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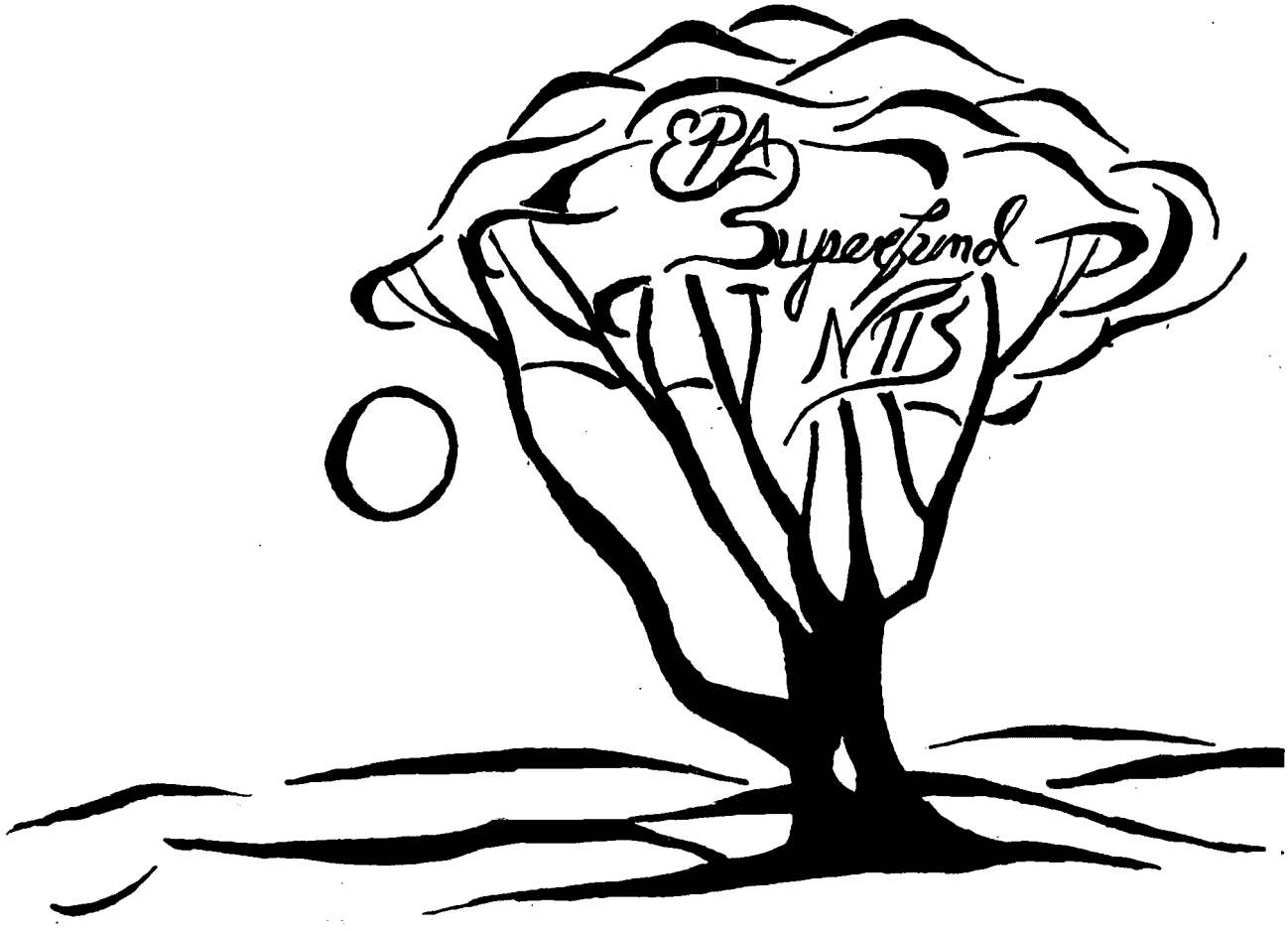
July 1994

EPA Superfund Record of Decision:

George Air Force Base (O.U. 1) Site, CA, 3/8/1994



INSTALLATION RESTORATION PROGRAM

FINAL
RECORD OF DECISION
OPERABLE UNIT 1

GEORGE AIR FORCE BASE
CALIFORNIA

Prepared For:

U.S. Army Corps of Engineers
Sacramento District
Sacramento, California

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March 1994

RECORD OF DECISION
OPERABLE UNIT 1
GEORGE AIR FORCE BASE

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ACRONYMS AND ABBREVIATIONS

AFBCA	Air Force Base Conversion Agency
APCD	Air Pollution Control District
AQMD	Mojave Air Quality Management District
ARARs	applicable or relevant and appropriate requirements
ARB	Air Resources Board
bgs	below ground surface
CAO	Cleanup and Abatement Order
CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
cfs	cubic feet per second
CMP	corrugated metal pipe
CRP	Community Relations Plan
DHS	Department of Health Services
DTSC	Department of Toxic Substances Control
DWR	California Department of Water Resources
EIS	Environmental Impact Statement
ESA	Endangered Species Act
ET	evapotranspiration
FFA	Federal Facility Agreement
FS	Feasibility Study
GAC	granular activated carbon
GAFB	George Air Force Base
gpd/ft	gallons per day per foot
gpd	gallons per day
gpm	gallons per minute
HWM	Hazardous Waste Management
IRP	Installation Restoration Program
LF	linear feet
MCL	maximum contaminant level
MCLG	maximum contaminant level goals
mph	miles per hour
msl	mean sea level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEDA	Northeast Disposal Area
NPL	National Priorities List
OAQPS	Office of Air Quality Planning and Standards
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
PID	photoionization detector
PPE	personal protective equipment
RAB	Restoration Advisory Board
RCP	reinforced concrete pipe
RCRA	Resource Conservation and Recovery Act of 1976

