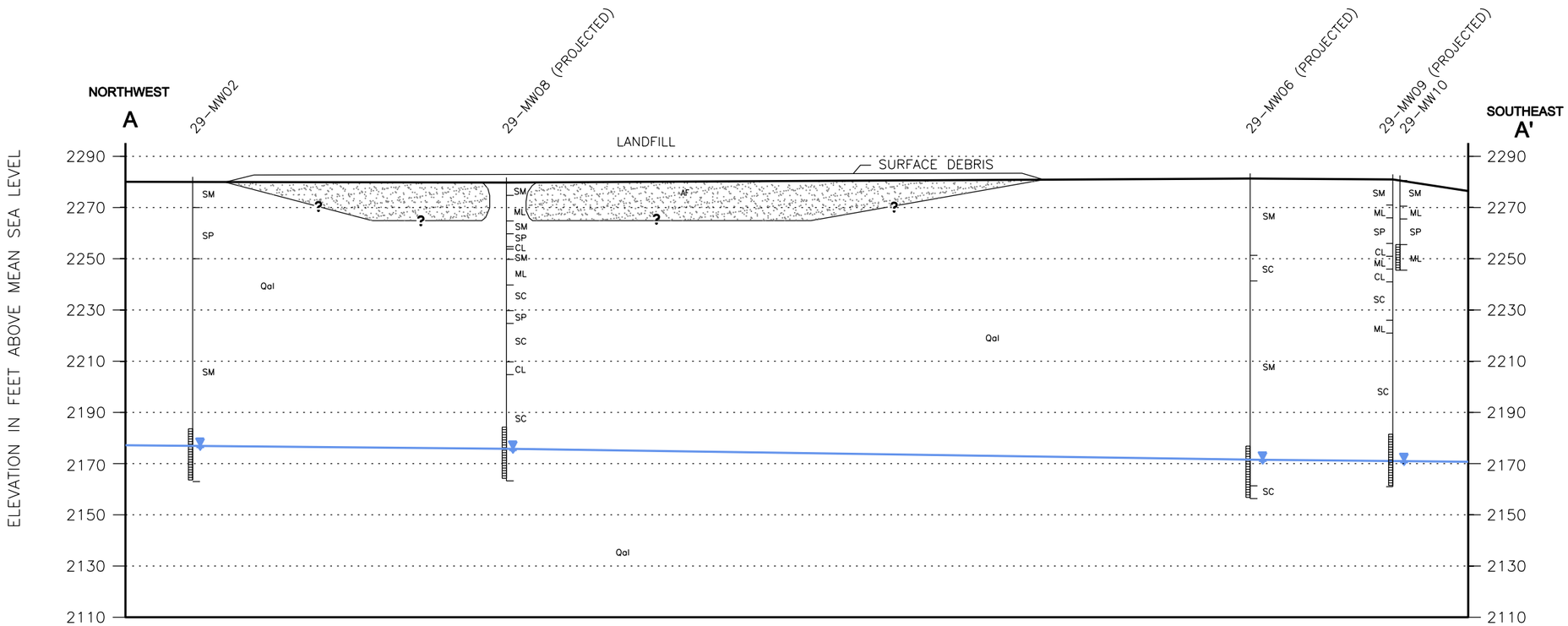

EXPLANATION

- SCREEN INTERVAL
- POTENTIOMETRIC SURFACE
- 5.4, NOV '07 — TCE CONCENTRATION IN µg/L, DATE SAMPLED
- * — WELL CONTAINS FLOATING PRODUCT (THICKNESS EVALUATED TO BE LESS THAN TWO INCHES)
- > — GREATER THAN
- µg/L — MICROGRAMS PER LITER
- TCE — TRICHLOROETHENE

- AF — ARTIFICIAL FILL
- SC — CLAYEY SAND, SILTY CLAYEY SAND
- SM — SILTY SAND
- SP — POORLY GRADED SAND
- ML — SILT, SANDY SILT
- CL — CLAY, SANDY CLAY, SILTY CLAY
- Qal — QUATERNARY ALLUVIUM

NOTES:

1. NO CONSTITUENTS ABOVE THE DETECTION LIMITS; SAMPLED OCT. 2006.
2. REFER TO FIGURE 2.7-2 FOR THE LOCATION OF CROSS SECTION A-A'.

0 100 200 FEET

HORIZONTAL SCALE: 1"= 200'
VERTICAL SCALE: 1"= 50'
VERTICAL EXAGERATION= 1:4

OU2 ROD

Site 29
Geologic Cross Section A-A'

Date 3-09	South Base Edwards AFB	Figure
Project No. 101302		2.7-3

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TABLE 2.7-1. MAXIMUM CONCENTRATIONS OF ORGANIC AND INORGANIC CONSTITUENTS DETECTED IN GROUNDWATER COMPARED TO CALCULATED BACKGROUND CONCENTRATIONS AND PRIMARY MCLs - SITE 29

Analyte	Unit	Maximum Concentration	Location ID of Maximum Concentration	No. Detections/ Total No. Samples	Calculated Background Concentration [a]	No. Samples Exceeding Background/ Total No. Samples	Maximum Contaminant Level [b] (MCL)	No. Samples Exceeding MCL/Total No. Samples
Volatile Organics								
1,1,2-trichlorotrifluoroethane	μg/L	0.58 J	29-MW07	1/17	-	-	1,200	0/17
Semivolatile Organics								
diethyl phthalate	μg/L	4.0 J	29-MW09	1/13	-	-	NP	-
Metals and Other Elements								
aluminum	mg/L	5.8	29-MW05	3/17	228	0/17	1	2/17
arsenic	mg/L	0.020	29-MW06	10/17	0.075	0/17	0.01	9/17
barium	mg/L	0.075	29-MW05	17/17	0.75	0/17	1	0/17
calcium	mg/L	37.0	29-MW05	17/17	528	0/17	NP	-
chromium, total	mg/L	0.19	29-MW08	11/17	1.33	0/17	0.05	2/17
iron	mg/L	3.8	29-MW05	6/17	206	0/17	NP	-
manganese	mg/L	0.097	29-MW05	2/17	4	0/17	NP	-
sodium	mg/L	98.8	29-MW09	17/17	426	0/17	NP	-
zinc	mg/L	0.038	29-MW09	4/17	0.65	0/17	NP	-

Notes:

Data for groundwater samples collected in 2004 and 2006 (last two sampling rounds).

[a] Background level calculated for OU2 (Earth Tech 1996). Background levels for metals and other elements were calculated from analytical results from unfiltered groundwater samples.

[b] Federal (USEPA) and Title 22 California Code of Regulations (CDHS) - MCLs (10/18/2007).

[c] U.S. EPA Secondary MCL (10/18/2007).

[d] California Secondary MCL (10/18/2007).

- not applicable

CDHS California Department of Health Services
MCL Maximum Contaminant Level
mg/L milligrams per liter
NP not promulgated
USEPA United States Environmental Protection Agency

Laboratory Data Qualifier:

J Estimated result. Result is below the reporting limit

Nature and Extent of Residual Site Contamination

No volatile organic gases or methane were detected in the landfill gas samples collected from landfill gas probes during the SWAT investigation (BSK & Associates 1990).

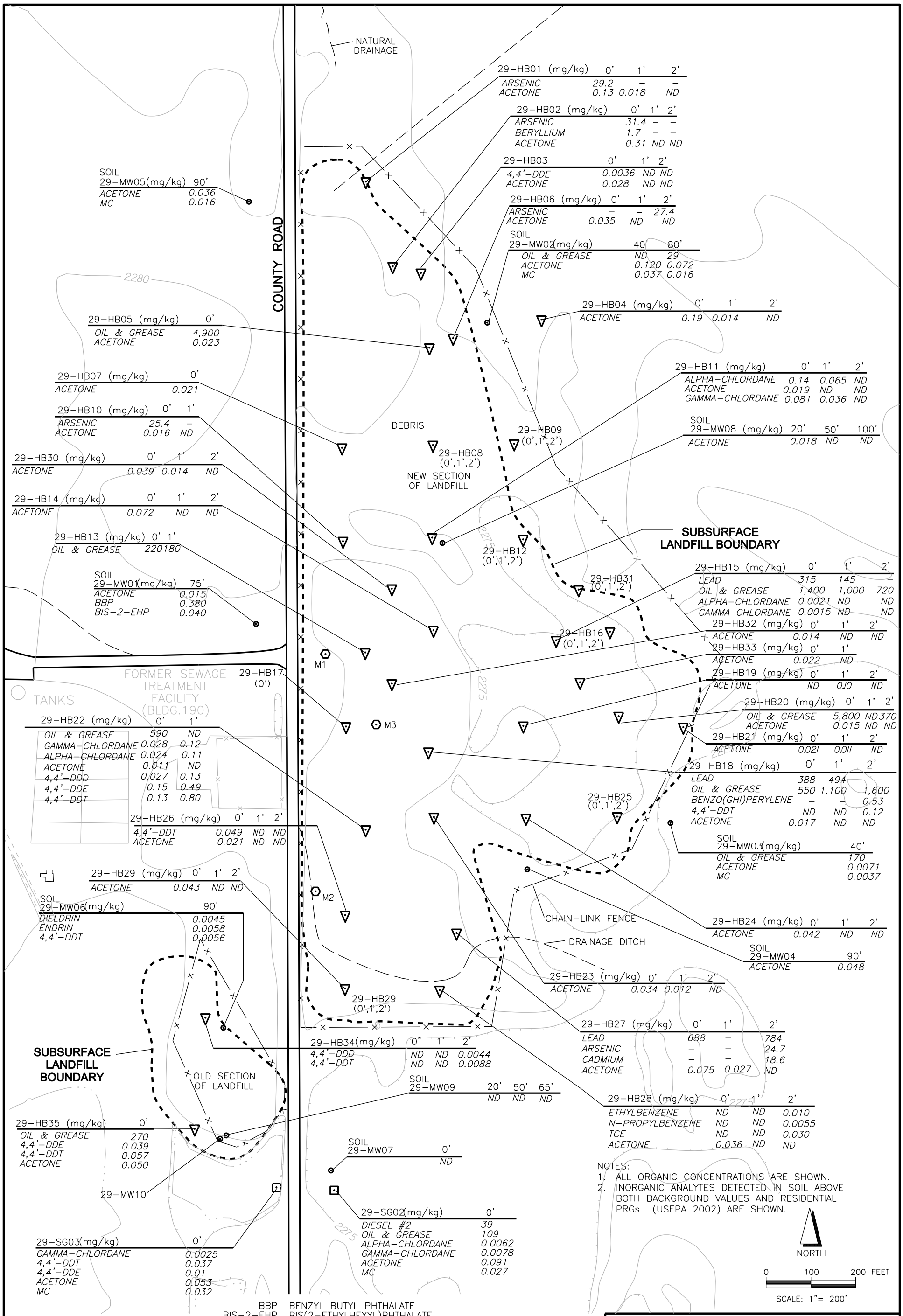
Low concentrations of solvents (trichloroethane [TCA], TCE, and PCE), total volatile petroleum hydrocarbons (TVPH), and aromatic hydrocarbons (benzene, toluene, ethylbenzene, and xylenes [BTEX]) were detected in the soil gas samples. No vinyl chloride or methane (common landfill gas constituents) was detected in any of the samples.

Low concentrations of fuels, solvents, and pesticides were detected in surface and shallow soil samples collected at Site 29 (Figure 2.7-4), but not at concentrations exceeding residential PRGs (Table 2.7-2). Arsenic, cadmium, iron, and lead were detected at concentrations exceeding the residential PRGs and the background concentrations calculated for OU2. None of the contaminants are present at concentrations that are a continuing source of pollution to groundwater (Earth Tech 2005c).

Although very low concentrations of organic compounds have been sporadically detected in the groundwater samples collected at Site 29 in the past, there have not been any organic compounds detected at concentrations above the MCLs since May 2002 (Figure 2.7-5). Although chromium and nickel have been detected in groundwater at concentrations above the MCLs and background concentrations for OU2, the high concentration levels were detected in the shallow perched groundwater which is not a potential source of drinking water under State Water Resources Control Board (SWRCB) Resolution 88-63 because the well yield is less than 200 gallons per day (gpd). In October 2006, the monitoring well used to sample the shallow perched groundwater was dry (Earth Tech 2007d).

Conceptual Site Model

The conceptual site model illustrating the potential risk from contaminant migration and exposure pathways for Site 29 is shown on Figure 2.7-6. Factors influencing the distribution of contaminants and completed pathways that present risk to human health and biota are described in greater detail below.



NOTES:
1. ALL ORGANIC CONCENTRATIONS ARE SHOWN.
2. INORGANIC ANALYTES DETECTED IN SOIL ABOVE BOTH BACKGROUND VALUES AND RESIDENTIAL PRGs (USEPA 2002) ARE SHOWN.

EXPLANATION

- MONITORING WELL LOCATION
- SURFACE SOIL SAMPLING LOCATION
- HAND-AUGER LOCATION
- SOLID WASTE ASSESSMENT TEST GAS PROBE LOCATION (BSK & ASSOC.1990)

SAMPLING LOCATION (UNIT) DEPTH OR DATE
PARAMETER *VALUE*

BBP	BENZYL BUTYL PHTHALATE
BIS-2-EHP	BIS(2-ETHYLHEXYL)PHTHALATE
MC	METHYLENE CHLORIDE
TCE	TRICHLOROETHENE
4,4'-DDT	DICHLORODIPHENYLTRICHLOROETHANE
4,4'-DDE	DICHLORODIPHENYLTRICHLOROETHYLENE
4,4'-DDD	DICHLORODIPHENYLDICHLOROETHANE
ND	NOT DETECTED

OU2 ROD

Extent of Soil Contamination Site 29

Date 3-09	South Base Edwards AFB	Figure 2.7-4
Project No. 81001		

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TABLE 2.7-2. MAXIMUM CONCENTRATIONS OF ORGANIC AND INORGANIC CONSTITUENTS DETECTED IN SOIL COMPARED TO CALCULATED BACKGROUND CONCENTRATIONS AND RESIDENTIAL PRGs - SITE 29

(Page 1 of 3)

Analyte	Maximum Concentration (mg/kg)	Location ID of Maximum Concentration	Sample Depth (ft bgs)	No. Detections/ Total No. Samples	Calculated Background Concentration [a] (mg/kg)	No. Samples Exceeding Background/ Total No. Samples	2000 Residential PRG [b] (mg/kg)	No. Samples Exceeding Residential PRG/Total No. Samples
Petroleum Hydrocarbons					-	-		
oil & grease	5,800	29-HB20	0	16/101	-	-	NP	-
unknown extractable hydrocarbons	39	29-SG02	0	1/9	-	-	NP	-
Volatile Organics					-	-		
acetone	0.31 (L)	29-HB02	0	41/111	-	-	1,600	0/111
ethylbenzene	0.010	29-HB28	2	1/111	-	-	230	0/111
methylene chloride	0.037 (J1)	29-MW03	40	10/111	-	-	8.9	0/111
n-propylbenzene	0.0055	29-HB28	2	1/97	-	-	140	0/97
trichloroethene (TCE)	0.030	29-HB28	2	1/111	-	-	2.8	0/111
Semivolatile Organics					-	-		
benzo(g,h,i)perylene	0.53	29-HB18	2	1/79	-	-	NP	-
butyl benzyl phthalate	0.38 (J1)	29-MW01	75	1/79	-	-	12,000	0/79
Pesticides and PCBs					-	-		
alpha-chlordane	0.14	29-HB11	0	6/113	-	-	NP	-
gamma-chlordane	0.12 (K)	29-HB22	1	7/113	-	-	NP	-
4,4'-DDD	0.13 (K)	29-HB22	1	3/113	-	-	2.4	0/113
4,4'-DDE	0.49 (K)	29-HB22	1	4/113	-	-	1.7	0/113
4,4'-DDT	0.80 (K)	29-HB22	1	10/113	-	-	1.7	0/113
dieldrin	0.0045	29-MW06	90	1/113	-	-	0.03	0/113
endrin	0.0058	29-MW06	90	1/113	-	-	18	0/113

TABLE 2.7-2. MAXIMUM CONCENTRATIONS OF ORGANIC AND INORGANIC CONSTITUENTS DETECTED IN SOIL COMPARED TO CALCULATED BACKGROUND CONCENTRATIONS AND RESIDENTIAL PRGs - SITE 29

(Page 2 of 3)

Analyte	Maximum Concentration (mg/kg)	Location ID of Maximum Concentration	Sample Depth (ft bgs)	No. Detections/ Total No. Samples	Calculated Background Concentration [a] (mg/kg)	No. Samples Exceeding Background/ Total No. Samples	2000 Residential PRG [b] (mg/kg)	No. Samples Exceeding Residential PRG/Total No. Samples
Metals and Other Elements								
aluminum	48,100 G	29-HB02	0	103/103	35,900	2/103	76,000	0/103
arsenic	32.5	29-HB02	0	98/113	22.7	5/113	0.39	98/113
barium	394	29-HB06	2	112/113	301	1/113	5,400	0/113
beryllium	1.7 G	29-HB02	0	86/113	1.4	1/113	150	0/113
cadmium	18.6	29-HB27	2	5/113	0.5	5/113	9	1/113
calcium	155,000	29-HB09	2	103/103	129,000	2/103	NP	-
chromium, total	41.2	29-HB27	2	113/113	39.1	1/113	210	0/113
cobalt	20.2	29-HB27	2	111/113	18	1/113	4,700	0/113
copper	113	29-HB27	2	110/113	48.7	1/113	2,900	0/113
fluoride	5.33	29-SG02	0	2/2	-	-	3,700	0/2
iron	146,000	29-HB27	2	103/103	36,100	3/103	23,000	16/103
lead	784	29-HB27	2	113/113	28.2	14/113	400	3/113
magnesium	34,100 G	29-HB02	0	103/103	30,900	1/103	NP	-
manganese	884 G	29-HB02	0	103/103	905	0/103	1,800	0/103
mercury	0.24	29-HB33	0	5/113	0.1	4/113	23	0/113
molybdenum	8.3	29-HB27	2	1/103	2	1/103	390	0/103
nickel	56.9	29-HB27	2	85/113	16.9	14/113	150	0/113
potassium	16,500 G	29-HB02	0	103/103	10,900	2/103	NP	-
selenium	1.1	29-HB25	2	2/113	0.5	2/113	390	0/113
silver	49.7	29-SG02	0	10/113	1	9/113	390	0/113
sodium	11,100	29-HB25	1	102/103	12,500	0/103	NP	-
vanadium	117 G	29-HB02	0	113/113	74.5	3/113	550	0/113
zinc	341	29-HB27	2	113/113	107	10/113	23,000	0/113

TABLE 2.7-2. MAXIMUM CONCENTRATIONS OF ORGANIC AND INORGANIC CONSTITUENTS DETECTED IN SOIL COMPARED TO CALCULATED BACKGROUND CONCENTRATIONS AND RESIDENTIAL PRGs - SITE 29

(Page 3 of 3)

Notes:

Data for soil samples collected from July 1992 through October 1996.