ACRONYMS AND ABBREVIATIONS
(Continued)

RD/RA	Remedial Design/Remedial Action
RME	reasonable maximum exposure
ROD	Record of Decision
RSA	regional statistical area
RWQCB	Regional Water Quality Control Board
SAL	State Action Levels
SARA	Superfund Amendments and Reauthorization Act
scfm	standard cubic feet per minute
SDWS	secondary Drinking Water Standards
SHMP	sodium hexamethaphosphate
SIP	State Implementation Plans
SMCL	secondary maximum contaminant level
STP	Sewage Treatment Plant
TBC	to-be-considered
TCE	trichloroethene
TM	Technical Memorandum
TMV	toxicity, mobility, and volume
TPY	tons per year
TRC	Technical Review Committee
USAF	U.S. Air Force
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VOC	volatile organic compound
VVWRA	Victor Valley Wastewater Reclamation Authority

1.0 DECLARATION

1.1 SITE NAME AND LOCATION

George Air Force Base
Operable Unit 1
San Bernardino County, California

1.2 STATEMENT OF BASIS AND PURPOSE

This decision document, a Record of Decision (ROD), presents the selected remedial action for Operable Unit (OU) 1 at George Air Force Base (GAFB), which was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). OU 1 includes groundwater beneath the northeastern portion of GAFB (Northeast Disposal Area [NEDA]) and adjacent off-base areas, the Industrial/Storm Drain (site SD-25[S-20]), and the Sewage Treatment Plant (STP) Percolation Ponds (site WP-26[S-21]). This decision is based on the administrative record for this site and complies with 40 Code of Federal Regulations (CFR), Part 300.

The purpose of this ROD is to set forth the remedial action to be conducted to remediate groundwater contaminated by trichloroethene (TCE) beneath the NEDA and adjacent off-base areas. No further action is planned for sites SD-25 (S-20), the Industrial/Storm Drain, and WP-26 (S-21), the STP Percolation Ponds, which are also included in OU 1, as these sites were within acceptable risk levels based upon the risk assessment performed as part of the remedial investigation (JMM, 1992a).

The U.S. Air Force (USAF), Environmental Protection Agency (USEPA) Region IX, and the State of California concur with the selected remedy.

1.3 ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the remedial action presented in this ROD, may present a risk to public health, welfare, or the environment.

1.4 DESCRIPTION OF THE SELECTED REMEDY

Based on alternatives evaluated in the Feasibility Study (FS) (JMM, 1993a), the USAF, the USEPA, and the State of California have selected Alternative 2 as the remedy for the TCE-contaminated groundwater beneath and adjacent to the NEDA at GAFB, OU 1. The selected remedy, designed to be implemented in two phases (Phase I has been completed), consists of:

- installation of an estimated 19 groundwater extraction wells, the exact number to be determined based on Phase I system efficiency;

- groundwater treatment using two air stripping towers with direct discharge of emissions to the atmosphere;

- discharge of treated water to the Upper Aquifer using the former STP Percolation Ponds;

- temporary discharge of treated water to an arroyo during the treatability study and potential future discharge to the base golf course;

- installation and quarterly sampling of an estimated eight new monitoring wells in conjunction with basewide groundwater monitoring, the exact number to be determined based on Phase I system efficiency; and

- implementation of deed restrictions as appropriate to prohibit use of groundwater until groundwater cleanup levels have been achieved.

No further action is required for the Industrial/Storm Drain and STP Percolation Ponds to protect public health, welfare, or the environment.

1.5 STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment technology to the maximum extent practicable, and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, and volume (TMV) as a principal element. The estimated restoration time frame for the selected remedy is 30 years. A review of this ROD will be conducted every 5 years to ensure that the remedy continues to provide adequate protection of human health and the environment.

1.6 SIGNATURES

John Wise — 3.8.94

John Wise
Deputy Regional Administrator
Environmental Protection Agency
Region IX

Date

Alan K. Olsen
Director
Air Force Base Conversion Agency

Date

Anthony J. Landis
DSMOA Technical Program Manager
State of California
Department of Toxic Substances Control

Date

Harold Singer
Executive Officer
California Regional Water Quality Control Board
Lahontan Region

Date

1.6 SIGNATURES

John Wise Deputy Regional Administrator Environmental Protection Agency Region IX	Date
Alan K. Olsen Director Air Force Base Conversion Agency	March 5, 1994 Date
Anthony J. Landis DSMOA Technical Program Manager State of California Department of Toxic Substances Control	Date
Harold Singer Executive Officer California Regional Water Quality Control Board Lahontan Region	Date

1.6 SIGNATURES

John Wise Deputy Regional Administrator Environmental Protection Agency Region IX	Date
Alan K. Olsen Director Air Force Base Conversion Agency	Date
Anthony J. Landis DSMOA Technical Program Manager State of California Department of Toxic Substances Control	3-7-94 Date
Harold Singer Executive Officer California Regional Water Quality Control Board Lahontan Region	Date

1.6 SIGNATURES

John Wise
Deputy Regional Administrator
Environmental Protection Agency
Region IX

Date

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Director
Air Force Base Conversion Agency

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Anthony J. Landis
DSMOA Technical Program Manager
State of California
Department of Toxic Substances Control

Robert G. Lodge

March 7, 1994

Date

for Harold Singer
Executive Officer
California Regional Water Quality Control Board
Lahontan Region

2.0 DECISION SUMMARY

This decision summary provides a description of OU 1 including the regional setting, physiography, meteorology, demography and land use, hydrology, hydrogeology, and water use. This section also summarizes the problems posed by the conditions at OU 1, the remedial alternatives, and the rationale for the selection and how the selected remedy satisfies statutory requirements.

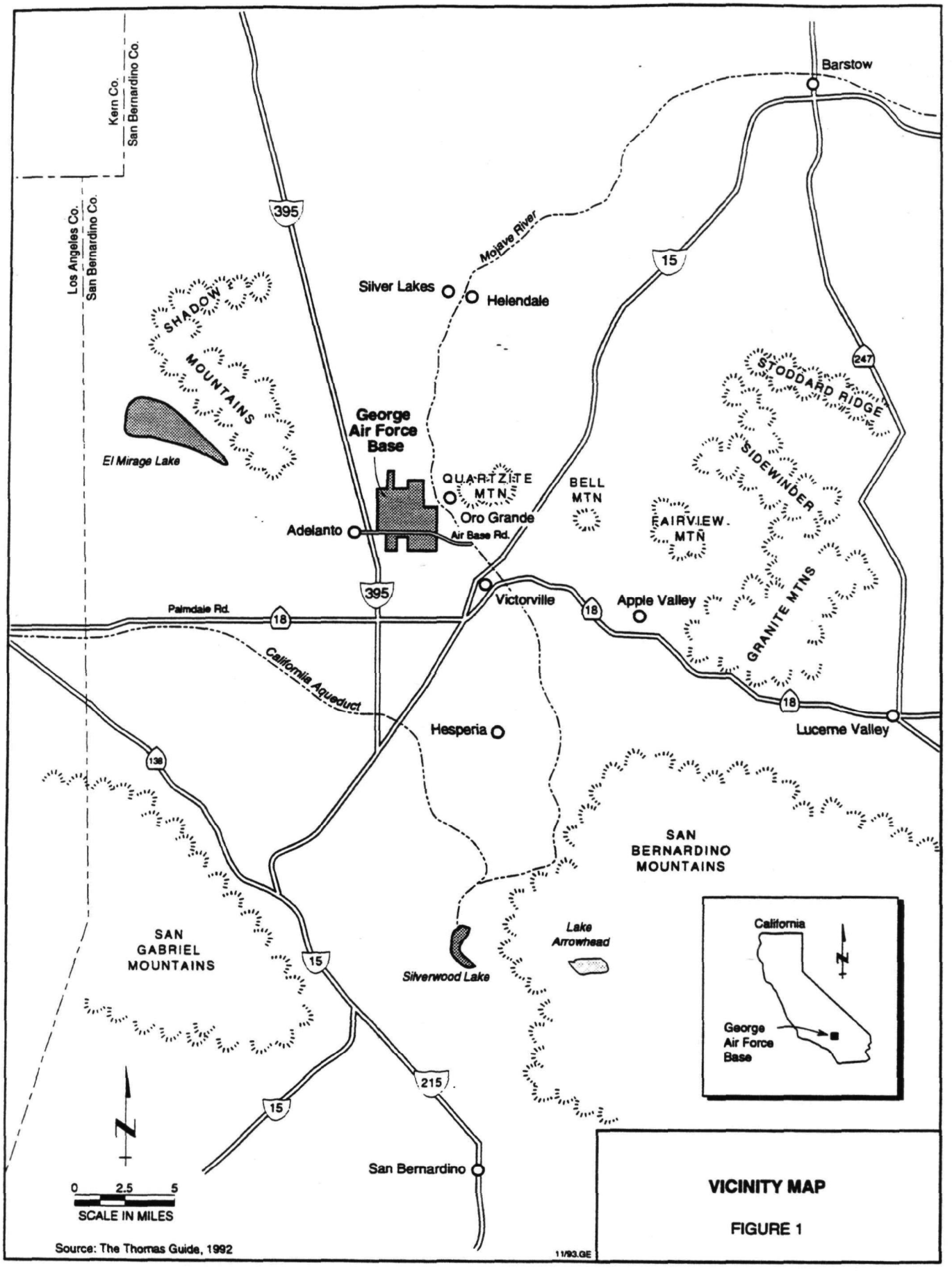
2.1 SITE NAME, LOCATION, AND DESCRIPTION