(a) Background level calculated for OU2 (Earth Tech 1995).

(b) USEPA Region IX PRGs (USEPA 2000).

- not applicable

4,4'-DDD	dichlorodiphenyldichloroethane
4,4'-DDE	dichlorodiphenyldichloroethylene
4,4'-DDT	dichlorodiphenyltrichloroethane
ft bgs	feet below ground surface
mg/kg	milligrams per kilogram
NP	not promulgated
PCBs	polychlorinated biphenyls
PRG	Preliminary Remediation Goal
QC	Quality Control
USEPA	United States Environmental Protection Agency

Laboratory Data Qualifier:

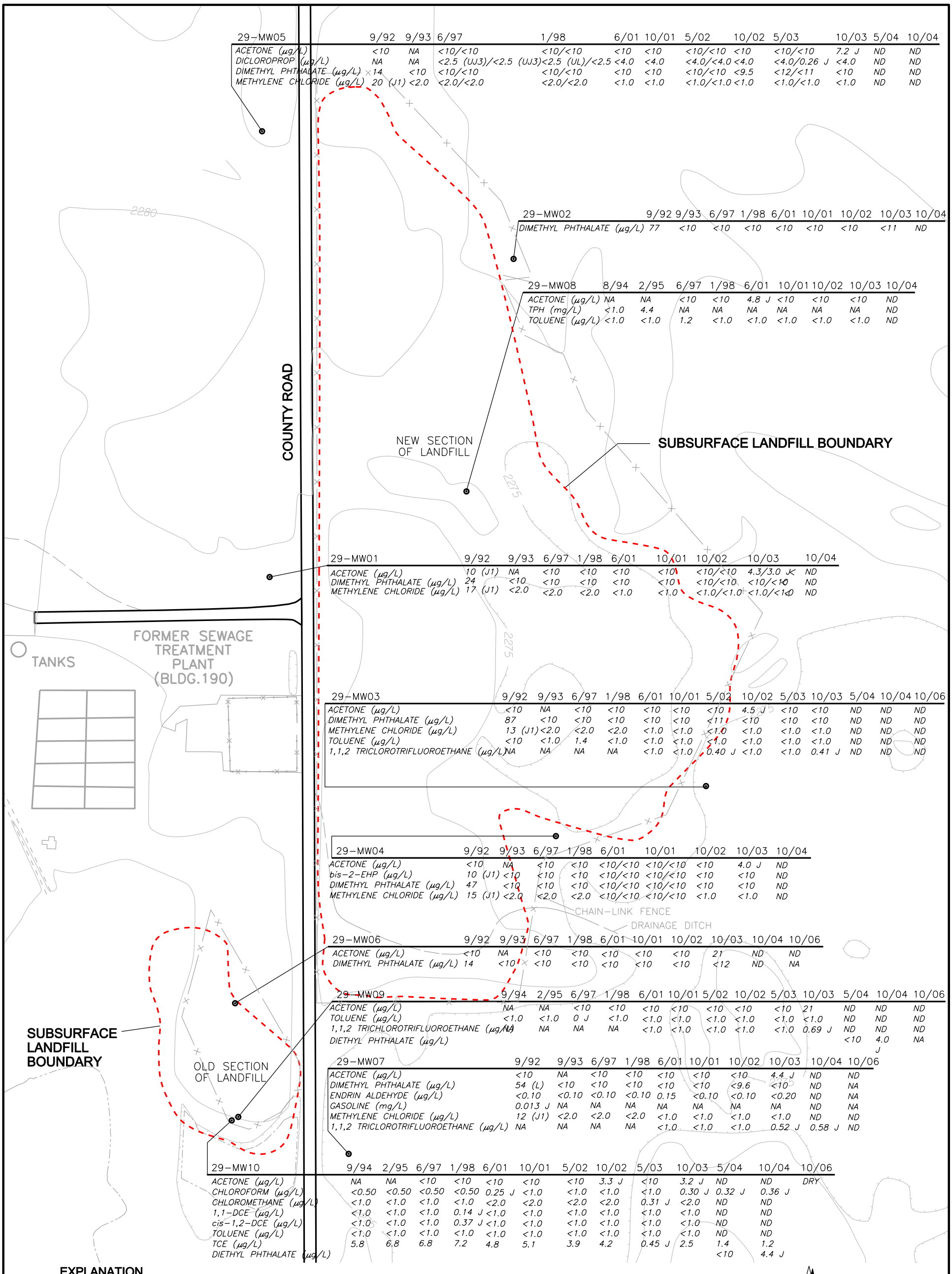
G Elevated reporting limit. The re porting limit is elevated due to matrix interference.

Earth Tech Data Qualifiers:

(J1) Blank contamination: indicates possible high bias and/or false positives. Blank level multiplied by 5 is higher than sample results, except for contamination from methylene chloride, acetone, 2-butanone and common phthalate esters where the multiplier is 10.

(K) Values may be biased high because one or more surrogates are out high. Non-detects are not qualified.

(L) Estimated value. Recoveries for one or more surrogates are below QC limits. Values may be biased low.



29-MW05	9/92	9/93	6/97	1/98	6/01	10/01	5/02	10/02	5/03	10/03	5/04	10/04
ACETONE (µg/L)	<10	NA	<10/<10	<10/<10	<10	<10	<10/<10	<10	<10/<10	7.2 J	ND	ND
DICLOROPROP (µg/L)	NA	NA	<2.5 (UJ3)/<2.5 (UJ3)	<2.5 (UL)/<2.5	<4.0	<4.0	<4.0/<4.0	<4.0	<4.0/0.26 J	<4.0	ND	ND
DIMETHYL PHTHALATE (µg/L)	14	<10	<10/<10	<10/<10	<10	<10	<10/<10	<9.5	<12/<11	<10	ND	ND
METHYLENE CHLORIDE (µg/L)	20 (J1)	<2.0	<2.0/<2.0	<2.0/<2.0	<1.0	<1.0	<1.0/<1.0	<1.0	<1.0/<1.0	<1.0	ND	ND

29-MW02	9/92	9/93	6/97	1/98	6/01	10/01	10/02	10/03	10/04
DIMETHYL PHTHALATE (µg/L)	77	<10	<10	<10	<10	<10	<10	<11	ND

29-MW08	8/94	2/95	6/97	1/98	6/01	10/01	10/02	10/03	10/04
ACETONE (µg/L)	NA	NA	<10	<10	4.8 J	<10	<10	<10	ND
TPH (mg/L)	<1.0	4.4	NA	NA	NA	NA	NA	NA	ND
TOLUENE (µg/L)	<1.0	<1.0	1.2	<1.0	<1.0	<1.0	<1.0	<1.0	ND

29-MW01	9/92	9/93	6/97	1/98	6/01	10/01	10/02	10/03	10/04
ACETONE (µg/L)	10 (J1)	NA	<10	<10	<10	<10	<10/<10	4.3/3.0 J	ND
DIMETHYL PHTHALATE (µg/L)	24	<10	<10	<10	<10	<10	<10/<10	<10/<10	ND
METHYLENE CHLORIDE (µg/L)	17 (J1)	<2.0	<2.0	<2.0	<1.0	<1.0	<1.0/<1.0	<1.0/<1.0	ND

29-MW03	9/92	9/93	6/97	1/98	6/01	10/01	5/02	10/02	5/03	10/03	5/04	10/04	10/06
ACETONE (µg/L)	<10	NA	<10	<10	<10	<10	<10	4.5 J	<10	<10	ND	ND	ND
DIMETHYL PHTHALATE (µg/L)	87	<10	<10	<10	<10	<10	<11	<10	<10	<10	ND	ND	ND
METHYLENE CHLORIDE (µg/L)	13 (J1)	<2.0	<2.0	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	ND	ND	ND
TOLUENE (µg/L)	<10	<1.0	1.4	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	ND	ND	ND
1,1,2 TRICLOROTRIFLUOROETHANE (µg/L)	NA	NA	NA	NA	<1.0	<1.0	0.40 J	<1.0	<1.0	0.41 J	ND	ND	ND

29-MW04	9/92	9/93	6/97	1/98	6/01	10/01	10/02	10/03	10/04
ACETONE (µg/L)	<10	NA	<10	<10	<10/<10	<10/<10	<10	4.0 J	ND
bis-2-EHP (µg/L)	10 (J1)	<10	<10	<10	<10/<10	<10/<10	<10	<10	ND
DIMETHYL PHTHALATE (µg/L)	47	<10	<10	<10	<10/<10	<10/<10	<10	<10	ND
METHYLENE CHLORIDE (µg/L)	15 (J1)	<2.0	<2.0	<2.0	<10/<10	<10/<10	<1.0	<1.0	ND

29-MW06	9/92	9/93	6/97	1/98	6/01	10/01	10/02	10/03	10/04	10/06
ACETONE (µg/L)	<10	NA	<10	<10	<10	<10	<10	21	ND	ND
DIMETHYL PHTHALATE (µg/L)	14	<10	<10	<10	<10	<10	<10	<12	ND	NA

29-MW09	9/94	2/95	6/97	1/98	6/01	10/01	5/02	10/02	5/03	10/03	5/04	10/04	10/06
ACETONE (µg/L)	NA	NA	<10	<10	<10	<10	<10	<10	<10	21	ND	ND	ND
TOLUENE (µg/L)	<1.0	<1.0	0 J	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	ND	ND	ND
1,1,2 TRICHLOROTRIFLUOROETHANE (µg/L)	NA	NA	NA	NA	<1.0	<1.0	<1.0	<1.0	<1.0	0.69 J	ND	ND	ND
DIETHYL PHTHALATE (µg/L)											<10	4.0 J	NA

29-MW07	9/92	9/93	6/97	1/98	6/01	10/01	10/02	10/03	10/04	10/06
ACETONE (µg/L)	<10	NA	<10	<10	<10	<10	<10	4.4 J	ND	ND
DIMETHYL PHTHALATE (µg/L)	54 (L)	<10	<10	<10	<10	<10	<9.6	<10	ND	NA
ENDRIN ALDEHYDE (µg/L)	<0.10	<0.10	<0.10	<0.10	0.15	<0.10	<0.10	<0.20	ND	NA
GASOLINE (mg/L)	0.013 J	NA	NA	NA	NA	NA	NA	NA	ND	NA
METHYLENE CHLORIDE (µg/L)	12 (J1)	<2.0	<2.0	<2.0	<1.0	<1.0	<1.0	<1.0	ND	ND
1,1,2 TRICLOROTRIFLUOROETHANE (µg/L)	NA	NA	NA	NA	<1.0	<1.0	<1.0	0.52 J	0.58 J	ND

29-MW10	9/94	2/95	6/97	1/98	6/01	10/01	5/02	10/02	5/03	10/03	5/04	10/04	10/06
ACETONE (µg/L)	NA	NA	<10	<10	<10	<10	<10	3.3 J	<10	3.2 J	ND	ND	DRY
CHLOROFORM (µg/L)	<0.50	<0.50	<0.50	<0.50	0.25 J	<1.0	<1.0	<1.0	<1.0	0.30 J	0.32 J	0.36 J	
CHLOROMETHANE (µg/L)	<1.0	<1.0	<1.0	<1.0	<2.0	<2.0	<2.0	<2.0	0.31 J	<2.0	ND	ND	
1,1-DCE (µg/L)	<1.0	<1.0	<1.0	0.14 J	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	ND	ND	
cis-1,2-DCE (µg/L)	<1.0	<1.0	<1.0	0.37 J	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	ND	ND	
TOLUENE (µg/L)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	ND	ND	
TCE (µg/L)	5.8	6.8	6.8	7.2	4.8	5.1	3.9	4.2	0.45 J	2.5	1.4	1.2	
DIETHYL PHTHALATE (µg/L)											<10	4.4 J	

EXPLANATION

- ⊙ MONITORING WELL LOCATIONS
- - - - SUBSURFACE LANDFILL BOUNDARY

SAMPLING LOCATION	DATE
PARAMETER	*VALUE*

NA	NOT ANALYZED
J	ESTIMATED VALUE.COMPOUND DETECTED BELOW LABORATORY DETECTION LIMIT.
(J1)	ESTIMATED VALUE.BLANK CONTAMINATION: INDICATES POSSIBLE HIGH BIAS AND/OR FALSE POSITIVES.
(L)	ESTIMATED VALUE.ONE OR MORE SURROGATES ARE OUT LOW.VALUES MAY BE BIASED LOW.
(UJ3)	REPORTING LIMIT ESTIMATED.EXTRACTION OR ANALYSIS OUT OF HOLDING TIME.INDICATES LOW BIAS FOR MOST ANALYTES.
(UL)	REPORTING LIMIT ESTIMATED.ONE OR MORE SURROGATES ARE OUT LOW.
1,1-DCE	1,1-DICHLOROETHENE
bis-2-EHP	BIS(2-ETHYLHEXYL)PHTHALATE
cis-1,2-DCE	CIS-1,2-DICHLOROETHENE
TPH	TOTAL PETROLUEM HYDROCARBONS
TCE	TRICHLOROETHENE
mg/L	MILLIGRAMS PER LITER
µg/L	MICROGRAMS PER LITER
<	DUPLICATE SAMPLE

NORTH

0 100 200 FEET

SCALE: 1"= 200'

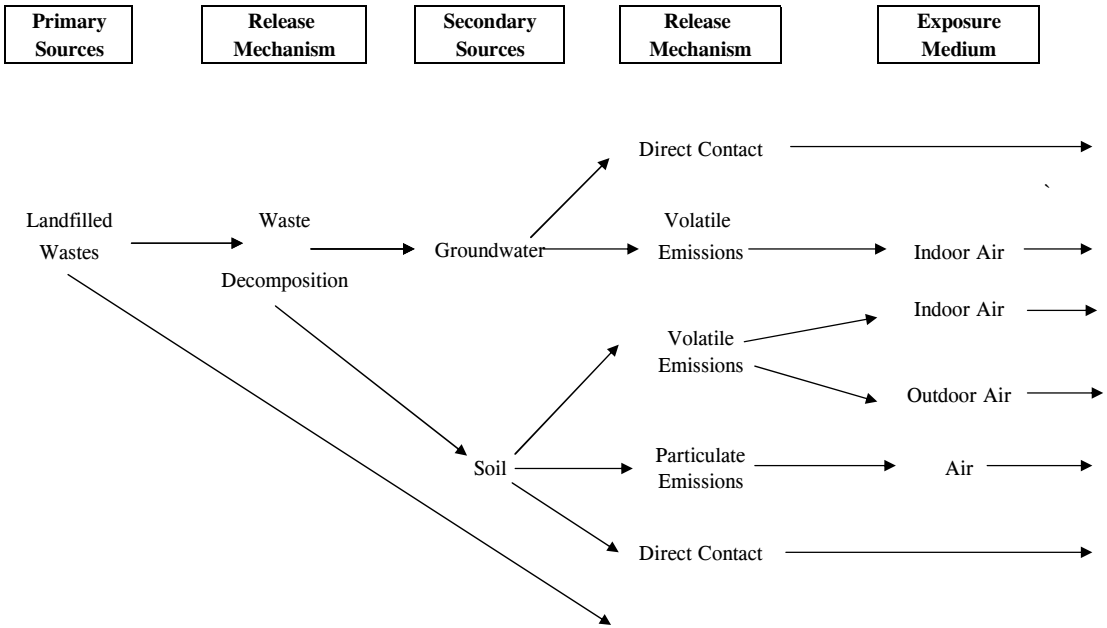
OU2 ROD

Distribution of Groundwater Contaminants - Site 29

Date 3-09	South Base Edwards AFB	Figure
Project No. 77194		2.7-5

EDWARDS\ 77194\B7113FGA.A01

FIGURE 2.7-6. CONCEPTUAL SITE MODEL - SITE 29



Potential Exposure Route	Hypothetical Future Residents	Site Workers	Construction Workers	Biota
Ingestion/ Dermal	Yes[1]	No[2]	No[2]	No[2]
Inhalation	No[3]	No[3]	N/A	N/A
Inhalation	No[4]	No[4]	N/A	N/A
Inhalation	No[4]	No[4]	No[4]	No[4]
Inhalation	Yes[5]	Yes[5]	Yes[5]	Yes[5]
Ingestion/ Dermal	Yes[1]	Yes[1]	Yes[1]	Yes[1]
Ingestion/ Dermal	Yes[6]	Yes[6]	Yes[6]	Yes[6]

[1] Pathway potentially complete, however risk within acceptable limits (see Table 2.7-3).
[2] Depth to groundwater over 12 feet below ground surface; no complete pathway.
[3] Not specifically evaluated; however, volatile organic compounds only sporadically detected in groundwater.
[4] Landfill gases (including methane) not detected in probes during remedial investigation; volatile organic compounds only sporadically detected in soil.
[5] Pathway potentially complete; however, risk within acceptable limits (pathway included in PRGs for soil [see Table 2.7-3]).
[6] Not specifically evaluated; however, the presence of hazardous wastes cannot be ruled out.

N/A - Not applicable, not a valid pathway

Contaminant Sources

Landfilled wastes at Site 29 are potential sources of contamination to groundwater, soil, and ambient air. Leachate is produced when moisture enters the refuse in a landfill, extracts contaminants into the liquid phase, and produces moisture content sufficiently high to initiate liquid flow. Sources of moisture potentially entering the landfill include liquids present in the refuse at placement, precipitation falling on refuse at placement, and precipitation infiltrating the landfill after cover application. If these leachates exceed the storage capacity of the landfill, they will percolate into the groundwater. Gases produced by waste decomposition cool as they migrate upwards, producing condensates that can also potentially contaminate cover and subsurface soils and groundwater. If cover soils become contaminated, they can produce contaminated dusts which create an inhalation hazard.