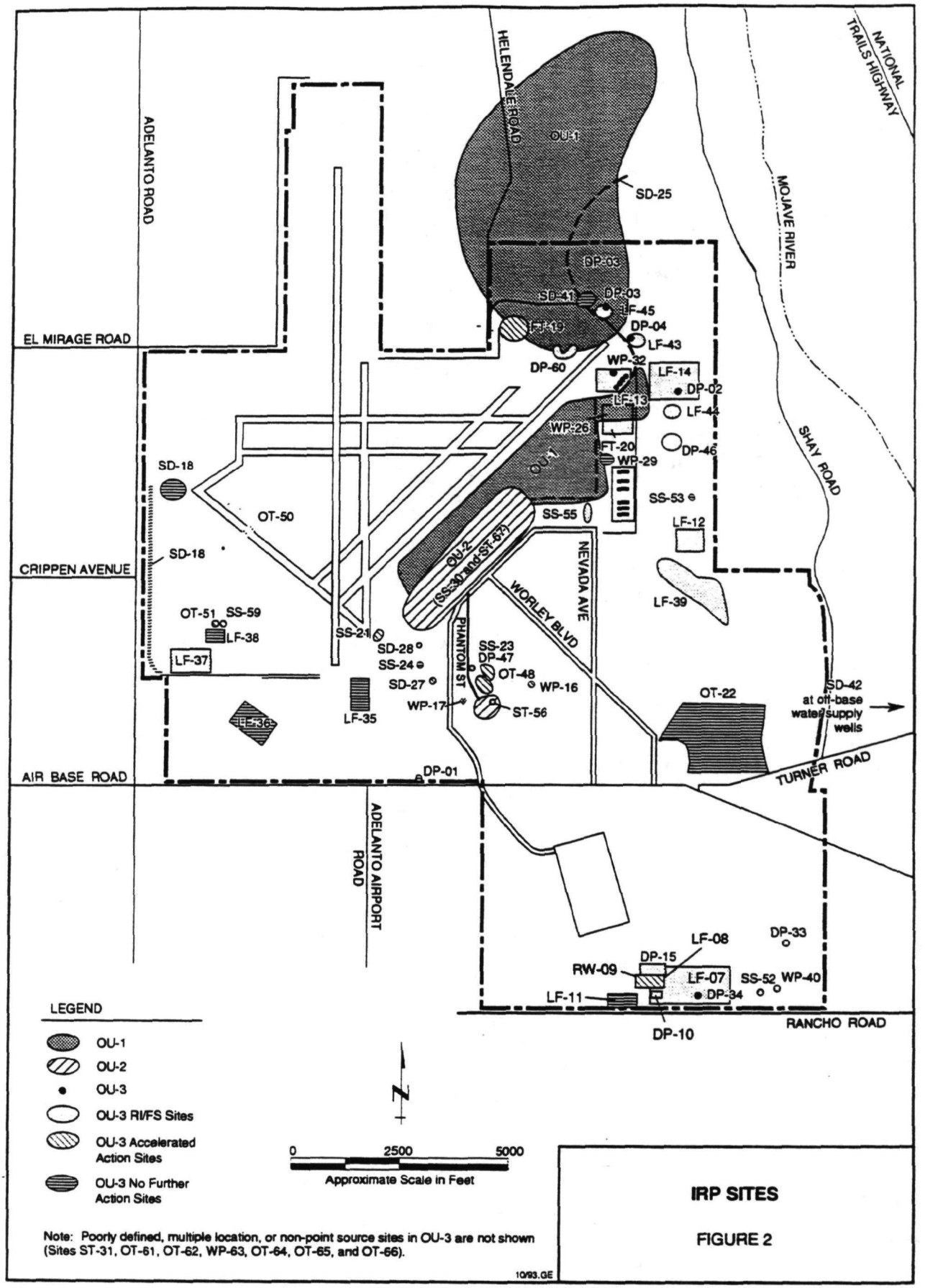
GAFB encompasses an area of approximately 5,347 acres and is located in the western Mojave Desert in the area of Victorville, California and adjacent to the City of Adelanto, California. Victorville is located on Interstate 15, approximately 35 miles north of San Bernardino and 31 miles south of Barstow (Figure 1).

OU 1 consists of the TCE plume beneath the NEDA and areas north of the base, the STP Percolation Ponds, and the Industrial/Storm Drain. Figure 2 shows the location of the OUs at GAFB. Within OU 1, the only concern is groundwater contamination. Several waste disposal sites within the NEDA were identified as potential sources of TCE contamination in the groundwater. These sites consist of burial sites, landfill disposal sites, and spill or liquid disposal sites. Characterization of potential soil contamination at these sites is being addressed with ongoing activities at OU 3.

The STP Percolation Ponds, Site WP-26 (S-21), consists of five wastewater treatment plant percolation ponds that were used from the early 1950s to 1980. The site consisted of the three large main ponds and two smaller ponds that may not have been used. The percolation ponds were used primarily for discharge of treated sanitary wastes, but also may have received waste oils and solvents from industrial shops that discharged to the sanitary system. Contaminants of concern for the percolation ponds include heavy metals, solvents, and nitrate. The location of the STP Percolation Ponds is shown on Figure 3. Investigation at the STP Percolation Ponds indicate that the concentration of contaminants of concern are within background concentrations for desert soils, with the possible exception of nitrates (JMM, 1992a). Elevated concentrations of nitrates are limited to the upper 46 feet of soil.

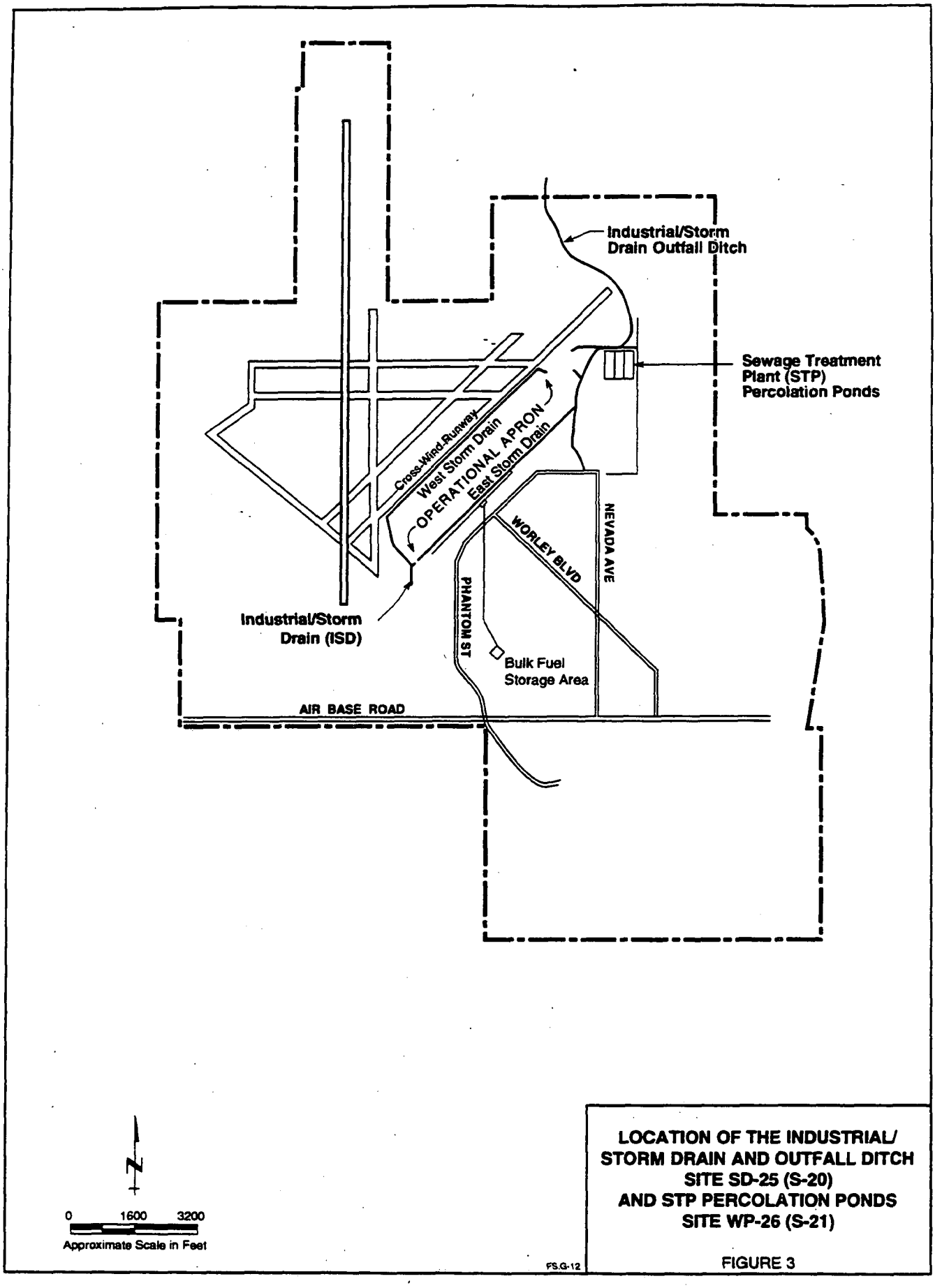
The Industrial/Storm Drain, Site SD-25 (S-20), is located within the central and northeastern portions of GAFB as shown on Figure 3. The Industrial/Storm Drain has been in operation since the early 1940s. The Industrial/Storm Drain consists of the storm drain southeast of the operational apron (East Storm Drain) and the storm drain between the operational apron and the Crosswind (Secondary) Runway (West Storm Drain), as well as the outfall ditch downgradient from the storm drains (Figure 3). As shown, the East Storm Drain is parallel to and just east of the operational apron. The East Storm Drain was constructed of various piping materials including reinforced concrete pipe (RCP) and corrugated metal pipe (CMP), but the pipe is predominantly CMP. Pipe sizes range from 4 to 24 inches in diameter. Overall length of the east pipe, including all laterals, is 10,235 linear feet (LF). Of this length, over 3,800 LF of the CMP section was perforated pipe. Figure 4 shows schematically the location of the piping for


Kern Co.
San Bernardino Co.
Los Angeles Co.
San Bernardino Co.
Barstow
395
Mojave River
15
Silver Lakes
Helendale
SHADOW MOUNTAINS
El Mirage Lake
George Air Force Base
247
STODDARD RIDGE
SIDEWINDER
QUARTZITE MTN.
BELL MTN
Oro Grande
Air Base Rd.
Adelanto
FAIRVIEW MTN
395
Victorville
Apple Valley
18
Palmdale Rd.
GRANITE MTNS
California Aqueduct
Hesperia
Lucerne Valley
138
SAN BERNARDINO MOUNTAINS
SAN GABRIEL MOUNTAINS
Lake Arrowhead
Silverwood Lake
15
215
San Bernardino
California
George Air Force Base
N
0 2.5 5
SCALE IN MILES
Source: The Thomas Guide, 1992
11/93.GE
VICINITY MAP
FIGURE 1