If containers of hazardous waste exist within a landfill, these containers could corrode and leak hazardous chemicals into the landfilled wastes, which could be transported as leachate to groundwater.

Factors Controlling the Distribution of Contaminants

Physical, chemical, and biological factors control the vertical and horizontal distribution of the contaminants at Site 29 as discussed below.

Physical Factors

The groundwater under Site 29 is part of the Middle Aquifer of the Lancaster Subbasin (see Figures 2.2-2 and 2.7-3). Approximately 85 feet of lacustrine deposits separate the bottom of the landfill and the top of the Middle Aquifer. These lacustrine deposits impede the vertical transport of leachates generated by the landfill into the Middle Aquifer. Shallow perched groundwater has been detected in the past in the lacustrine deposit layer; however, the well at Site 29 that was situated in the perched groundwater (29-MW10) is now dry. It is possible that the perched groundwater was a result of leaching from adjacent former evaporation ponds that are now inactive.

Base water supply wells (S-2, S-3, and S-7) located approximately 2,500 feet southwest of Site 29 (see Figure 2.1-2) influence groundwater flow direction, creating a cone of depression to the southwest, whereas natural groundwater flow in the area is to the southeast, toward Rogers Dry Lake.

Biological/Chemical Factors

As discussed above, physical factors largely preclude any leachates generated by the landfill from reaching groundwater. Because contaminants have only been sporadically detected in the groundwater at Site 29 in the past, and no contaminants were detected at Site 29 in 2006 above background concentrations, it is likely that any contaminants reaching groundwater from the landfill are rapidly attenuated.

Exposure Pathways

There are three potentially complete exposure pathways that may cause risk to receptors: (1) if waste within the landfill decomposes, causes a release to groundwater, and exposes hypothetical future residents to untreated (i.e., contaminated) groundwater through ingestion or dermal contact, (2) if ecological receptors come in contact with contaminated surface soils, and (3) if hypothetical future residents, future site workers, or biota unearth and come in contact with potentially hazardous or explosive debris.

2.7.1.3 Current and Potential Future Land and Resource Uses

According to the *General Plan* (HB&A 2001), the northern part of Site 29 is located within the Developed Area of the Base, and the land use is categorized as Industrial. The southern part of the site is located within the Undeveloped Area of the Base, and the land use is categorized as Aircraft Overflight Test Area. All these land uses are considered industrial for risk assessment purposes. According to the Base *General Plan*, which indicates future land use out for a period of five years, land use at OU2, including Site 29, is expected to be similar to current use. No residential uses of any portion of OU2 are anticipated.

2.7.1.4 Summary of Site Risks

Human Health Risk

The results of the HHRA are summarized in Table 2.7-3. A more comprehensive discussion of the HHRA for this site is presented in the *South Base HHRA* (Earth Tech 2003b and 2008d).

TABLE 2.7-3. SUMMARY OF HUMAN HEALTH RISK ASSESSMENT RESULTS – SITE 29

Potential Exposure Scenario	Exposure Medium	Cancer Risk[a]	Primary Risk Drivers[b]	Noncancer Hazard Index[c]	Primary Risk Drivers[b]
Residential (Hypothetical future)	Soil	$3x10^{-7}$	None	0.28	None
	Groundwater	$3x10^{-6}$	None	0.60	None
	Indoor Air (volatilization from soil)	$5x10^{-6}$	None	0.03	None
Industrial	Soil	$3x10^{-8}$	None	0.15	None
	Groundwater	NA	NA	NA	NA
	Indoor Air (volatilization from soil)	$3x10^{-7}$	None	<0.01	None
Construction Worker	Soil	$5x10^{-10}$	None	0.06	None
	Groundwater	NA	NA	NA	NA
	Indoor Air	NA	NA	NA	NA

Notes:

Values in bold exceed USEPA 1991 generally acceptable criteria for cancer and noncancer risks.

Results for indoor air using Air Force-recommended toxicity criteria are presented. Results using USEPA provisional TCE toxicity criteria are presented in the indoor air pathway tables for each site.

[a] To manage risks from known or suspected carcinogens, the United States Environmental Protection Agency (USEPA 1980) has developed the following exposure range: more than one additional cancer case for 10,000 people is unacceptable (i.e., greater than $1x10^{-4}$); one additional cancer case for 10,000 to one million people is considered generally acceptable (i.e., between $1x10^{-4}$ and $1x10^{-6}$); and one additional cancer case for one million or more people is considered acceptable (i.e., less than $1x10^{-6}$). However, if multiple contaminants are present and multiple pathways of exposure exist, the more stringent end of the range should be used to establish cleanup goals.

[b] "None" indicates that there are no primary risk drivers because the total risk is characterized as generally acceptable or acceptable according to the USEPA (1980) exposure range. If a constituent is shown as a primary risk driver, the number in parentheses is the percentage of the risk accounted for by the constituent.

[c] A Hazard Index less than 1 is considered generally acceptable (USEPA 1991).

% percent

NA Not applicable; no exposure pathway identified.

TCE trichloroethene

The calculated cancer risks and noncancer HIs to future residents and industrial workers exposed to soils at the site are considered acceptable.

The calculated cancer risk to future residents exposed to groundwater at the site is considered acceptable. The noncancer HI to future residents exposed to groundwater at the site is considered acceptable. There are no potential cancer risks or noncancer HIs to industrial or construction workers exposed to the groundwater at Site 29 because the groundwater is not used for any purpose and workers are unlikely to come in contact with groundwater.

Ecological Risk

The ecological risk assessment for Site 29 concluded that there could be some potential risk to some plants and animals that live at or use the site (USGS 2004). This conclusion was driven primarily by the detections of cadmium, lead, and zinc in 9 to 12 percent of the soil samples at concentrations that exceed the naturally occurring background concentrations. However, the risk assessors determined that the contaminants are limited to small isolated areas, and that there is no consistent and substantial risk to the plant and animal communities as a whole from the contaminants.

Threat to Groundwater or Surface Water

As of the 2006 sampling round, there is no current threat to groundwater. However, because refuse remains in place at Site 29, there is a potential for migration of contaminants in the landfill waste to groundwater.

2.7.1.5 Remedial Action Objectives

The RAOs are to:

1. Protect human health and animals by preventing direct contact with landfill wastes or any associated contaminated soils, which could potentially contain physical or chemical hazards;

2. Protect groundwater by preventing contaminant migration from the buried waste to groundwater;

3. Protect groundwater by controlling surface water runoff and erosion that may allow the infiltration of stormwater into the landfill to a degree that would cause subsequent migration of landfill contaminants to groundwater; and

4. Protect human health by preventing human inhalation of a potential future release of VOCs that could potentially produce concentrations of contaminants in indoor air in future construction to levels exceeding those listed in Table 2.6-8.

2.7.1.6 Description of Alternatives

Containment (i.e., preventing the migration of contaminants by physical means and LUCs) is the presumptive remedy for landfills (USEPA 1993 and 1996). Four alternatives for the containment of wastes and prevention of exposures at Site 29 were evaluated. A more comprehensive discussion of the alternatives is presented in the *OU2 FS* (Earth Tech 2005c).

The four alternatives considered are:

1. **No Action.** This alternative is listed only to compare to other alternatives. Existing fences surrounding both the old and new sections of the landfill currently provide access control. The fences are eight feet high, and topped with three strands of barbed wire. Signs are posted on the perimeter fences, and there are locks on the landfill gates. This alternative assumes that no further actions (including maintenance of the fences and groundwater monitoring) will be taken at Site 29. This alternative has no cost.

2. **Land Use Controls, Stormwater Controls, and Long-term Monitoring.** This alternative includes the implementation of LUCs and long-term groundwater monitoring. The stormwater control system adjacent to the landfill would be improved and maintained. Improvements to the drainage channels would control stormwater runoff and prevent significant ponding and leaching of landfill contaminants to groundwater. Access controls currently in place (i.e., the existing chain-link fences and gates) would be routinely inspected and repaired (as needed) to ensure there are no breaks in the fences, and the gates and fences are flush to ground. The LUCs would be implemented to minimize the potential for human exposure to physical hazards, prevent unauthorized dumping, prohibit digging in waste cells unless monitored by authorized UXO personnel, ensure access for monitoring and maintenance, and protect the monitoring wells. Procedures to maintain LUCs would be documented in the *General Plan*. Maintenance of the access controls and groundwater monitoring wells is also included in this alternative. Groundwater monitoring would be conducted biennially (i.e., every other year) as long as the unit poses a threat to water quality to confirm that contaminants which may be present in the refuse have not migrated to groundwater. If a release to groundwater above background concentrations is detected and confirmed as part of the long-term monitoring program, an evaluation monitoring program will be instituted to evaluate the nature and extent of the release. Based on the results of the evaluation monitoring program, a corrective action program, if required, will be developed. This alternative was estimated to cost $2.3 million over 30 years in the *OU2 FS* (Earth Tech 2005c) (Table 2.7-4).

TABLE 2.7-4. COSTS OF THE SITE 29 ALTERNATIVES

Cost in 2007 dollars	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Timeframe	NA	30 years	30 years	30 years
Capital	$0	$283,000	$2,320,000	$8,650,000
LUCs/LTM	NA	$1,460,000	$1,460,000	$1,460,000
Operation and Maintenance	NA	NA	NA	NA
Escalated Cost[1]	$0	$2,330,000	$4,430,000	$11,000,000
Present Value Cost[2]	$0	$1,100,000	$3,200,000	$9,740,000

Notes:

[1] Escalated cost is the inflationary adjustment from current dollars to the future estimated cost when the work is performed.

[2] Present value is the amount of money that would need to be invested in the present to cover the total cost of the project, assuming an interest rate of 7 percent.

LTM long-term management
LUC land use controls
NA not applicable
OU2 Operable Unit 2
USEPA United States Environmental Protection Agency

As recommended by the USEPA (2000), cost estimates for each alternative are to be within an accuracy range of −30 to +50 percent. The complete cost estimates can be found in the OU2 Feasibility Study (Earth Tech 2005c).

3. **Removal of Recently Emplaced Surface Debris, Land Use Controls, Stormwater Controls, and Long-term Monitoring (Selected Alternative).** This alternative includes all of the provisions of Alternative 2, with the addition that all of the recently emplaced surface debris would be removed from the site. An estimated 60,000 cubic yards of surface debris would be removed. The concrete and asphalt debris at the site would be stockpiled near the site for later use as road base. Metal debris (primarily pipes and rebar) would be trucked to a recycling center. Non-recyclable, non-hazardous debris would be sent to a landfill. Potentially hazardous debris would be sent to an on-Base facility for characterization and off-site treatment and disposal. The cover would then be evaluated to ensure it is still protective of water quality. The landfill cover would be regraded to fill in depressions that could cause significant ponding. Soil stabilizer would be applied to the surface of the site for dust control, and the site would be allowed to naturally revegetate. This alternative was estimated to cost $4.4 million over 30 years in the *OU2 FS* (Earth Tech 2005c) (see Table 2.7-4).

4. **Engineered Landfill Cover Constructed with On-Base Borrow Soil, Land Use Controls, and Long-term Monitoring.** This alternative includes all the provisions of Alternative 2, with the addition of construction of an engineered landfill cover. The engineered landfill cover design includes a one-foot thick foundation layer derived from crushing the existing concrete and asphalt surface debris, and a four-foot thick cover consisting of soil from elsewhere on the Base. Additionally, vegetation would be planted on the soil cover to prevent moisture from entering the landfill. This alternative was estimated to cost $11 million over 30 years in the *OU2 FS* (Earth Tech 2005c) (see Table 2.7-4).

2.7.1.7 Comparative Analysis of Alternatives

The comparative analysis of the alternatives for Site 29 is presented in Table 2.7-5. All of the active alternatives would provide adequate overall protection of human health and the environment through the use of LUCs. In addition, all provide enhanced protection from a future release of contaminants potentially contained within the landfill to groundwater.

Alternative 2 provides enhanced stormwater controls that would minimize infiltration into the landfill wastes by collecting and diverting precipitation off-site, thereby reducing the potential for contaminant migration. In addition to providing stormwater controls, Alternative 3 provides enhanced protection to the groundwater over Alternative 2. Filling in depressions in the landfill surface to prevent significant ponding, and patching of the landfill surface after all surface debris is removed minimizes stormwater infiltration through the landfill surface. Removing the surface debris also allows for access to all portions of the landfill so that future cover maintenance can occur. Removal of household

TABLE 2.7-5. COMPARATIVE ANALYSIS OF ALTERNATIVES - SITE 29
(Page 1 of 2)

CERCLA Criteria [a]	ALTERNATIVE 1 No Action	ALTERNATIVE 2 Land Use Controls, Stormwater Controls, and Long-Term Monitoring	ALTERNATIVE 3 Removal of Recently Emplaced Surface Debris, Land Use Controls, Stormwater Controls, and Long-Term Monitoring (Selected Alternative)	ALTERNATIVE 4 Engineered Landfill Cover Constructed with On-Base Borrow Soil, Land Use Controls, and Long-Term Monitoring
Overall Protection of Human Health and the Environment	Does not eliminate the potential for future exposure to contaminants, if they are present in landfill waste and migrate to groundwater. Existing land use controls may degrade in the future if not maintained. ○	Reduces the potential for future migration of contaminants to groundwater, if they are present in landfill waste. Land use controls will reduce human health risks associated with site. ●	Reduces the potential for future migration of contaminants to groundwater, if they are present in landfill waste. Land use controls will reduce human health risks associated with site. ●	Reduces the potential for future migration of contaminants to groundwater, if they are present in landfill waste. Land use controls will reduce human health risks associated with site. ●
Compliance with ARARs	Alternative does not address ARARs for landfill containment. ○	Alternative is not fully compliant with ARARs for landfill containment. ◒	Compliant with CCR Title 27 requirements for closure of landfill units that were closed, abandoned, or inactive (CAI) before November 27, 1984. ●	Expected to be compliant with CCR Title 27 landfill closure requirements for active landfills based upon modeling results. ●
Long-Term Effectiveness and Permanence	Lack of inspection and maintenance for existing fence may increase risk to human health posed by exposed waste and allow for unauthorized dumping. ◒	Land use controls will reduce physical risks to human health associated with site. Long-term monitoring will indicate if a release to groundwater has occurred. ●	Land use controls will reduce physical risks to human health associated with site. Long-term monitoring will indicate if a release to groundwater has occurred. ●	Enhanced landfill cover and land use controls will reduce physical risks to human health associated with the site. Long-term monitoring will indicate if a release to groundwater has occurred. ●
Reduction of Toxicity, Mobility, and Volume through Treatment	If contaminants are present in landfill waste, the only reduction of toxicity that would occur is by natural processes. ○	The only reduction of toxicity or volume that would occur is by natural processes. Stormwater controls would reduce the mobility of contaminants. ●	The only reduction of toxicity or volume that would occur is by natural processes. Stormwater controls would reduce the mobility of contaminants. ●	The only reduction of toxicity or volume that would occur is by natural processes. Stormwater controls and an enhanced cover would reduce the mobility of contaminants. ●
Short-Term Effectiveness	Existing fencing currently protects Base workers. ●	Minimal risk to workers modifying stormwater controls and conducting LTM. Risks to workers could be mitigated by following accepted health and safety protocols. ●	In addition to risks associated with Alternative 2, physical hazards may impact construction workers processing surface debris. These risks could be mitigated by following accepted health and safety protocols. ●	Risks to site workers would be similar to those in Alternative 3. These risks could be mitigated by following accepted health and safety protocols. ●

TABLE 2.7-5. COMPARATIVE ANALYSIS OF ALTERNATIVES - SITE 29
(Page 2 of 2)

CERCLA Criteria [a]	ALTERNATIVE 1 No Action	ALTERNATIVE 2 Land Use Controls, Stormwater Controls, and Long-Term Monitoring	ALTERNATIVE 3 Removal of Recently Emplaced Surface Debris, Land Use Controls, Stormwater Controls, and Long-Term Monitoring (Selected Alternative)	ALTERNATIVE 4 Engineered Landfill Cover Constructed with On-Base Borrow Soil, Land Use Controls, and Long-Term Monitoring
Implementability	Not applicable, no activities proposed. ●	This alternative can readily be implemented. ●	This alternative can readily be implemented. ●	This alternative can readily be implemented. ◒
Cost	●	●	●	◒
Escalated Cost [b]	None	$2,328,000	$4,427,000	$10,967,000
Present Value Cost [c]	None	$1,104,000	$3,203,000	$9,743,000
Regulatory Agency Acceptance	Not acceptable. ○	Not acceptable. ○	Acceptable. ●	Acceptable. ●
Community Acceptance	No public comments specific to this alternative. ◒	No public comments specific to this alternative. ◒	Acceptable. ●	No public comments specific to this alternative. ◒

Notes:

(a) Source: USEPA (1999).

(b) Escalated cost is in 2007 dollars.

(c) Present value cost is in 2007 dollars (assumes a 7 percent discount factor).

○ Does not meet criteria

◒ Partially meets criteria

● Meets criteria

ARARs applicable or relevant and appropriate requirements
CAI closed, abandoned, or inactive
CCR California Code of Regulations
CERCLA Comprehensive Environmental Response, Compensation, and Liability Act
LTM long-term monitoring

hazardous or other non-inert wastes from the landfill surface serves to remove a source of future contamination. Alternative 4 provides some additional protection by including an enhanced landfill cover.

Because Alternative 2 leaves surface debris deposited after November 27, 1984 uncovered, it may not fully comply with the action-specific ARARs for landfill containment identified in RCRA, Subtitle D and CCR, Title 27 for CAI units. However, because uncovered surface debris is removed in Alternative 3, the alternative should fully comply with the action-specific ARARs for CAI units. Including development of design documents, Alternative 3 should bring Site 29 in compliance with ARARs within two years. Alternative 4 is also expected to fully comply with the action specific ARARs, and bring Site 29 in compliance with ARARs within two years.

As shown on Table 2.7-4, Alternative 3 is the lowest cost alternative that is compliant with ARARs. Based on the evaluation of alternatives, the implementation of Alternative 3 is selected.