IRP SITES

FIGURE 2



LOCATION OF THE INDUSTRIAL/ STORM DRAIN AND OUTFALL DITCH SITE SD-25 (S-20) AND STP PERCOLATION PONDS SITE WP-26 (S-21)

FIGURE 3

FS.G-12

both storm drain pipelines. Investigations indicated that the sediments within the storm drain were potentially hazardous. Consequently, the West Storm Drain was cleaned in place. Sections of the East Storm Drain were cleaned, and the perforated sections were replaced with nonperforated piping. Soils underlying the perforated piping were also excavated and disposed of appropriately. Subsequent confirmation sampling of soils underneath the Industrial/Storm Drain indicated the chemical concentrations were at background levels. Hence, the Industrial/Storm Drain appears to be free of contamination by hazardous materials.

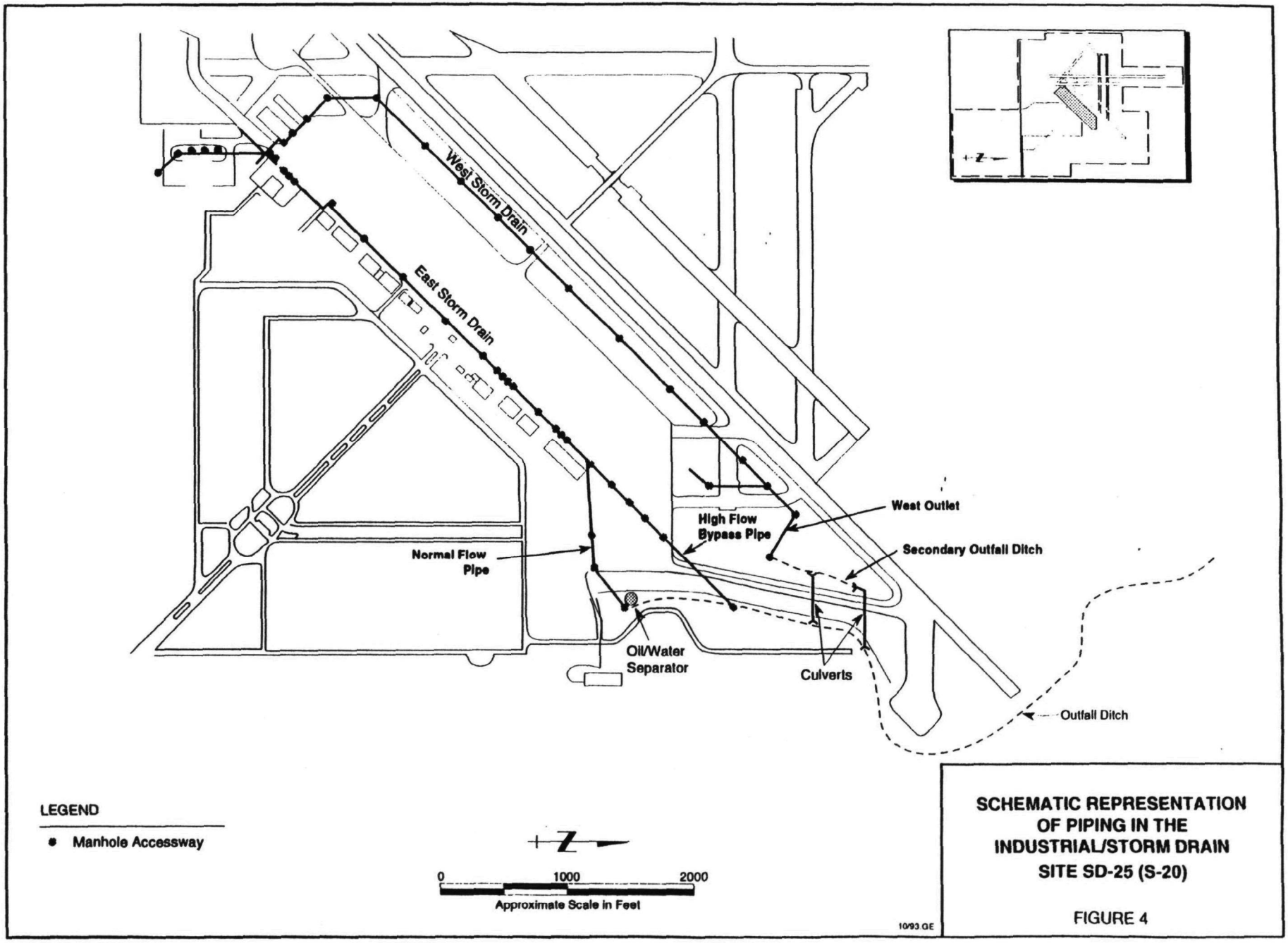
2.1.1 Regional Physiography

GAFB is located in San Bernardino County, California, approximately 70 miles northeast of the City of Los Angeles. The base is located in the Victor Valley in the western Mojave Desert, a roughly triangular-shaped tectonic block bounded by the Garlock Fault Zone on the northwest, the Lockhart and Helendale faults on the northeast, and the San Andreas Fault on the southwest (Figure 5). This western portion of the Mojave Desert is flanked by the Sierra Nevada Mountains to the northwest; the Fry, Radman, and Cady mountains to the northeast; and the San Bernardino Mountains to the southwest. The Victor Valley is comprised of alluvial fan deposits derived from the surrounding mountains, river deposits associated with the Mojave River system, and lacustrine deposits from former lakes (Figure 6). The headwaters of the Mojave River are located in the San Gabriel Mountains near Silverwood Lake at an elevation greater than 3,355 feet above mean sea level (msl). The Mojave River flows to Soda Dry Lake Bed, south of Baker, at an elevation of approximately 923 feet above msl. Valley elevations in the vicinity of GAFB range from 2,650 feet above msl at the northeast corner of GAFB to 2,920 feet above msl at the southwest corner of the base, south of Air Base Road. The average elevation of the Mojave River floodplain immediately east of the base is approximately 2,580 feet above msl. The average elevation at GAFB is approximately 2,750 feet above msl, with an average topographic gradient of 2 percent to the northeast.

The Mojave River flows along the east side of GAFB in a northwesterly direction. Communities within the Victor Valley area include the town of Adelanto, directly west and adjacent to GAFB, the City of Victorville, directly southeast, and Silver Lakes, Apple Valley, and Hesperia. The Victor Valley Wastewater Reclamation Authority (VVWRA) treatment plant is located approximately 0.5 mile northeast of the northern border of GAFB.

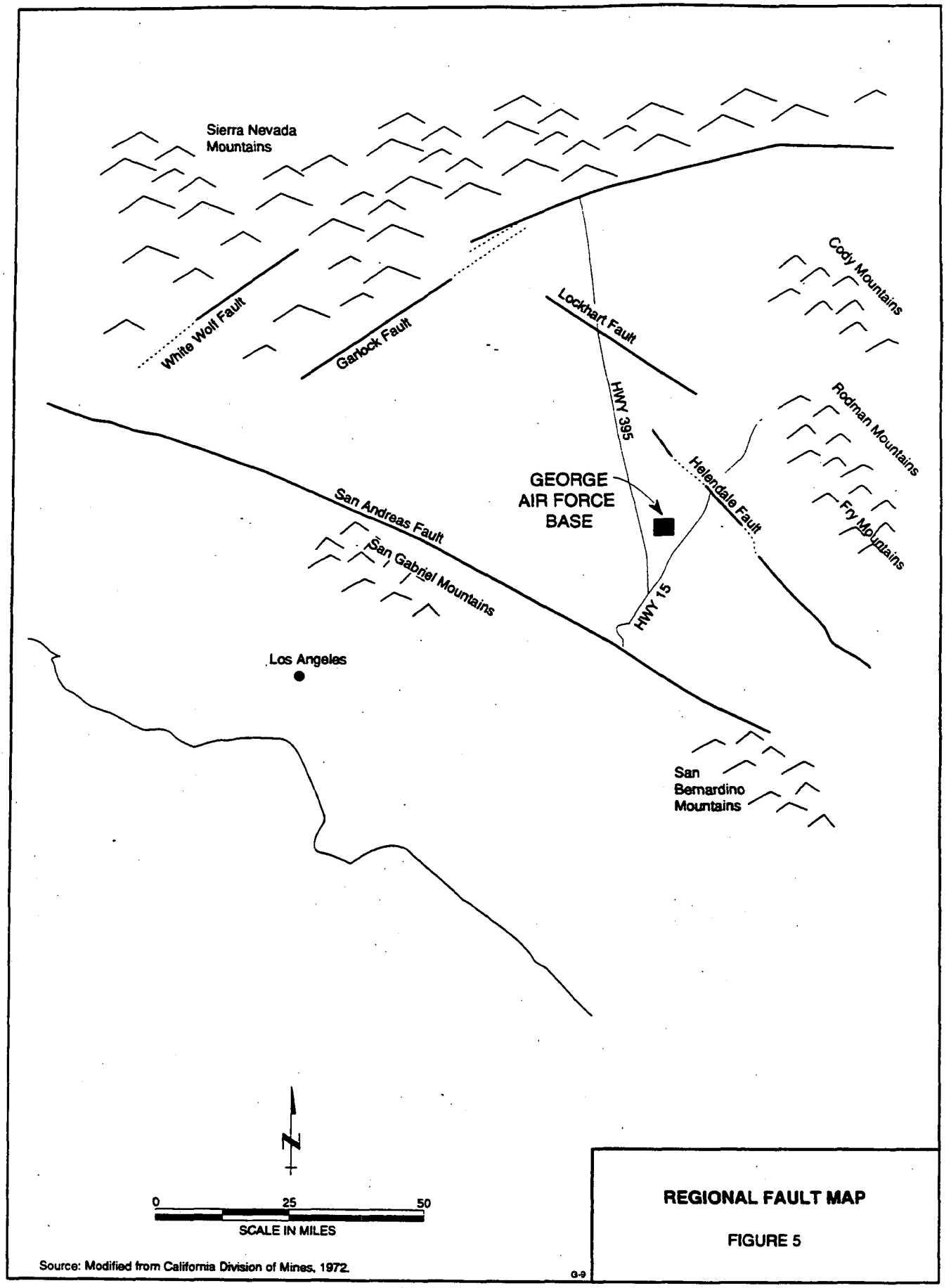
2.1.2 Meteorology

The climate in the GAFB area is typical of the high desert region of California and Nevada. The summers are extremely hot and dry while the winters are cool and dry. The annual average temperature is 62°F. July and August are the hottest months with maximum daily temperatures often exceeding 100°F. Temperatures in December and January are the coldest, with nighttime temperatures often falling below freezing. Based on records from 1942 to 1992, annual precipitation at GAFB ranges from 0.77 to 11.22 inches, with an average