2.7.1.8 Principal Threat Wastes

No principal threat wastes have been identified at Site 29.

2.7.1.9 Selected Remedy

The USAF and USEPA, with concurrence from Cal/EPA DTSC and the Water Board, selected Alternative 3 for Site 29. The USAF, USEPA, and Cal/EPA DTSC concur with the selected remedy because it is the lowest cost alternative that is protective of human health and the environment and complies with ARARs. The Water Board concurs with the selected remedy because it meets the technical requirements of California water quality law, plans, and policies.

The Selected Remedy includes the removal of the recently emplaced surface debris, the implementation of LUCs and stormwater controls, and long-term groundwater monitoring. Figure 2.7-7 shows the conceptual layout (including engineering LUCs) for the selected remedy. Details regarding the design and layout of the stormwater control system, and the details of the long-term monitoring program will be specified during the Remedial Design phase. An evaluation of the existing cover for protectiveness of groundwater will also be conducted during the Remedial Design phase.

24-INCH CULVERT

2,140,400 N

6,598,500 E

29-MW05

PROPOSED STORMWATER DIVERSION CHANNEL

SITE 29 LAND USE CONTROL COMPLIANCE BOUNDARY

29-MW02

2280

FLOW DIRECTION IN PROPOSED CHANNEL

COUNTY ROAD

SUBSURFACE LANDFILL BOUNDARY

EXISTING CHAIN-LINK FENCE

APPROXIMATE LOCATION OF EXISTING CONCRETE AND ASPHALT STOCKPILE AREA

NEW SECTION OF LANDFILL

29-MW08

2275

LIMIT OF SURFACE DEBRIS

29-MW01

24-INCH CULVERT

FORMER SEWAGE TREATMENT FACILITY (BLDG. 190)

2275

2275

LIMIT OF SURFACE DEBRIS

29-MW03

29-MW04

29-MW06

SUBSURFACE LANDFILL BOUNDARY

OLD SECTION OF LANDFILL

2275

EXISTING CHAIN-LINK FENCE

29-MW09

29-MW10

29-MW07

6,596,730 E

ABANDONED EVAPORATION POND

2,137,660 N

2275

EXPLANATION

EXISTING GROUNDWATER MONITORING WELL LOCATION

NORTH

0 100 200 FEET

SCALE: 1"= 200'

OU2 ROD

Conceptual Layout of the Selected Remedy Site 29

Date 3-09	South Base Edwards AFB	Figure
Project No. 81001		2.7-7

EDWARDS\ 77194\B5507FGA.A01

The Selected Remedy consists of the following components:

a. **Removal of surface debris that was deposited on the landfill cover in 1985:** An estimated 60,000 cubic yards of recently emplaced surface debris will be removed from the landfill surface to protect humans and animals from the physical hazards posed by the debris. Debris removal will be performed in accordance with the Site 29 Interim Removal Action Work Plan (2008c). Recyclable refuse will be taken to the Main Base Active Landfill Recycling Center. Non-recyclable refuse will be taken to the Base Hazardous Waste Storage Facility. Base personnel will determine if this refuse may be disposed at the Main Base Active Landfill. The debris removal will allow improvements or repairs (e.g., regrading to prevent ponding or exposure of previously buried material) to the existing landfill cover to be made (see Selected Remedy component b). This remedy component is being implemented prior to the issuance of this ROD so that an assessment can be made of the state of the existing cover as discussed in component b (addresses RAOs #1 and #2);

b. **The existing landfill cover will be used to contain buried municipal waste:** During preparation of the RAWP for Site 29, a technical evaluation, which will include an evaluation of historical groundwater monitoring data, and the thickness and hydraulic conductivity of the existing cover, will be performed to assess if the existing cover of the landfill isolates the waste and is protective of groundwater quality. During the Remedial Action phase, necessary improvements or repairs to the landfill cover will be made, including but not limited to regrading to prevent ponding or exposure of previously buried material, to assure the cover will continue to isolate the waste and protect the groundwater at least as well as would a final cover built in accordance with applicable prescriptive standards under CCR, Title 27, Section 21090(a)(1-3) (addresses RAOs #1, #2, and #3);

c. **Erosion control to ensure municipal wastes remain buried:** Soil stabilizer will be applied to the surface of the site after the debris has been removed. The site will be allowed to naturally revegetate (addresses RAOs #1, #2, and #3);

d. **A stormwater management system to prevent stormwater run-on and promote stormwater run-off:** Additional stormwater drainage channels will be installed and existing drainage channels will be improved (addresses RAOs #2 and #3);

e. **Groundwater monitoring to confirm that contaminants which may be present in the refuse have not migrated to groundwater:** A groundwater monitoring plan will be developed during the Remedial Design phase, which will include an evaluation of the placement of groundwater monitoring wells. The groundwater monitoring plan will meet the requirements in CCR, Title 27, Section 20420 (SWRCB - Detection Monitoring Program). If monitoring data indicate "measurably significant" evidence of a release from the landfill (as defined in CCR, Title 27, Section 20164), an evaluation will be performed that meets the requirements of CCR, Title 27, Section 20425 (Evaluation Monitoring Program). At the completion of the evaluation (if required), technical information will be submitted which complies with CCR, Title 27, Section 20425(d)(2). The Air Force will determine the appropriate design modifications in consultation with the USEPA, Cal/EPA DTSC, and Water Board (addresses RAOs #2 and #3);

f. **Engineering controls to protect human health and animals:** Engineering controls will include fences to prevent human and burrowing animal access. Existing fences will remain 8 feet tall, with barbed wire tops, locked gates, and signs. The fence will be maintained flush with the ground surface. Fences will be located along the LUC compliance boundary determined by the limits of subsurface debris (addresses RAO #1);

g. **Institutional controls to protect human health:** Institutional controls will include signs to restrict access and provide warning. Signs will be posted or existing signs will be maintained that prohibit unauthorized dumping, and prohibit digging in waste cells unless monitored by authorized UXO personnel (addresses RAO #1);

h. **Institutional controls to protect human health:** Institutional controls will include restrictions on building. Due to the presence of buried waste, industrial, residential, and sensitive development will be prohibited within the LUC boundary unless engineering controls are instituted and maintained to ensure indoor air vapor levels are below those listed in Table 2.6-8. These engineering controls may include, but are not limited to, actions such as sub-slab depressurization; installation of vapor barriers; foundation ventilation systems; and protective HVAC designs (addresses RAO #4);

i. **Institutional controls to restrict installation of groundwater extraction wells**: The installation of groundwater extraction wells will be prohibited by institutional controls within the footprint of the Site 29 landfill, with the exception of groundwater monitoring wells, until the site is approved for unrestricted use and unlimited exposure (addresses RAO #1);

j. **Institutional controls to protect infrastructure:** Until Site 29 is approved for unrestricted use and unlimited exposure, infrastructure related to the remedies as presented in Components b, d, e, f, and g including, but not limited to, landfill cover, monitoring wells, fences, and stormwater controls will be protected by institutional controls from activities that may negatively impact their ongoing maintenance, effectiveness, and safety (addresses RAOs #1, #2, #3, and #4);

k. **Maintenance of landfill cover:** Post-closure maintenance will be performed to ensure the landfill cover continues to isolate the waste and is protective of groundwater quality. Post-closure cover maintenance will also be performed to prevent colonization of the landfill by burrowing animals. The landfill cover will be visually inspected periodically. Holes and fissures in the landfill cover will be filled. Any sensitive species found in burrows within the landfill boundary will be relocated under the supervision of a qualified biologist (addresses RAOs #1, #2, and #3); and

l. **LUC and IC Components:** All LUC and IC components described and listed above will be implemented and administered according to requirements and procedures described and listed in Section 2.8.1. Site-specific LUC and IC requirements will be included in the Air Force's routinely-updated *General Plan* (addresses RAOs #1 and #4).

The selected remedy was estimated to cost $4.4 million over 30 years. The selected remedy is designed to bring Site 29 in compliance with ARARs within two years.

2.7.1.10 Statutory Determinations

The following sections discuss how the selected remedy meets the statutory requirements.

Protection of Human Health and the Environment

The selected remedy will protect human health and the environment by removing physical hazards caused by the presence of surface debris on the landfill surface, and by minimizing the infiltration of stormwater into the landfill. LUCs will prevent unauthorized access to the buried debris present in the site.

Compliance with ARARs

The selected remedy will comply with the technical requirements of all Federal and State ARARs identified for the remedial action (see Section 2.8 and Appendix B) as follows:

<u>Chemical-Specific ARARs</u>

- Primary Drinking Water Standards (Table B-1, Item No. 1) - The NCP states that primary drinking water standards are legally applicable only to drinking water at the tap, but are relevant and appropriate as cleanup standards for groundwater and surface water that have been determined to be current or future drinking water sources. The selected remedy uses comparison to Primary MCLs to assess if a release from the landfill has occurred.
- Water Quality Control Plan, South Lahontan Basin (Basin Plan) (Table B-1, Item No. 2) - The beneficial uses of groundwater listed in Section 2 of the Basin Plan are relevant and appropriate to groundwater at Site 29.

<u>Location-Specific ARARs</u>

- California Endangered Species Act (Table B-1, Item No. 3) – State protected species will be protected when practicable during construction and operations activities and the appropriate State authority will be contacted if conflicts arise. The California desert tortoise, a Federal- and State-listed threatened species, is known to occur in the vicinity of Site 29.

- Wildlife Species/Habitats (Table B-1, Item No. 4) – State protected species will be protected when practicable during construction and operations activities and the appropriate State authority will be contacted if conflicts arise.

Action-Specific ARARs

- Standards Applicable to Generators of Hazardous Waste (Table B-1, Item No. 5) – Although not identified during remedial investigations, containerized hazardous waste may be present in the surface debris at Site 29. The selected remedial action will comply with standards applicable to the disposal of containerized hazardous waste if encountered during removal of surface debris.

- Sources of Drinking Water Policy (Table B-1, Item No. 8) – The Air Force agrees with the designation of the current and potential use of the groundwater at Site 29 as drinking/domestic use.

- Definition of and Criteria for Identifying Hazardous Wastes (Table B-1, Item No. 9) – The criteria contained in this ARAR will be used to define if waste encountered during the removal of surface debris is hazardous.

- Hazardous Waste Land Disposal Restrictions (LDRs) (Table B-1, Item No. 10) - The criteria contained in this ARAR will be used to define if waste encountered during the removal of surface debris is subject to LDRs.

- Land Use Controls (Table B-1, Item No. 11) – LUCs will be administered during the implementation of the selected remedy as indicated in Section 2.8 of this document and the Basewide LUC Implementation Plan.

- California Integrated Waste Management Board Requirements (Table B-1, Item No. 12; Table B-2) – The selected remedy will meet the technical requirements contained in CCR, Title 27 for closed, abandoned, or inactive (CAI) landfills.

Cost Effectiveness

The selected alternative is the lowest cost remedy that complies with ARARs.

Utilization of Permanent Solutions and Alternative Treatment Technologies

The selected alternative does not incorporate permanent solutions or alternative treatment technologies but provides the best balance of tradeoffs among short-term effectiveness, long-term effectiveness and permanence, implementability, and cost. It is expected to be permanent and effective over the long term as long as routine maintenance of the fence, cover, and erosion control features is performed, the LUCs are enforced, and groundwater monitoring is continued.

Preference for Treatment as a Principal Element

Because treatment of the potential contaminant source at the site (i.e., buried municipal waste) was found to be not practicable due to the volume of the waste and the potential for buried UXO at the site, this remedy does not satisfy the statutory preference for treatment as a principal element of the remedy. The size of the landfills, and the fact that there are no localized areas at the site with elevated contaminant concentrations that represent a major source of contamination, preclude a remedy in which contaminants could be excavated and treated effectively. In addition, containment (i.e., preventing the migration of contaminants by physical means and LUCs) is the presumptive remedy for landfills (USEPA 1993 and 1996).

Five-Year Review Requirements

Five-year reviews will be required to evaluate the protectiveness of the remedy as long as waste is left in place that poses a risk to human health and the environment.

2.7.1.11 Documentation of Significant Changes from the OU2 Proposed Plan

The remedy for Site 29 in the Proposed Plan included the construction of a subsurface fence to restrict access by burrowing animals. There is a low density of California desert tortoise at South Base. The California Department of Fish and Game does not believe a desert tortoise fence would be a deterrent to other burrowing species. Therefore, a desert tortoise fence will not be required at Site 29. Instead, a fence will be installed flush with the ground surface. Maintenance of the LUCs at Site 29 will include ensuring that the fence remains flush with the ground surface, visually inspecting the landfill cover, and filling in any detected holes and fissures after any sensitive species inhabiting these features have been relocated outside the landfill boundary.

2.8 DECISION SUMMARY – KEY DECISIONS APPLICABLE TO ALL SITES

The following subsections summarize the key decisions that are applicable to all sites.

2.8.1 LAND USE CONTROLS IMPLEMENTATION AND ADMINISTRATION

The Air Force is committed to implement, monitor, maintain, and enforce remedies that protect human health and the environment in accordance with CERCLA and the NCP.

2.8.1.1 General Requirements

LUC measures to be used at OU2 are in accordance with specific provisions of CCR, Title 22, Section 67391.1 that were determined by the Air Force to currently be relevant and appropriate requirements. Subsections (a), (b), and (e)(2) of CCR, Title 22, Section 67391.1 provide that if a remedy at property owned by the Federal government results in hazardous substances remaining on the property at concentration levels not suitable for unrestricted use and unlimited exposure, and it is not feasible to record a land use covenant (as is the case with the OU2 sites subject to LUCs), then the ROD is to clearly define and include limitations on land use and other institutional control (IC) mechanisms to ensure that future land use will be compatible with the levels of hazardous substances remaining on the property.

The Air Force will implement the following measures at all sites with LUCs.

1. Include in the *General Plan* any specific restrictions required at each site, a statement that restrictions are required because of the presence of pollutants or contaminants, the current land users and uses of the site, the geographic control boundaries, and the objectives of the land use restrictions.

2. The Air Force shall not modify or terminate Land Use Controls, implementation actions, or modify land use without approval from the USEPA, Cal/EPA DTSC, and Water Board. The Air Force shall seek prior concurrence before any anticipated action that may disrupt the effectiveness of the LUCs or any action that may alter or negate the need for LUCs.

3. The Air Force is responsible for implementing, maintaining, reporting on, and enforcing the land use controls. Although the Air Force may later transfer these procedural responsibilities to another party by contract, property transfer agreement, or through other means, the Air Force shall retain ultimate responsibility for remedy integrity.

4. The Air Force will notify the USEPA, Cal/EPA DTSC, and Water Board as soon as practicable but no longer than 10 days after discovery of any activity that is inconsistent with the IC objectives or use restrictions, or any other action that may interfere with the effectiveness of the ICs. The Air Force will notify the USEPA, Cal/EPA DTSC, and Water Board regarding how the Air Force has addressed or will address the breach within

10 days of sending the USEPA, Cal/EPA DTSC, and Water Board notification of the breach.

5. The Air Force shall notify the USEPA, Cal/EPA DTSC, and Water Board 45 days in advance of any proposed land use changes that are inconsistent with LUC objectives or the selected remedy.

6. Whenever the Air Force transfers real property that is subject to LUCs and resource use restrictions to another Federal agency, the transfer documents shall require that the Federal transferee include the LUCs and applicable resource use restrictions in its resource use plan or equivalent resource use mechanism. The Air Force shall advise the recipient Federal agency of all obligations contained in the ROD, including the obligation that a State Land Use Covenant will be executed and recorded pursuant to CCR, Title 22, Section 67391.1 in the event the Federal agency transfers the property to a non-Federal entity.

7. Whenever the Air Force proposes to transfer real property subject to resource use restrictions and LUCs to a non-Federal entity, it will provide information to that entity in the draft deed and transfer documents regarding necessary resource use restrictions and LUCs, including the obligation that a State Land Use Covenant will be executed and recorded pursuant to CCR, Title 22, Section 67391.1. The signed deed will include LUCs and resource restrictions equivalent to those contained in the State Land Use Covenant and this ROD.

8. The Air Force will provide notice to the USEPA, Cal/EPA DTSC, and Water Board at least six months prior to any transfer or sale of OU2 so that the USEPA, Cal/EPA DTSC, and Water Board can be involved in discussions to ensure that appropriate provisions are included in the transfer terms or conveyance documents to maintain effective LUCs. If it is not possible for the facility to notify the USEPA, Cal/EPA DTSC, and Water Board at least six months prior to any transfer or sale, then the facility will notify the USEPA, Cal/EPA DTSC, and Water Board as soon as possible but no later than 60 days prior to the transfer or sale of any property subject to LUCs. In addition to the land transfer notice and discussion provisions above, the Air Force further agrees to provide the USEPA, Cal/EPA DTSC, and Water Board with similar notice, within the same time frames, of Federal-to-Federal transfer of property. The Air Force shall provide a copy of the executed deed or transfer assembly to the USEPA, Cal/EPA DTSC, and Water Board.

9. The Air Force will address as soon as practicable any activity that is inconsistent with LUC objectives or use restrictions or any other action that may interfere with the effectiveness of LUCs, but in no case will the process be initiated later than 30 days after the Air Force becomes aware of the activity.

10. Monitoring of the environmental use restrictions and controls will be conducted annually by the Air Force. The monitoring results will be included in a separate report or as a section of another environmental report, if appropriate, and provided to the USEPA, Cal/EPA DTSC, and Water Board. The annual monitoring reports will be used in preparation of the Five-Year Review to evaluate the effectiveness of the remedy.

11. The annual monitoring report, submitted to the regulatory agencies by the Air Force, will evaluate the status of the ICs and how any IC deficiencies or inconsistent uses have been addressed. The annual evaluation will address whether the use restrictions and controls referenced above were communicated in the deed(s), whether the owners and State and local agencies were notified of the use restrictions and controls affecting the property, and whether use of the property has conformed to such restrictions and controls.

It is understood that the Air Force is responsible for remedy implementation and ensuring integrity of the remedy, including monitoring, maintaining, reporting, and enforcing the identified controls. If the Air Force determines that it cannot meet specific LUC requirements, it is understood that the remedy may be reconsidered and that additional measures may be required to ensure the protection of human health and the environment.

In addition, to assure the USEPA, Cal/EPA DTSC, Water Board, and the public that the Air Force will fully comply with and be accountable for the performance measures identified herein, the Air Force will submit to the USEPA, Cal/EPA DTSC, and Water Board in a timely manner an annual monitoring report on the status of LUCs and/or other remedial actions, including the operation and maintenance and monitoring thereof, and how any LUC deficiencies or inconsistent uses have been addressed. The report also will be filed in the information repositories. The report will not be subject to approval and/or revision by the USEPA, Cal/EPA DTSC, and Water Board. The annual monitoring reports will be used in preparation of the Five-Year Reviews to evaluate the effectiveness of the remedy and will verify that State and local agencies were notified of the use restrictions and controls affecting the property and that the use of the property has conformed to such restrictions and controls.

2.8.1.2 Implementation Procedures

Only USAF-approved projects are allowed on-Base and they must be covered by one of the following documents: Air Force Flight Test Center (AFFTC) Form 5926 (Civil Engineering [CE] Work Clearance Request) and/or AF Form 332 (CE Work Request). The AFFTC Form 5926 is required for any project that involves mechanical soil excavation or drilling, such as digging trenches for underground lines, excavating soil for building foundations, or drilling to install groundwater monitoring wells.

Documentation of LUCs and Restricted Areas

All areas requiring LUCs will be documented in the *General Plan* and the Edwards AFB GIS. The *General Plan* includes general information about LUCs, and incorporates the GIS, which contains site-specific LUC information, by reference. It resides in the office of the Base community planner. Restrictions required by the ROD will either be entered into the *General Plan* and GIS or incorporated by reference to an external document such as an LUC implementation work plan.

Until a site is cleaned to standards appropriate for unrestricted use and unlimited exposure, the *General Plan* will reflect the restrictions on development and land use. Upon completion of a remedial action at a site, the *General Plan* will be updated to modify the site-specific use restrictions as appropriate.

The footprints of areas impacted with chemicals of concern will be periodically updated in the GIS from ERP documents. LUC boundaries for Site 29 will be based on the site boundary; LUC boundaries for Sites 5/14, 76, and 86 will be based on contamination boundaries, which will be updated on a regular basis when new data are available. For Site 29, the Air Force shall provide additional details regarding engineered LUCs (e.g., fences and signs) in the RAWP, which will be submitted in accordance with the OU2 FFA Schedule. The RAWP is an enforceable primary document under Section 7.3 of the FFA.

The Air Force shall notify the USEPA, Cal/EPA DTSC, and Water Board in advance of any changes to the *General Plan* and internal administrative procedures that would affect the LUCs.

Enforcement Process

Any project requiring change in land use designation, and/or construction requires approval by the appropriate Environmental Management Office to ensure compliance with the *General Plan*. Environmental Management has primary responsibility to ensure that LUCs are enforced; however, the Installation Commander has the ultimate responsibility for the enforcement of LUCs.

AF Form 332, the CE Work Request, must be submitted and approved before the start of any building project on Edwards AFB. Approval of this form involves the comparison of the building site with the constraints in the *General Plan* and GIS. The Work Request serves as the document for communicating any construction constraints to the appropriate offices. Any constraints at the site result in the disapproval of the form unless the requester makes appropriate modifications to the building plans. The

CE Work Management Office is responsible for the final approval of proposed building projects through the Configuration Control Board review process.

AFFTC Form 5926, the EAFB CE Work Clearance Request, will also be used to enforce the groundwater LUCs. The requester submits an AFFTC Form 5926 to CE Customer Service, for any project that involves any mechanical soil excavation, and it is circulated to appropriate offices for review of needed safety procedures. Approval of this form involves the comparison of the site with the constraints in the *General Plan* and GIS. The CE Real Estate Office is responsible for the final approval of excavation projects through the permit review process.

Removal of Site Specific Restrictions

Once the cleanup standards designated for a site are achieved, risks from all exposure pathways will also be reduced to acceptable limits. These sites will be available for unrestricted use and unlimited exposure, and there will be no need to establish, maintain, monitor, report on, or enforce LUCs. The USEPA, Cal/EPA DTSC, and Water Board agree to delete LUC requirements.

2.8.2 COMPLIANCE WITH ARARS

The selected remedies for Sites 5/14, 76 and 86, and 29 will comply with all Federal and State ARARs identified for the remedial actions for Operable Unit 2 (see Appendix B).

2.8.2.1 Chemical-Specific ARARs

Chemical-specific ARARs are promulgated, health- or risk-based numerical values that, when applied to site-specific conditions, establish acceptable concentrations of a chemical that may be found in, or discharged to, the ambient environment. If a chemical has more than one cleanup level, the most stringent level is identified as an ARAR to be met for the remedial actions at the Operable Unit 2 sites. Chemical-specific ARARs identified for these remedial actions include the following State requirements:

- Primary Drinking Water Standards (Non-zero MCLGs and MCLs) (Item No. 1 in Table B-1); and
- Water Quality Control Plan, South Lahontan Basin (Basin Plan) (Item No. 2 in Table B-1).

Chemical-specific ARARs identified for these remedial actions include the following Federal requirement:

- Primary Drinking Water Standards (Non-zero MCLGs and MCLs) (Item No. 1 in Table B-1).

The selected alternatives will comply with these chemical-specific ARARs as annotated in Table B-1.

Applicability of State of California Promulgated Standards as ARARs for Groundwater Contaminant Plumes

The selected alternatives for Sites 5/14, 76, and 86 are necessitated by the SWRCB Resolution No. 88-63 ("Adoption of Policy Entitled 'Sources of Drinking Water'") classification of all groundwater in the State as a potential source of drinking water (if the water meets certain quality criteria), and the Water Board's designation in the Basin Plan of the groundwater at OU2 as a potential source of drinking water. The Air Force has determined that the requirement in SWRCB Resolution No. 92-49 ("Policies and Procedures for Investigation and Cleanup and Abatement of Discharges under Water Code Section 13304") to "clean up and abate the effects of discharges in a manner that promotes attainment of either background water quality, or the best water quality which is reasonable if background levels of water quality cannot be restored" is not an ARAR for the purpose of this remedial action (see Section 2.8.2.1). Notwithstanding this determination (see the Air Force, USEPA, and Water Board positions discussed below), the Air Force has met the intent of SWRCB Resolution No. 92-49 by conducting a TEFA (USAF 2009) in accordance with CCR, Title 23, Section 2550.4, Chapter 15.

Air Force Position

The Air Force's position is that all remedial actions under CERCLA must, as a threshold matter, be determined by the lead agency to be necessary to protect human health and/or the environment from unacceptable risk, and furthermore must be appropriate and relevant to the circumstances of a site release (42 USC Section 9621(a)(1) and (d)(1)). Both CERCLA and the NCP focus on cleaning up contaminated groundwater, where practicable and achievable within a reasonable timeframe, to a standard that will restore the designated uses of the groundwater, not to the lowest standard achievable regardless of risk (42 USC Section 9621(d)(2)(B)(i) and 40 Code of Federal Regulations [CFR]

Section 300.430(a)(1)(iii)(F)). As discussed in the TEFA, a reason for limiting groundwater withdrawal from the upper aquifer at Edwards AFB is to prevent or minimize land and lakebed subsidence. Increasing the level of groundwater withdrawal from the upper aquifer at OU2 for any other use (e.g., as a source of drinking water) could potentially accelerate land and lakebed subsidence, resulting in the formation of larger and deeper cracks and fissures on the surface of Rogers Dry Lake thereby limiting its designated use as an emergency aircraft landing site. Additionally, the declining water table and any further land subsidence would result in an ecological impact to deep rooted trees and shrubs. Accordingly, California non-degradation provisions (to include SWRCB Resolution No. 92-49 and the Basin Plan) based on achieving background or the lowest cleanup standard that is technically and economically achievable are not risk-based, necessary, or relevant or appropriate to returning contaminated groundwater to a drinking water standard of service; and, therefore, the Air Force does not consider them to be ARARs.

Regarding applicability, and without prejudice to the Air Force's position above, the California non-degradation provisions are not applicable because they are directed toward State agencies who in turn are directing cleanup under State law, whereas this is a Federal CERCLA cleanup action where the State is a support agency; or apply to current discharges as opposed to historic releases or further migration of such releases; or apply to specific, discrete regulated units that received hazardous waste after 26 July 1982, none of which apply here.

State non-degradation provisions are not relevant and appropriate requirements (RARs) because:

- MCL standards that are set at zero are categorically not relevant and appropriate (40 CFR Section 300.430(e)(2)(i)(C)). Additionally, because background levels for the hazardous substances at issue at Edwards AFB OU2 would be zero; such background provisions in California non-degradation provisions are similarly not relevant and appropriate.

- 40 CFR Section 300.430(e)(2)(i)(C) and 40 CFR Section 300.400(g)(2)(viii) together require that a potential relevant and appropriate requirement for groundwater reasonably relate, that is be relevant and appropriate, to the beneficial use of the groundwater being addressed. As discussed above, California non-degradation provisions requiring that cleanup standards be set at zero or the lowest standard technically and economically feasible, are not reasonably related to any actual or potential use of the water or risks to users thereof.

- CCR provisions are designed for specific and discrete units that manage hazardous waste, such as landfills, surface impoundments, and other similar transfer, treatment, storage or disposal units, thus they are not reasonably related to the diffuse release sites at Edwards AFB.

Based upon all of the above, the only provisions of the California regulations that are potential ARARs are those that require more stringent cleanup concentrations or standards than the Federal MCLs. If State MCLs are the same as Federal MCLs, they are not more stringent and therefore are not ARARs. If a State MCL is more stringent than the Federal MCL, then it is an ARAR under CERCLA as set forth in 42 USC Section 9621(d)(2)(A)(ii).

Although tables in this ROD may contain information showing COCs to the Water Board and comparison of these COCs to Water Quality Objectives including Secondary MCLs, the presentation of these data do not constitute an admission by the Air Force that Water Quality Objectives are ARARs.

USEPA Position Regarding State Requirements as ARARs for OU2

Only State standards, requirements, criteria, or limitations that have been promulgated under State environmental or facility-siting laws that are more stringent than Federal ARARs and that have been identified by the State of California in a timely manner are potential State ARARs.

With regard to the Porter-Cologne Water Quality Control Act, it is USEPA's position that the Act itself is not an ARAR; rather, it is an enabling statute that authorizes the SWRCB to regulate activities which may affect the quality of the waters of the State. With regard to the Basin Plan, it is the USEPA's position that only those parts of the Basin Plan which set out the designated uses (beneficial uses) and the water quality criteria based upon such uses (water quality objectives) meet the NCP definition of substantive standards. Other parts of the Basin Plan express general goals and/or enumerate factors that the Regional Boards consider in the process of enforcing water quality standards; these do not set standards themselves.

With regard to SWRCB Resolution No. 92-49, only Section III.G has substantive standards that are potentially relevant and appropriate to CERCLA groundwater cleanups. The first three pages of SWRCB Resolution No. 92-49 contain "Whereas" clauses, followed by Sections I and II which state the policies and procedures that the Regional Boards apply in overseeing cleanups.

Likewise, Sections III.A through III.E simply enumerate the factors the Regional Boards must consider in implementing cleanups. Section III.F requires the Regional Board to require cleanup actions to conform to SWRCB Resolution No. 68-16 ("Statement of Policy with Respect to Maintaining High Quality Waters in California"), and to implement the provisions of Chapter 15 that are applicable to the cleanup activity. While SWRCB Resolution No. 68-16 and Chapter 15 regulations have substantive requirements that impact cleanup standards, these two State requirements have to be analyzed in and of themselves as to whether they are potential ARARs, independent of their incorporation by reference in SWRCB Resolution No. 92-49. It is the USEPA's position that SWRCB Resolution No. 68-16 is an ARAR when setting limits for discharge or reinjection into groundwater; it is not an ARAR for setting aquifer cleanup standards in CERCLA groundwater cleanup. This is because the USEPA does not believe that continuing migration of contamination in groundwater is a "discharge" subject to SWRCB Resolution No. 68-16. It is the USEPA's position that Chapter 15 has limited applicability to CERCLA cleanups because of the exemption language in Section 2511(d) which generally exempts cleanups undertaken by or at the direction of public agencies. Incorporation of SWRCB Resolution No. 68-16 and Chapter 15 into SWRCB Resolution No. 92-49 does not broaden the applicability of these two State regulations outside these parameters.

With regard to secondary MCLs, the USEPA has consistently stated that these are not ARARs because they are not promulgated Federal environmental standards that go to the protection of human health and the environment. Even when promulgated by the State, secondary MCLs address taste and odor. The USEPA considers taste and odor cosmetic, not health-based environmental standards. The NCP remedy selection process is based on the CERCLA mandate to protect human health and the environment.

Water Board Position Regarding State Requirements

<u>SWRCB Resolution No. 92-49 and 68-16</u>

The Water Board has identified SWRCB Resolution No. 92-49 and California Code of Regulations, Title 23, Section 2550.4 as proposed ARARs for determining cleanup standards for VOCs in the groundwater at Edwards AFB. The Air Force and the Water Board disagree about whether these Water Board requirements are ARARs for this cleanup.

With regard to SWRCB Resolution No. 92-49, the Water Board asserts that this resolution is an applicable requirement for remedial actions of the contaminated groundwater and complies with California Code of Regulations, Title 23, Section 2550.4. Furthermore, the Water Board does not believe that the application of SWRCB Resolution No. 92-49 is strictly limited to Section III.G. In this case, SWRCB Resolution No. 92-49 requires remediation of the contaminated groundwater to the lowest concentration levels of constituents technically and economically feasible, which must at least protect the beneficial uses of groundwater, but need not be more stringent than is necessary to achieve background levels of the constituents in groundwater.

With regard to SWRCB Resolution No. 68-16, the Water Board asserts that this resolution is an ARAR for the injection of any discharge of waste or proposed discharge of waste into groundwater and is not strictly limited to a discharge of waste to treat contaminants. Waste is defined pursuant to Water Code Section 13050, subdivision (d), and includes, but is not limited to, injected chemical reagents. A discharge also occurs where polluted groundwater migrates to areas of high quality groundwater. Discharges subject to SWRCB Resolution No. 68-16 include the continuing migration of any in situ treatment reagents or other waste as defined in Water Code Section 13050(d) from the injection wells to groundwater. Under SWRCB Resolution No. 68-16, some degradation may be allowed so long as the cleanup action applies best practicable treatment and control to prevent further migration of waste to "Waters of the State" at concentration levels that exceed water quality objectives or impact beneficial uses. "Waters of the State" includes surface water and groundwater pursuant to Water Code Section 13050(e).

Porter-Cologne Water Quality Control Act (Water Code Section 13000 et seq.)

The Water Board asserts that various provisions of the Porter-Cologne Water Quality Control Act are applicable requirements. First of all, Water Code Section 13000 is an applicable requirement and requires the activities and factors which may affect the quality of the waters of the State shall be regulated to attain the highest water quality which is reasonable, considering all demands being made and to be made on those waters and the total values involved, beneficial and detrimental, economic and social, tangible and intangible. Water Code Section 13000 applies to contaminants in "waters of the State" as defined in Water Code Section 13050, subdivision (e) and to contaminants in soil that may degrade waters of the State.

Second, Water Code Section 13243 is an applicable requirement and states that the Water Board may specify certain conditions or areas where the discharge of waste, or certain types of waste, will not be permitted. Water Code Section 13243 applies to discharges of soil or contaminants where the discharge may affect water quality.

Third, Water Code Section 13267(b) is an applicable requirement and states that the Water Board may require any person suspected of discharging, or who proposes to discharge, waste to furnish technical or monitoring program reports. Water Code Section 13267(b) applies to discharges of soil or contaminants where the discharge may affect water quality.

Fourth, Water Code Section 13304(a) is an applicable requirement and states that the Water Board may require any person who causes or permits any waste to be deposited where it is, or probably will be, discharged to waters of the State and create a condition of pollution or nuisance to clean up the waste or abate the effects of the waste. Water Code Section 13304(a) applies to discharges of soil or contaminants where the discharge may affect water quality.

Fifth, Water Code Section 13375 is an applicable requirement and states that the discharge of any radiological, chemical, or biological warfare agent into the waters of the state is prohibited. Water Code Section 13375 applies to discharges of radiological, chemical, or biological warfare agents.

Furthermore, although not a provision of State law, the California Water Quality Control Board, Central Valley Region's "Designated Level Methodology for Waste Classification and Cleanup Level Determination" is a "To Be Considered" requirement and provides guidance on how to classify waste according to CCR, Title 23, Division 3, Chapter definitions. This document is to be considered in determining the classification of wastes and contaminated soils.

California Code of Regulations, Title 23, Division 3, Chapter 15

With regard to CCR, Title 23, Division 3, Chapter 15, the Water Board asserts that Chapter 15 regulates all discharges of hazardous waste to land that may affect water quality. A "waste management unit" is defined in Chapter 15 as "an area of land, or a portion of a waste management unit, at which waste is discharged" (CCR, Title 23, Section 2601). Pursuant to Water Code Section

13050(d), the definition of "waste" is extremely broad and includes the injection of one or more chemicals to groundwater to the extent that there is a discharge to an "area of land".

CCR, Title 23, Section 2550.4 requires the consideration of beneficial uses when establishing cleanup standards above background. The factors that are to be considered by Edwards AFB in performing a TEFA for groundwater are listed under CCR, Title 23, Section 2550.4(d). Section 2550.6 requires monitoring for compliance with RAOs for three years from the date of achieving the cleanup standards. Section 2550.10 requires implementation of corrective action measures that ensure Title 23 cleanup standards are achieved through the zone affected by the release by removing waste constituents or by treating them in place.

Basin Plan

With respect to the Basin Plan, the Water Board asserts that Chapter 2, Beneficial Uses; Chapter 3, Water Quality Objectives; and the sections in Chapter 4, Implementation entitled "Regionwide Prohibitions", "Requirements for Site Investigation and Remediation", and "Cleanup Levels" are ARARs and apply to determine the appropriate cleanup standard in groundwater to protect beneficial uses and to meet the water quality objectives.

Secondary MCLs

With respect to secondary MCLs, the Water Board asserts that the taste and odor water quality objective specified in the Basin Plan for the Lahontan Region, which incorporates State primary and secondary drinking water standards, is an ARAR that applies to the establishment of cleanup standards in OU2. In particular, secondary MCLs for taste and odor based on drinking water standards specified in Table 64449-A (Secondary Maximum Contaminant Levels - Consumer Acceptance Limits) and Table 64449-B of Section 64449 (Secondary Maximum Contaminant Levels and Compliance), CCR, Title 22, as incorporated by reference in the Basin Plan, are ARARs and water quality objectives which apply to groundwater.

Conclusion

In summary, (1) SWRCB Resolution No. 92-49; (2) Water Code Sections 13000, 13243, 13267(b), 13304(a), and 13375, (3) Chapter 2, Beneficial Uses; Chapter 3, Water Quality Objectives; and the Sections "Regionwide Prohibitions", "Requirements for Site Investigation and Remediation" and "Cleanup Levels" in Chapter 4, Implementation of the Basin Plan; (4) CCR, Title 23, Division 3, Chapter 15; and (5) secondary MCLs are applicable requirements because they specifically address remedial actions taken in order to protect the quality of the "Waters of the State". They are substantive requirements that are legally enforceable, of general applicability, and more stringent than Federal requirements. Furthermore, although the Air Force has recognized the applicability of SWRCB Resolution No. 68-16, the Water Board notes that the appropriate scope of the applicability of SWRCB Resolution No. 68-16 in this particular case is subject to some disagreement between the Air Force and the Water Board.

Technical and Economic Feasibility Analysis (TEFA)

The Air Force conducted a qualitative TEFA (USAF 2009) of achieving cleanup standards more stringent than Federal and State Primary MCLs for groundwater cleanup. The results of the TEFA indicated that achieving background levels for constituents in the groundwater, although technically feasible, is not economically feasible or environmentally desirable because use of the groundwater aquifer for drinking water purposes could potentially accelerate lakebed subsidence. The USGS believes that aquifer compaction in the Lancaster basin is inelastic, that is, once collapsed the effect of subsidence cannot be reversed (Sneed and Galloway 2000). All parties agree that the groundwater cleanup levels established in this Record of Decision, as supported by the TEFA, provides substantive compliance with SWRCB Resolution No. 92-49 and CCR, Title 23, Section 2550.4. SWRCB Resolution No. 92-49 and CCR, Title 23, Section 2550.4 are intended to result in cleanup to the lowest standard that is technically and economically feasible and that will protect beneficial uses of the "Waters of the State". All parties agree that, at this time, cleanup standards for all VOCs in the groundwater are State or Federal Primary MCLs, whichever is more stringent.

Summary

The parties, however, desire to avoid disputing the issue of whether certain provisions of State law are ARARs, particularly if, in utilizing the State non-degradation provisions and the TEFA analyses therein, a joint determination can be made that cleanup to background for substances released from a site are not technically and economically feasible. The parties acknowledge that one factor specified in the NCP for determining the relevance and appropriateness of any requirement is variance, waiver or exemption provisions specified in the requirement (40 CFR Section 300.430[g][2][v]). Accordingly, without prejudice to the positions of the respective parties, which all parties have respectively reserved and preserved, and without any precedence, the Air Force conducted an analysis of the technical and economic feasibility of achieving cleanup standards more stringent than MCLs. In doing so, the Air Force is neither directly nor indirectly acknowledging that either concentration levels below MCLs or the TEFA process itself are ARARs. The Air Force has determined that it is not technically or economically feasible to clean the groundwater at Edwards AFB OU2 to background concentrations for all substances released from the sites, and that it is not necessary to do so, in this particular case, to protect human health and the environment. Further, as a result of the TEFA evaluations, all parties agree that the groundwater cleanup levels established in this ROD are the lowest concentrations technically and economically achievable. Based in part on information in the TEFA, the USEPA, Cal/EPA DTSC, and Water Board agree with the TEFA analysis and determination that, in this particular case, the CERCLA and NCP compliant cleanup standards in the groundwater shall be the Federal or State Primary MCLs, whichever are more stringent. The Cal/EPA DTSC and Water Board further concur that such standards will not pose a substantial threat or potential hazard to human health.

2.8.2.2 Location-Specific ARARs

Location-specific ARARs are restrictions on the concentrations of hazardous substances or on activities solely because they are in specific locations such as floodplains, wetlands, historic places, and sensitive ecosystems or habitats. Location-specific ARARs identified for the OU2 remedial actions include the following State requirements:

- California Endangered Species Act (Item No. 3 in Table B-1); and
- Wildlife Species/Habitats (Item No. 4 in Table B-1).

The selected alternatives will comply with location-specific ARARs as annotated on Table B-1.

2.8.2.3 Action-Specific ARARs

Action-specific ARARs are technology- or activity-based requirements or limitations that apply to particular remedial activities. Action-specific ARARs identified for the OU2 remedial actions include the following State requirements:

- Standards Applicable to Generators of Hazardous Waste (Item No. 5 in Table B-1);
- Statement of Policy with Respect to Maintaining High Quality Waters in California (Non-degradation Policy) (Item No. 7 in Table B-1);
- Sources of Drinking Water Policy (Item No. 8 in Table B-1);
- Definition of and Criteria for Identifying Hazardous Wastes (Item No. 9 in Table B-1);
- Hazardous Waste Land Disposal Restrictions (LDRs) (Item No. 10 in Table B-1);
- Land Use Controls (Item No. 11 in Table B-1); and
- California Integrated Waste Management Board (CIWMB) Requirements (Item No. 12 in Table B-1).

State requirements specific to Site 29 are found in Table B-2.

Action-specific requirements also include the following Federal requirements:

- Standards Applicable to Generators of Hazardous Waste (Item No. 5 in Table B-1);
- Underground Injection Control Program (Item No. 6 in Table B-1);
- Definition of and Criteria for Identifying Hazardous Wastes (Item No. 9 in Table B-1); and
- Hazardous Waste Land Disposal Restrictions (LDRs) (Item No. 10 in Table B-1).

The selected alternatives will comply with action-specific ARARs as annotated on Table B-1.

2.8.3 DOCUMENTATION OF OTHER SIGNIFICANT CHANGES FROM PROPOSED PLAN

Remedial actions for two former skeet range sites (Sites 81 and 102) were evaluated in the *OU2 FS* (Earth Tech 2005c), and included in the *OU2 Proposed Plan* (Earth Tech 2006a). Sites 81 and 102 are

former skeet ranges where skeet target debris scattered on the ground surface is contaminated with polycyclic aromatic hydrocarbons (PAHs), which were used as a clay binder in the targets for a short time in the 1940s. The Air Force, with concurrence from the USEPA, Cal/EPA DTSC, and Water Board, have determined that these two sites require further investigation to fully characterize the potential impact from the skeet target debris and lead shot. Therefore, these sites are not included in this ROD, but will be addressed in a future Edwards AFB ROD.

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3.0 Part 3: Responsiveness Summary

3.0 PART 3: RESPONSIVENESS SUMMARY

This Responsiveness Summary is intended to provide a summary of information about the views of the public regarding both the remedial alternatives and general concerns about OU2 submitted during the public comment period. The notice of the availability of the *OU2 Proposed Plan* (Earth Tech 2006a) to the public was published in local newspapers in September 2006. The public comment period was held from 31 August to 2 October 2006, and on-Base and off-Base public meetings were held on 28 September 2006. No public comments were received.

Appendix A

APPENDIX A

MEMORANDUMS FOR RECORD
OPERABLE UNIT 2

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE FLIGHT TEST CENTER (AFMC)
EDWARDS AIR FORCE BASE, CALIFORNIA

20 May 2004

MEMORANDUM FOR RECORD

SUBJECT: CERCLA Status of Site and AOCs, Operable Unit (OU) 2, Edwards AFB California.

The purpose of this letter is to clarify which sites at the South Base Operable Unit No. 2 (OU2) were closed as part of a Site Inspection Study, and which sites are active in the Remedial Investigation phase of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process as defined by the criteria contained in Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final, OSWER Directive 9355.3-01 (U S. Environmental Protection Agency 1988). This letter updates and supercedes the Memorandum for Record on the same subject dated 16 January 2003.

An investigation of OU2 at Edwards AFB was conducted between 1993 and 2000 under the Environmental Restoration Program (ERP). The investigation included both Site Inspection (SI) studies of locations identified under the Expanded Source Investigation/ RCRA Facility Assessment (ESI/RFA) as "Potential Release Locations (PRLs)" and Remedial Investigation of known release areas identified as "Sites".

To expedite the investigation process, a single document entitled "Remedial Investigation/Feasibility Study Work Plan, Sampling and Analysis Plan, and Health and Safety Plan, South Base Operable Unit No. 2, Edwards AFB, CA " (The Earth Technology Corporation [Earth Tech] 1993) was produced. This document included proposed Remedial Investigation (RI) activities at Sites that were previously investigated for which a source area for contaminants was identified, and proposed SI activities at PRLs, where no confirmation of a release existed.

The Sites included in the planning documents were 5, 14, and 15; the PRLs included were 22, 29, 69 through 112, and 218 through 223. PRLs 290, 291, 341, 364, 408, and 417, and Areas of Concern (AOCs) 458, 459, and 460 were added to OU2 after the initial planning documents were finalized. In 1997, all PRLs were redesignated AOCs or Sites by the Air Force.

AOCs (PRLs) 218 through 220, 222, 364, and 408, and Sites 15, 22, 71 through 75, 80, 82, 85, 88 through 92, 94, 95, 97 through 100, 104, 105, 108, 221, 223, and 341 were locations where the potential or actual release was from a petroleum-only source. The Kern County Environmental Health Services Department (KCEHSD) and the California Regional Water Quality Control Board (RWQCB) – Lahontan Region are overseeing the restoration, where required, of these sites. The Air Force has removed these Sites and AOCs from the CERCLA process.

AOCs 290, 291, 458, 459, and 460 and Sites 70, 77, 83, 93, 101, 103, and 109 were locations where no significant contamination was found during the SI. The Air Force will not carry these AOCs forward in the Remedial Investigation/Feasibility Study process and they will not be included in the OU2 Record of Decision.

Non-petroleum contaminants were detected at Sites 5, 14, 29, 69, 76, 78, 79, 81, 86, 96, 102, and 417. Contaminants were removed at Sites 78, 79, 96, and 417 as part of Interim Remedial Actions (IRAs). Sites 69, 78, 79, 81, 84, 87, 96, 102, 106, 107, 111, 112, and 417 had NFI letters signed by the RPMs, but were identified as having low levels of risk following the performance of human and ecological risk assessments for OU2. A Risk Management Meeting was held 10 December 2003 to evaluate if sufficient risk remained at the sites for them to be retained in the CERCLA process. As a result of this meeting, Sites 84, 87, 106, 107, 111, and 112 will be considered closed in the SI phase. Sites 78, 79, 96, and 417 will be administratively retained in the CERLA process to document the removals, but will be closed to further remedial action. Sites 29, 69, 81, and 102 will be retained for a Feasibility Study of remedial alternatives, along with Sites 5, 14, 76, and 86.

A summary table listing the CERCLA status of the Sites and AOCs in OU2 is attached. As discussed above, the decision to not carry Sites and AOCs forward in the Remedial Investigation/Feasiblity Study process is based on either the site containing only petroleum-derived waste, or the finding during the SI that the site contained no significant contamination.

If you have any questions or comments, please contact Mr. David Steckel at (661) 277-1474.

We, the undersigned, concur with the site status findings contained in this Memorandum.

20 MAY 04	5/20/04
DAVID E. STECKEL DATE	SHERYL LAUTH DATE
Remedial Project Manager	Remedial Project Manager
U.S. Air Force	U.S. Environmental Protection Agency, Region 9
5/20/04	5/20/04
JOHN A. O'KANE, JR DATE	ELIZABETH LAFFERTY DATE
Remedial Project Manager	Remedial Project Manager
California Department of Toxic Substances Control, Region 1	California Regional Water Quality Control Board, Region 6

1 Atch
CERCLA STATUS OF SITES AND AOCS IN SOUTH BASE OU2

CERCLA STATUS OF SITES AND AOCS IN SOUTH BASE OU2

		Primary Basis for No Further Investigation				
Site/AOC	Continue in RI/FS Process	Petroleum Only		No Significant Contamination		Date of No Further Investigation (NFI) Letter
		Finding	Supporting Reference	Finding	Supporting Reference	
Site 5	X	-		-	-	-
Site 14	X	-		-	-	-
Site 15	-	Note (a)	Reference (a)	-	-	-
Site 22	-	Note (a)	Reference (b)	-	-	8/28/97
Site 29	X	-	-	-	-	-
Site 69	X		-	Note (e)	-	8/28/97
Site 70	-	-	-	X	Reference (a)	2/8/96
Site 71	-	X	Reference (a)	-	-	-
Site 72	-	X	Reference (a)	-	-	6/30/98
Site 73	-	X	Reference (a)	-	-	6/30/98
Site 74	-	X	Reference (a)	-	-	-
Site 75	-	X	Reference (b)	-	-	8/20/98
Site 76	X	-	-	-	-	-
Site 77	-	-	-	X	Reference (e)	8/20/98
Site 78	X	-	-	Note (d)	-	6/30/98
Site 79	X	-	-	Note (d)	-	6/30/98
Site 80	-	X	Reference (b)	-	-	8/13/93
Site 81	X	-	-	Note (f)	-	2/8/96
Site 82	-	X	Reference (a)	-	-	-
Site 83	-	-	-	X	Reference (a)	2/8/96
Site 84	-	-	-	Note (c)	-	6/30/98
Site 85	-	Note (a)	Reference (a)	-	-	8/16/01
Site 86	X	-	-	-	-	-
Site 87	-	-	-	Note (c)	-	6/30/98
Site 88	-	X	Reference (a)	-	-	-
Site 89	-	X	Reference (a)	-	-	6/2/99
Site 90	-	X	Reference (b)	-	-	6/2/99
Site 91	-	X	Reference (b)	-	-	6/2/99
Site 92	-	X	Reference (b)	-	-	3/7/95
Site 93	-	-	-	X	Reference (a)	2/8/96
Site 94	-	X	Reference (a)	-	-	-
Site 95	-	X	Reference (a)	-	-	8/20/98
Site 96	X	-	-	Note (d)	-	6/1/01
Site 97	-	X	Reference (b)	-	-	8/20/98
Site 98	-	X	Reference (a)	-	-	6/30/98
Site 99	-	X	Reference (a)	-	-	8/20/98
Site 100	-	X	Reference (a)	-	-	6/30/98
Site 101	-	-	-	X	Reference (a)	6/30/98
Site 102	X	-	-	Note (f)	-	4/9/96
Site 103	-	-	-	X	Reference (a)	2/8/96
Site 104	-	X	Reference (c)	-	-	6/30/98
Site 105	-	X	Reference (a)	-	-	4/15/99
Site 106	-	-	-	Note (c)	-	2/28/97

		Primary Basis for No Further Investigation				
Site/AOC	Continue in RI/FS Process	Petroleum Only		No Significant Contamination		Date of No Further Investigation (NFI) Letter
		Finding	Supporting Reference	Finding	Supporting Reference	
Site 107	-	-	-	Note (c)	-	2/8/96
Site 108	-	X	Reference (a)	-	-	8/28/97
Site 109	-	-	-	X	Reference (f)	4/15/99
Site 110	-	Note (b)	-	-	-	8/28/97
Site 111	-	-	-	Note (c)	-	4/15/99
Site 112	-	-	-	Note (c)	-	2/8/96
AOC 218	-	X	Reference (a)	-	-	8/28/97
AOC 219	-	X	Reference (b)	-	-	8/27/97
AOC 220	-	X	Reference (b)	-	-	8/27/97
Site 221	-	X	Reference (a)	-	-	-
AOC 222	-	X	Reference (b)	-	-	8/27/97
Site 223	-	X	Reference (a)	-	-	-
AOC 290	-	-	-	X	Reference (a)	6/30/98
AOC 291	-	-	-	X	Reference (a)	6/30/98
Site 341	-	X	Reference (b)	-	-	8/13/93
AOC 364	-	Note (b)	Reference (b)	-	-	4/15/99
AOC 408	-	X	Reference (b)	-	-	8/27/97
AOC 417	X	-	-	Note (d)	-	6/30/98
AOC 458	-	-	-	X	Reference (d)	2/15/01
AOC 459	-	-	-	X	Reference (d)	2/15/01
AOC 460	-	-	-	X	Reference (d)	2/15/01

Notes:

(a) Underlying groundwater contamination is not site-related and is being administered using the source site.
(b) Site is now administered under the compliance program.
(c) Site was removed by Risk Management Meeting conducted 10 December 2003.
(d) Site is being administratively retained in CERCLA process to document completed IRA.
(e) Although site poses no current risk, it is being retained in CERCLA process due to presence of buried debris.
(f) Site retained in CERCLA process due to presence of contaminants discovered after NFI letter was approved for the site.

References:

(a) Informal Technical Information Reports have been prepared for each of these Sites and AOCs.
(b) Data regarding these Sites and AOCs is contained in UST reports to the Kern County Environmental Health Services Department.
(c) Data regarding these Sites and AOCs is contained in an Interim Removal Action completion report.
(d) Summary Reports have been prepared for each of these AOCs.
(e) This AOC was recommended for no further investigation in the *Expanded Source Investigation/RCRA Facility Assessment* for OU2
(f) The area encompassing Site 109 was excavated to create a borrow pit, so no remedial investigations were conducted.

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 95TH AIR BASE WING (AFMC)
EDWARDS AIR FORCE BASE, CALIFORNIA

17 September 2008

MEMORANDUM FOR DISTRIBUTION

FROM: 95 ABW/EMR
5 E. Popson Avenue
Edwards AFB CA 93524

SUBJECT: CERCLA Status of Sites and Areas of Concern (AOCs), Operable Unit (OU) 2, Edwards AFB, California

As a result of the August 2008 OU2 Record of Decision meeting with the Remedial Project Managers, this letter updates the latest status of each site and AOC at South Base, OU2. Sites and AOCs are classified as follows:

- Continue in Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as an action site (addressed in Feasibility Study, Proposed Plan [PP], and Record of Decision [ROD])
- Continue in CERCLA as a no-action site (addressed in PP, ROD)
- Excluded/removed from CERCLA based on
    - No contaminant release identified at conclusion of Site Inspection (SI)
    - Petroleum-only exclusion
    - Administratively closed

This letter updates and supercedes the Memorandum for Record on the same subject dated 20 May 2004.

Sites 5, 14, 29, 76, 81, 86, and 102 will continue in CERCLA as action sites in the OU2 ROD.

Sites 69, 78, 79, and 96, and AOC 417 will continue in CERCLA as no-action sites in the OU2 ROD. In the 20 May 2004 letter, Site 69 was listed as being retained in the CERCLA process due to buried debris. During an August 2008 meeting with the Remedial Project Managers, the site was removed from the CERCLA process because the debris at the site is inert homestead debris and should not be regulated by the Remedial Project Managers.

Sites 77, 83, 84, 87, 93, 101, 103, 106, 107, 109, 110, 111, and 112, and AOCs 290, 291, 458, 459, and 460 were removed from CERCLA because no contaminant release was identified at the conclusion of the Site Inspection phase.

Sites 15, 22, 71, 72, 73, 74, 75, 80, 82, 85, 88, 89, 90, 91, 92, 94, 95, 97, 98, 99, 100, 104, 105, 108, 221, 223, and 341, and AOCs 218, 219, 220, 222, 364, and 408 were excluded from CERCLA based on the petroleum-only exclusion.

A summary table listing the CERCLA status of the sites and AOCs in OU2 is attached.

If you have any questions or comments, please contact Mr. Ai Duong at 661-277-1474 or Ms. Rebecca Hobbs at 661-277-1409.

AI DUONG
Chief, Environmental Restoration Branch

1 Atch:
Status of CERCLA Sites, Edwards AFB, September 2008

DISTRIBUTION:

Mr. Joseph B. Healy, Jr
U.S. EPA, Region 9

Mr. John Harris
California EPA DTSC Office of Military Facilities

Mr. J. Cass
California RWQCB, Lahontan Region

Mr. Peter Phillips
URS Corporation

Status of CERCLA Sites
Edwards AFB
September 2008

Site/ AOC	Continue in CERCLA as Action Site (addressed in FS, PP, ROD)	Continue in CERCLA as No-Action Site (addressed in PP, ROD) (e) Risk Management Pending	Excluded/Removed from CERCLA based on: (a) No contaminant release identified at conclusion of SI (b) Petroleum-Only Exclusion (c) Administratively Closed – addressed by adjacent site (d) Administratively Closed – active site
		OU2	
5	X		
14	X		
15			X(b)
22			X(b)
29	X		
69		X	
70			X(a)
71			X(b)
72			X(b)
73			X(b)
74			X(b)
75			X(b)
76	X		
77			X(a)
78		X	
79		X	
80			X(b)
81	X		
82			X(b)
83			X(a)
84			X(a)
85			X(b)
86	X		
87			X(a)
88			X(b)
89			X(b)
90			X(b)
91			X(b)
92			X(b)
93			X(a)
94			X(b)
95			X(b)
96		X	
97			X(b)
98			X(b)
99			X(b)
100			X(b)
101			X(a)

Status of CERCLA Sites
Edwards AFB
September 2008

Site/ AOC	Continue in CERCLA as Action Site (addressed in FS, PP, ROD)	Continue in CERCLA as No-Action Site (addressed in PP, ROD) (e) Risk Management Pending	Excluded/Removed from CERCLA based on: (a) No contaminant release identified at conclusion of SI (b) Petroleum-Only Exclusion (c) Administratively Closed – addressed by adjacent site (d) Administratively Closed – active site
102	X		
103			X(a)
104			X(b)
105			X(b)
106			X(a)
107			X(a)
108			X(b)
109			X(a)
110			X(a)
111			X(a)
112			X(a)
218			X(b)
219			X(b)
220			X(b)
221			X(b)
222			X(b)
223			X(b)
290			X(a)
291			X(a)
341			X(b)
364			X(b)
408			X(b)
417		X	
458			X(a)
459			X(a)
460			X(a)

APPENDIX B

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR OPERABLE UNIT 2

TABLE B-1. APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS - OPERABLE UNIT 2
(Page 1 of 6)

Item No.	Requirement	Citation	Federal or State Requirement	Description	ARAR Determination	Comments	Applicable Sites
Chemical-specific ARARs							
1	Primary Drinking Water Standards (Non-zero MCLGs and MCLs)	Safe Drinking Water Act, 40 CFR Part 141, Sections 141.11, 141.50-.51, 141.61-.62	Federal	MCLGs are goals under the SDWA which are set at levels at which no adverse health effects will occur and allow an adequate margin of safety. MCLs are promulgated and enforceable maximum concentrations of drinking water priority pollutants that are set as closely as feasible to MCLGs, considering best technology, treatment techniques, and other factors. The NCP states that primary drinking water standards are legally applicable only to drinking water at the tap, but are relevant and appropriate as cleanup standards for groundwater and surface water that have been determined to be current or future drinking water sources. Under CERCLA 121(d)(2)(A), remedial actions shall attain MCLGs where relevant and appropriate. The NCP provides that where an MCLG has been set at a level of zero, the MCL for that contaminant shall be attained.	Relevant and appropriate	This regulation addresses drinking water-based cleanup standards for groundwater contaminant plumes at OU2. At Site 29, the standards will be used to assess if a release has occurred. The AF and State agree, in this particular case, that use of MCLs as cleanup standards, in conjunction with Institutional Controls, is protective of human health at OU2. Only State MCLs that are more stringent than Federal MCLs are ARARs. For the constituents at OU2, there are no State MCLs that are more stringent than Federal MCLs.	Sites 5/14, 29, 76, and 86
		40 CFR Part 300, Sections 300.430(e)(2)(i)(C) 22 CCR, Div. 4, Ch. 15, Articles 4, 4.5, and 5.5, Sections 64431 et seq., 64444	State	Establishes standards for public water supply systems, including primary MCLs. State MCLs must be at least as stringent as Federal MCLs. State MCLs are incorporated into State and Regional Water Quality Control Board Water Quality Control Plans as water quality objectives for protection of current and potential drinking water supply sources. MCLs are some of the applicable upper-end objectives for ambient groundwater and surface water where the water is a source of drinking water, as defined in the Water Quality Control Plans.			
2	Water Quality Control Plan, South Lahontan Basin (Basin Plan)	23 CCR Div. 4, Ch. 1, Article 6, Section 3950; Water Code Sections 13140 and 13240	State	The Porter-Cologne Water Quality Control Act established authority of the SWRCB and RWQCB to regulate discharges into Waters of the State. The Basin Plan establishes beneficial uses and the water quality criteria based upon such uses (water quality objectives). The Basin Plan serves to protect the beneficial uses and water quality of the surface and groundwater in the South Lahontan Basin.	Relevant and appropriate	The beneficial uses listed in Section 2 of the Basin Plan are relevant and appropriate.	Sites 5/14, 29, 76, and 86
Location-specific ARARs							
3	California Endangered Species Act	California Fish and Game Code, Div. 3, Ch. 1.5, Article 1, Sections 2050-2055; 14 CCR, Div. 1, Subdivision 3, Ch. 6, Article 1, Section 783.1	State	Establishes species, subspecies, and varieties of native California plants or animals as endangered, threatened, or rare. Prohibits the taking, importation, or sale of any species, or any part thereof, of an endangered species or a threatened species. Contains provisions concerning CDFG coordination and consultation with State and Federal agencies and with project applicants. Recommends avoidance of adverse impacts on species of special concern and their habitat.	Relevant and appropriate	Potentially an ARAR where the State law has a listing that is more stringent than the Federal Endangered Species Act and Migratory Bird Treaty Act. As stated in Air Force Instruction 32-7064, dated 17 September 2004, State-protected species will be protected when practicable and the appropriate State authority will be contacted if conflicts arise. State may provide procedures for minimization of impacts and harm to species.	Site 29

Note: The respective positions of the Air Force, USEPA, and Water Board regarding the ARARs included in the table are presented in more detail in Section 2.8.2.

TABLE B-1. APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS - OPERABLE UNIT 2
(Page 2 of 6)

Item No.	Requirement	Citation	Federal or State Requirement	Description	ARAR Determination	Comments	Applicable Sites
Location-specific ARARs (continued)							
4	Wildlife Species/Habitats	California Fish and Game Code; Div.3, Ch. 1, Section 2000; Div. 4, Part 1, Ch. 1, Section 3005, Part 2, Ch.1, Sections 3511 and 3513; and Div. 9, Ch.1, Section 12000 et seq. 14 CCR, Div. 1, Subdivision 2, Ch. 1, Section 250; Ch. 7, Section 507; Subdivision 3, Ch. 1, Section 650	State	Prohibits the taking of birds and mammals, except as otherwise provided in the Fish and Game Code and 14 CCR.	Relevant and appropriate	As stated in Air Force Instruction 32-7064, dated 17 September 2004, State-protected species will be protected when practicable and the appropriate State authority will be contacted if conflicts arise. State may provide procedures for minimization of impacts and harm to species.	All sites
Action-specific ARARs							
5	Standards Applicable to Generators of Hazardous Waste	40 CFR Part 262	Federal	These regulations apply to generators of hazardous waste. Edwards AFB is a large quantity generator of hazardous waste (EPA ID CA1570024504) and already subject to these requirements.	Applicable if wastes are hazardous as defined by 22 CCR.	Applicable to waste generated during remedial actions if these wastes are hazardous. Substantive requirements are potentially ARARs if excavated soils or treatment residuals exceed RCRA or [1]California hazardous waste thresholds. Hazardous remediation waste may be stored onsite in Corrective Action Temporary Units. These Corrective Action Temporary Units are not subject to the less than 90-day accumulation time requirement. Temporary units may operate for one year with an opportunity for a 1-year extension. Soil cuttings will be generated during well installation at Sites 5/14, 76, and 86; however, the soils at these sites have been historically evaluated to be non-hazardous. The GAC generated from the Site 14 Groundwater Extraction and Treatment System that will be operated as part of the remedial action at Sites 5/14 has historically not been hazardous. Hazardous wastes may be encountered during surface debris removal at Site 29. No hazardous soil cuttings will be generated by the enhancement to the drainage system around Site 29.	All sites
		22 CCR, Div. 4.5, Ch. 12, Articles 1-4, Sections 66262.10-.47	State	Establishes standards for generators of RCRA and California[(1)] hazardous wastes, including those for hazardous waste determination, accumulation, identification numbers, manifesting, pre-transport, and record keeping and reporting requirements.			

Note: The respective positions of the Air Force, USEPA, and Water Board regarding the ARARs included in the table are presented in more detail in Section 2.8.2.

TABLE B-1. APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS - OPERABLE UNIT 2
(Page 3 of 6)

Item No.	Requirement	Citation	Federal or State Requirement	Description	ARAR Determination	Comments	Applicable Sites
6	Underground Injection Control Program	40 CFR Parts 144, 146, 147, Sections 144.13(c) 144.82-.83, 144.89; Sections 146.5 and 146.10; Section 147.251	Federal	Protects groundwater from contamination by subsurface emplacement of fluids. According to Section 144.13(c), wells used to reinject contaminated groundwater that has been treated into the same formation from which it was drawn are not prohibited if such injection is approved by EPA, or a State, pursuant to provisions for cleanup of releases under CERCLA, 42 U.S.C. 9601–9657, or pursuant to requirements and provisions under RCRA, 42 U.S.C. 6901 through 6987. Wells for injection of treatment chemicals or treated groundwater are designated Class V wells according to Section 146.5. Section 144.82 prohibits the movement of fluid containing any contaminant into an underground source of drinking water if it would cause a violation of primary drinking water standards under 40 CFR Part 141, or other health-based standards, or may otherwise adversely affect the health of persons. Injection well closure must prohibit emplaced fluid movement. States and EPA Regions may establish more stringent requirements if needed to protect underground sources of drinking water. Section 144.83 specifies inventory requirements for the operation of injection wells. Section 144.89 contains well closure requirements. Section 146.10 contains well plugging and abandonment requirements. Section 147.251 states that EPA administers the UIC program in California for Class V wells.	Applicable	Substantive portions are applicable to the injection of treatment chemicals in the Sites 5/14, 76, and 86 plumes. Reinjection of treated groundwater qualifies for the exemption in Section 144.13(c) for groundwater treatment systems.	Sites 5/14, 76, and 86
7	Statement of Policy with Respect to Maintaining High Quality of Waters in California (Nondegradation Policy)	SWRCB Resolution Number 68-16 (23 CCR Section 2900)	State	Resolution No. 68-16 (nondegradation policy) has been incorporated into all Regional Board Basin Plans, including the Regional Water Quality Control Board - Lahontan Region Basin Plan. This resolution requires that the quality of waters of the State that is better than needed to protect all beneficial uses be maintained unless certain findings are made. Discharges to high quality waters must be treated using best practicable treatment or control necessary to prevent pollution or nuisance and to maintain the highest quality water. This resolution also requires cleanup to background quality or lowest concentrations technically and economically feasible to achieve. Beneficial uses, at a minimum, must be protected.	Applicable	State Water Resources Control Board Resolution 68-16 is an ARAR for the injection of any treatment chemicals, or any reagent into groundwater to treat contaminants.	Sites 5/14, 76, and 86
8	Sources of Drinking Water Policy	SWRCB Resolution No. 88-63; Porter-Cologne Water Quality Act (CWC Sections 13000, 13140, 13240); H&S Code Section 25356.1.5 (a)	State	Resolution 88-63 has been incorporated into all Regional Board Basin Plans, including the Regional Water Quality Control Board - Lahontan Region Basin Plan. This resolution designates all groundwater and surface waters of the State as drinking water except where the TDS is greater than 3,000 ppm, the well yield is less than 200 gpd from a single well, the water is a geothermal resource or in a wastewater conveyance facility, or the water cannot reasonably be treated for domestic use using either best management practices or best economically achievable treatment practices.	Applicable	The AF agrees with the designation of the current and potential use of the groundwater for this OU as drinking/domestic use.	Sites 5/14, 29, 76, and 86

Note: The respective positions of the Air Force, USEPA, and Water Board regarding the ARARs included in the table are presented in more detail in Section 2.8.2.

TABLE B-1. APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS - OPERABLE UNIT 2
(Page 4 of 6)

Item No.	Requirement	Citation	Federal or State Requirement	Description	ARAR Determination	Comments	Applicable Sites
9	Definition of and Criteria for Identifying Hazardous Wastes	40 CFR 261.3 22 CCR, Div. 4.5, Ch. 11, Article 1, Sections 66261.2-.3; Articles 3, Sections 66262.24 -.33; Article 5, Sections 66261.100-.101	Federal State	Defines wastes that are subject to regulation as a RCRA or [1]California hazardous waste. Excavated contaminated soil, extracted groundwater, and spent treatment residuals (e.g., granular activated carbon) must be classified using AF knowledge of the timing and nature of the release as well as waste toxicity characteristic testing. If, after good faith effort, the AF determines that the contaminated soil or groundwater contains a listed RCRA or [1]California hazardous waste or fails the Federal or State toxicity characteristic tests, then the excavated soil or extracted groundwater is considered hazardous based on EPA's "contained-in" policy and must be managed as hazardous remediation waste. Contaminated soils or groundwater that are treated *in situ* are not subject to the identification or classification requirements.	Applicable if wastes are hazardous as defined by 22 CCR.	The definitions of hazardous waste in Article 1 and toxicity characteristic criteria (i.e., TTLC and STLC levels) in Section 66261.24 are applicable for the characterization of soil cuttings from well installation, as well as purge water and spent carbon from groundwater monitoring and onsite water treatment. Soil cuttings will be generated during well installation at Sites 5/14, 76, and 86; however, the soils at these sites have been historically evaluated to be non-hazardous. The GAC generated from the Site 14 Groundwater Extraction and Treatment System that will be operated as part of the remedial action at Sites 5/14 has historically not been hazardous. Hazardous wastes may be encountered during surface debris removal at Site 29. No hazardous soil cuttings will be generated by the enhancement to the drainage system around Site 29.	All sites
10	Hazardous Waste Land Disposal Restrictions (LDR)	40 CFR Part 268 22 CCR, Div. 4.5, Ch. 18, Section 66268	Federal State	Identifies hazardous wastes that are restricted from land disposal without prior treatment to UTS. Hazardous remediation wastes that are managed off-site are subject to the LDR UTS specified in Section 66268 for wastewater (liquid) and non-wastewater (solid). Hazardous soils must be treated to 90% reduction in concentration capped at 10 times the UTS for principal hazardous constituents (90% capped at 10 x UTS). Onsite treatment or disposal of hazardous remediation wastes are not strictly subject to the LDR treatment standards, but are subject to similar treatment standards specified in the Corrective Action Management Unit Amendment Rule codified in 40 CFR 264.550-.555 and 22 CCR 66264.550-.553.	Applicable if wastes are hazardous as defined by 22 CCR.	LDR applicable to off-site disposal of soil cuttings, treated groundwater, and spent carbon if these remediation wastes are RCRA or [1]California hazardous waste, as determined through toxicity characteristic testing using TCLP and TTLC/STLC. Soil cuttings will be generated during well installation at Sites 5/14, 76, and 86; however, the soils at these sites have been historically evaluated to be non-hazardous. The GAC generated from the Site 14 Groundwater Extraction and Treatment System that will be operated as part of the remedial action at Sites 5/14 has historically not been hazardous. Hazardous wastes may be encountered during surface debris removal at Site 29. No hazardous soil cuttings will be generated by the enhancement to the drainage system around Site 29.	All sites

Note: The respective positions of the Air Force, USEPA, and Water Board regarding the ARARs included in the table are presented in more detail in Section 2.8.2.

TABLE B-1. APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS - OPERABLE UNIT 2
(Page 5 of 6)

Item No.	Requirement	Citation	Federal or State Requirement	Description	ARAR Determination	Comments	Applicable Sites
11	Land Use Controls	22 CCR, Div. 4.5, Ch. 39, Section 67391.1, Civil Code Section 1471	State	Requires that if a remedy will result in hazardous substances remaining on a property at levels not suitable for unlimited use and unrestricted exposure, the limitations or controls are clearly set forth and defined in the response action decision document, and that the decision document include an implementation and enforcement plan. In the event of a property transfer, requires the State to enter into restrictive land use covenants with land-owners and their successors, with exceptions for Federal-to-Federal property transfers.	Relevant and appropriate	Institutional controls, limiting exposure to contaminated groundwater, are required at OU2 Sites 5/14, 76, and 86 until hazardous substance concentrations in groundwater are suitable for unlimited use and unrestricted exposure. Institutional controls will be required at Site 29 as long as the buried waste remains in place due to the potential that buried UXO is present in the landfill. Institutional controls will be required at Site 14 until soil vapor contaminants are assessed to be at levels to allow for unlimited use and unrestricted exposure. Although it is not contemplated that property at OU2 will be transferred, in the event that such property is transferred, the AF and the State have agreed to follow the procedure laid out in the Basewide Land Use Control Implementation Plan. EPA agrees that the substantive portions of the regulation referenced are ARARs. EPA specifically considers sections (a), (d), (e), and (f) of 22 CCR, Section 67391.1 to be ARARs for this ROD. DTSC's position is that all of the state regulation is an ARAR.	Sites 5/14, 29, 76, and 86
12	California Integrated Waste Management Board (CIWMB) Requirements	27 CCR, Division 2, Subdivision 1, Chapter 1, Article 1; Chapter 3, Subchapter 2-5, Sections 20200 through 21420	State	Requirements for non-hazardous waste management units. These regulations also replace those codified by SWRCB in Title 23, Division 3, Chapter 15 regarding cleanup of hazardous waste discharges, including remedial action groundwater monitoring requirements. Requirements include classification, design, siting, construction, operation, monitoring, and closure and post-closure care. Sets forth the performance standards and the minimum substantive requirements for proper closure, post-closure maintenance, and ultimate reuse of solid waste disposal sites to assure that public health and safety and the environment are protected from pollution due to the disposal of solid waste. Sets up narrative standards for the cleanup of discharges of hazardous wastes to Waters of the State in accordance with SWRCB Resolution 92-49, Section III.G.	Relevant and appropriate	Relevant and appropriate for onsite facilities that manage non-hazardous remediation wastes. Portions of these regulations are more stringent than 40 CFR Part 258 for landfills without liner systems. Units that were closed, abandoned, or inactive (CAI) before November 27, 1984 (CAI Units) may not need to meet all of the Closure and Post-Closure Maintenance requirements of CCR, Title 27. Chapter 1, Article 1, Section 20090 exempts CERCLA remedial actions taken at unauthorized waste discharge sites from SWRCB provisions of this subdivision provided that wastes removed from the sites are discharged according to Section 20200 et seq. and that wastes contained at the release sites follow applicable SWRCB provisions of this division to the extent feasible. Section 20080(b) allows for engineered alternatives to the prescriptive cover requirements in Subch. 5 if the prescriptive cover standards are not feasible and the alternative is both consistent with the performance goals and affords equivalent protection. The performance standards in Chapter 3, Subch. 5, Article 1, Section 20950(a)(2)(A) apply to closure and post-closure care for disposal sites closed as a landfill (i.e., with wastes contained in place). The performance standard in Section 20950(a)(2)(B) applies to disposal sites that are clean-closed (i.e., all wastes removed from the disposal sites).	Site 29

Note: The respective positions of the Air Force, USEPA, and Water Board regarding the ARARs included in the table are presented in more detail in Section 2.8.2.

Notes:

[1] California hazardous waste (as used in this table) is the same as non-RCRA hazardous waste as defined in Section 66261.101 of CCR Title 22.

AF	Air Force
AFB	Air Force Base
ARARs	Applicable or Relevant and Appropriate Requirements
Basin Plan	Water Quality Control Plan for Lahontan Region
CAI	closed, abandoned, or inactive
CCR	California Code of Regulations
CDFG	California Department of Fish and Game
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
Ch.	Chapter
CIWMB	California Integrated Waste Management Board
CWC	California Water Code
Div.	Division
e.g.	*exempli gratia* (for example)
EPA	Environmental Protection Agency
et seq.	*et sequentes* (and the following)
GAC	granular activated carbon
gpd	gallons per day
H&S	health and safety
ID	identification
i.e.	*id est*, that is
LDR	land disposal restriction
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
NCP	National Contingency Plan
No.	number
OU2	Operable Unit 2
ppm	parts per million
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
RWQCB	Regional Water Quality Control Board
SDWA	Safe Drinking Water Act
STLC	soluble threshold limit concentration
Subch.	subchapter
SWRCB	State Water Resources Control Board
TCLP	toxic characteristic leaching procedure
TDS	total dissolved solids
TEFA	Technical and Economic Feasibility Analysis
TTLC	total threshold limit concentration
UIC	Underground Injection Control
U.S.C.	United States Code
UTS	universal treatment standard
UXO	unexploded ordnance

Note: The respective positions of the Air Force, USEPA, and Water Board regarding the ARARs included in the table are presented in more detail in Section 2.8.2.

TABLE B-2. PORTIONS OF TITLE 27, CALIFORNIA CODE OF REGULATIONS APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR SITE 29

Citation	Description	ARAR Determination	Comments
§20080(b, c, and g)	Allows for engineered alternatives to State Prescriptive Cover that afford equivalent protection against water quality impairment. Allows for demonstration that meeting the equivalent protection requirement is unreasonably and unnecessarily burdensome, or will cost substantially more than alternatives which meet the criteria, or is impractical and will not promote attainment of applicable performance standards. Defines Closed, Abandoned, or Inactive (CAI) units as those which were closed, abandoned, or inactive on or before November 27, 1984.	Applicable	During preparation of the Remedial Action Work Plan, a technical evaluation, which will include an evaluation of historical groundwater monitoring data, and the thickness and hydraulic conductivity of the existing cover, will be performed to assess if the existing cover of the landfill isolates the waste and is protective of groundwater quality. During the Remedial Action phase, necessary improvements or repairs to the landfill cover will be made, including, but not limited to, regrading to prevent ponding or exposure of previously buried material, to assure the cover will continue to isolate the waste and protect the groundwater at least as well as would a final cover built in accordance with applicable prescriptive standards under Title 27, Section 21090(a)(1-3) In this particular case, Site 29 will be treated as a CAI unit because presumably any waste deposited post November 27, 1984, is inert waste and closure will comply with California Code of Regulations, Title 27, Section 21090(a)(1) through (a)(4).
§20380 Water monitoring	Specifies detection, evaluation, and corrective action program requirements. Defines the required monitoring programs and their triggers. An evaluation monitoring program would be required to assess when a "measurably significant" release" occurs as defined in California Code of Regulations, Title 27, Section 20164.	Relevant and appropriate	During the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Remedial Investigation/Feasibility Study (RI/FS) phase, the Air Force sampled and analyzed the groundwater at Site 29, and therefore has met the intent of the Municipal Solid Waste Landfill (MSWLF) detection program requirements incorporated by reference in Title 27 (40 Code of Federal Regulations [CFR] 258.54-258.56) to monitor for "applicable" or "approved" Appendix II constituents. The selected alternative includes continued detection monitoring using 40 CFR 258 Appendix I constituents and would use the non-administrative portions of §20380 *et seq* in evaluating if a measurably significant release has occurred and in implementing a response if determined necessary in consultation with the USEPA, Cal/EPA Department of Toxic Substances Control, and Water Board.

TABLE B-2. PORTIONS OF TITLE 27, CALIFORNIA CODE OF REGULATIONS APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR SITE 29

Citation	Description	ARAR Determination	Comments
§20380 Water monitoring *(Continued)*	Specifies detection, evaluation, and corrective action program requirements. Defines the required monitoring programs and their triggers. An evaluation monitoring program would be required to assess when a "measurably significant" release" occurs as defined in California Code of Regulations, Title 27, Section 20164. *(Continued)*	Relevant and appropriate *(Continued)*	If the detection monitoring program shows a measurably significant release to the groundwater, as defined in California Code of Regulations, Title 27, Section 20164, the Air Force will institute an evaluation monitoring program pursuant to California Code of Regulations, Title 27, Section 20425. If the evaluation monitoring program shows the release exceeds water quality standards, the Air Force will re-evaluate the remedy for Site 29 in accordance with CERCLA.
§20415 General water quality monitoring and system requirements	Specifies actions and requirements for developing and implementing groundwater monitoring and response action programs.	Relevant and appropriate	§20415 would be used to develop the monitoring program for all active remedial alternatives. A general description of the monitoring program is included in this Record of Decision (ROD); greater details concerning the program will be contained in the Remedial Action Work Plan.
§20420 (b) Detection monitoring program	Requires installation of water quality monitoring systems that are appropriate for detecting, at the earliest possible time, a release from the Unit, and that comply with applicable provisions of §20415.	Relevant and appropriate	The detection monitoring program will be developed as part of the Remedial Action Work Plan for Site 29.
§21090(a)(1) – (a)(4) Closure and Post-Closure Maintenance Requirements for Solid Waste Landfills	Requires Alternative final cover designs to isolate the waste in the unit from precipitation and irrigation waters at least as well as a final cover built in accordance with: (1) Foundation Layer – consisting of at least two feet of appropriate material compacted to optimum moisture content,	Relevant and appropriate	The final closure and post closure maintenance plan will be developed as part of the Remedial Action Work Plan for Site 29. The final cover design will be demonstrated to comply with this standard.

TABLE B-2. PORTIONS OF TITLE 27, CALIFORNIA CODE OF REGULATIONS APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR SITE 29

Citation	Description	ARAR Determination	Comments
	(2) Low Hydraulic Conductivity Layer – consisting of at least one foot of soil with no waste placed on top of the foundation layer and compacted to attain a hydraulic conductivity of 1×10^{-6} centimeters per second (cm/sec) with a plan to protect the cover layer integrity from foreseeable damage, (3) Erosion Resistant Layer – consisting of either (a) vegetative layer of at least one foot of soil capable of sustaining plants, is initially planted, and replanted as needed, or (b) mechanical layer that is erosion and ultraviolet light resistant, and (4) Cover Maintenance Plan – that includes, as a minimum, (1) periodic leak search, (2) periodic identification of other problems, (3) prompt cover repair, and (4) vegetation maintenance.		

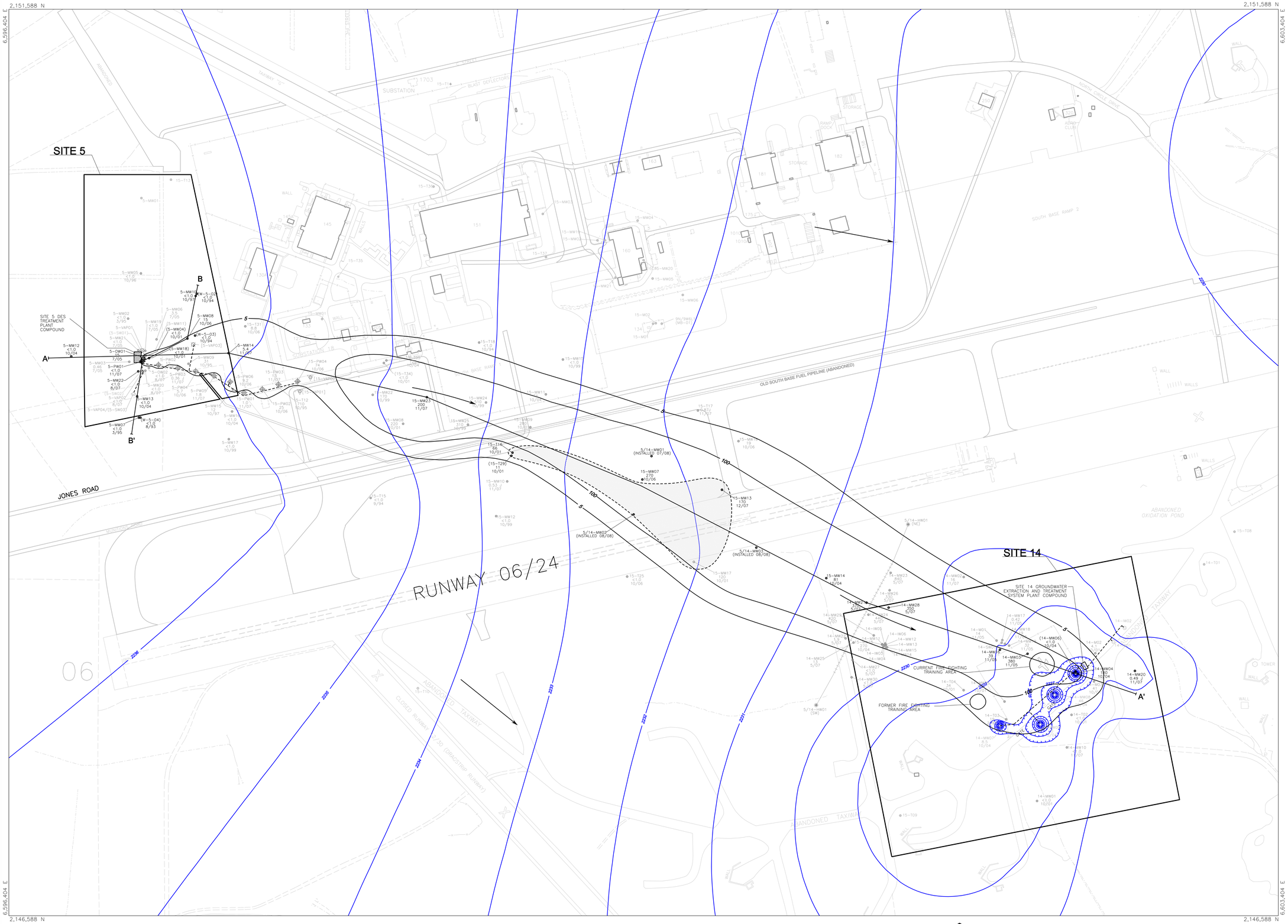
Notes:

§	Section	cm/sec	centimeters per second
CAI	closed, abandoned, or inactive	MSWLF	Municipal Solid Waste Landfill
Cal/EPA	California Environmental Protection Agency	RI/FS	Remedial Investigation/Feasibility Study
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act	ROD	Record of Decision
CFR	Code of Federal Regulations	USEPA	United States Environmental Protection Agemcy

Plate 1

PLATE

PLATE 1 EXTENT OF TCE CONTAMINATION AND FREE-PRODUCT IN GROUNDWATER (NOV/DEC 2007), SITES 5/14 CONTAMINANT PLUME



EXPLANATION

- EXISTING MONITORING WELL OR OBSERVATION WELL
- EXISTING VAPOR EXTRACTION WELL
- EXISTING DUAL EXTRACTION WELL
- EXISTING GROUNDWATER INJECTION WELL
- EXISTING GROUNDWATER EXTRACTION WELL
- EXISTING VAPOR MONITORING WELL
- EXISTING AIR SPARGING WELL
- EXISTING NESTED AIR SPARGING/VAPOR EXTRACTION WELL
- ABANDONED MONITORING WELL
- HORIZONTAL WELL SURFACE COMPLETION
- HORIZONTAL WELL CASING
- HORIZONTAL WELL SCREEN
- 14–MW20 — WELL ID; <0.47 — TCE CONCENTRATION IN MICROGRAMS PER LITER; 11/07 — DATE SAMPLED
- (5–MW18) — WELL SCREENED BELOW WATER TABLE.
- [5–VAPO3] — WELL SCREENED ABOVE WATER TABLE.
- EXTRACTION SYSTEM PIPING
- FREE–PRODUCT PLUME (NOVEMBER/DECEMBER 2007)
- 5 — EXTENT OF DISSOLVED PHASE TCE CONTAMINATION (EQUICONCENTRATION CONTOUR IN MICROGRAMS PER LITER)
- 2233 — GROUNDWATER ELEVATION CONTOUR (FEET ABOVE MEAN SEA LEVEL)
- GROUNDWATER FLOW DIRECTION
- A'—A' — CROSS SECTION

ABBREVIATIONS

ID	IDENTIFICATION
J	ESTIMATED CONCENTRATION; BELOW THE LABORATORY REPORTING LIMIT
TCE	TRICHLOROETHENE

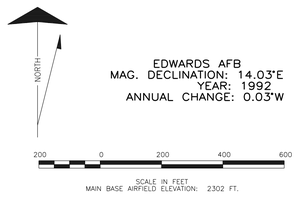
NOTES

WELLS IN GRAY WERE NOT SAMPLED IN NOVEMBER OR DECEMBER 2007 OR ARE NOT ASSOCIATED WITH THE SITES 5/14 CONTAMINANT PLUME.

WELLS 14–MW2, 14–MW3, 14–TO2, 14–TO3, 14–TO4, 15–TO5, 15–T12, 15–T18, 15–T29, 15–T31, AND 15–T34 BASED ON GLOBAL POSITIONING SYSTEM (GPS) SURVEY.

STATE PLANE COORDINATES ARE IN NORTH AMERICAN DATUM 1983.

WELLS NOT USED FOR CONTOURING INCLUDE:
15–T12, LAST SAMPLED IN 10/95, POSTED TCE CONCENTRATIONS ARE NOT CONSIDERED REPRESENTATIVE OF CURRENT CONDITIONS.
14–MW05, LAST SAMPLED 10/01, POSTED TCE CONCENTRATION IS NOT CONSIDERED REPRESENTATIVE OF CURRENT CONDITIONS.
14–MW01, 14–MW16, 14–MW17, 14–MW18, AND 14–MW19; POSTED TCE CONCENTRATIONS INFLUENCED BY PILOT TEST PERFORMED BETWEEN 08/05 AND 11/05.



EDWARDS AFB
MAG. DECLINATION: 14.03°E
YEAR: 1992
ANNUAL CHANGE: 0.03°W

MAIN BASE AIRFIELD ELEVATION: 2302 FT.

OU2 ROD

EXTENT OF TCE CONTAMINATION AND FREE-PRODUCT IN GROUNDWATER (NOV/DEC 2007) SITES 5/14 CONTAMINANT PLUME

DRAWN BY: TVS	DESIGNED BY: KWE	SCALE: 1"= 200'
CHECKED BY: KWE	APPROVED BY: KWE	DATE: 02–2009
PROJECT NUMBER 102133	PLATE 1	REV. NO. A01

EDWARDS\ 101302\B6985MPB.A01