annual precipitation of 5.72 inches. Monthly precipitation ranges from 0.25 to 4.47 inches, with January, February, and March being the wettest months. During storm events, daily precipitation has reached as high as 2.93 inches. Snowfall is infrequent, but typically totals a few inches per year and has



SCHEMATIC REPRESENTATION OF PIPING IN THE INDUSTRIAL/STORM DRAIN SITE SD-25 (S-20)

FIGURE 4

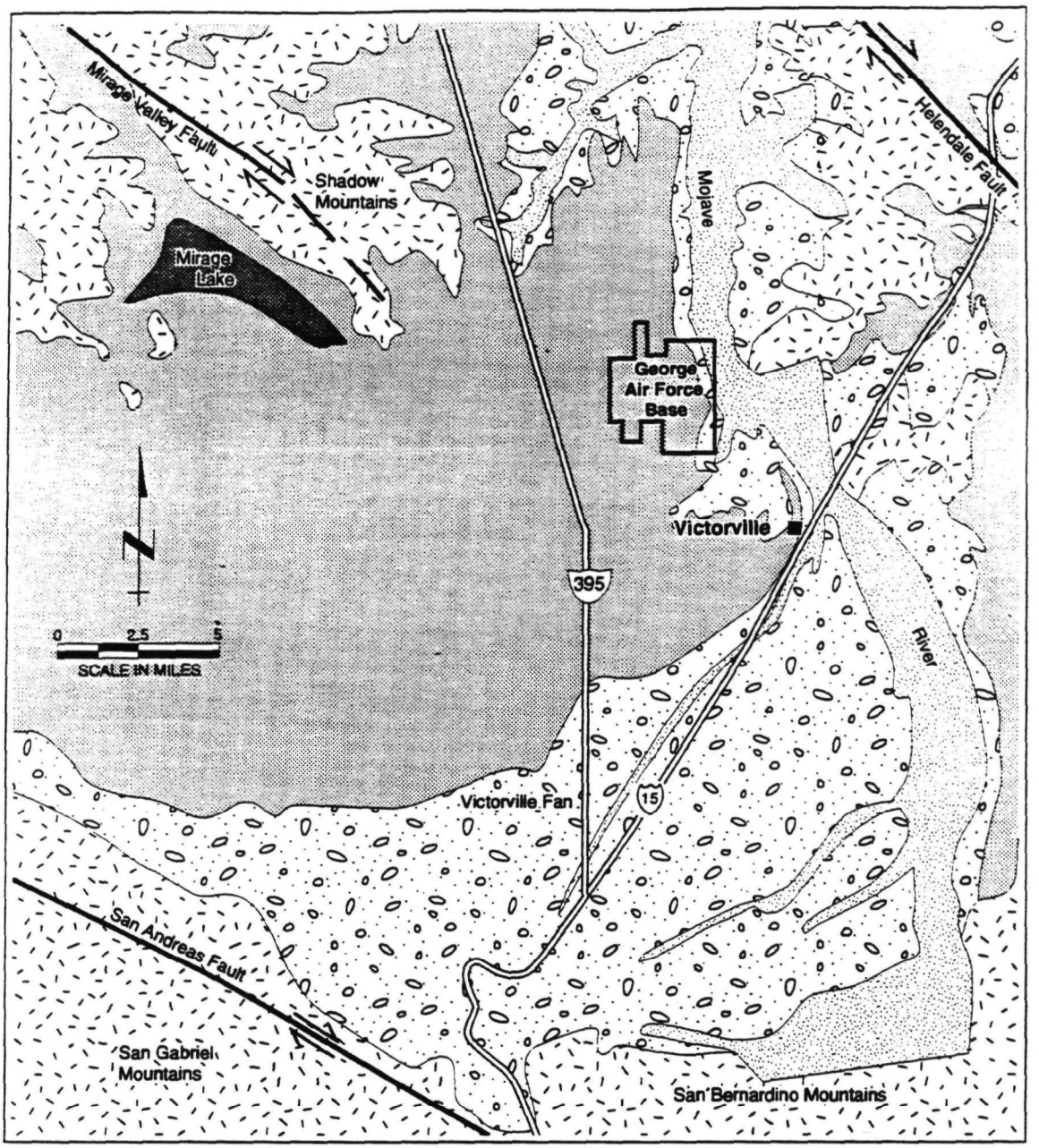


Source: Modified from California Division of Mines, 1972.

G-9

REGIONAL FAULT MAP

FIGURE 5



LEGEND

- Mojave River Alluvium
- Recent Fan Deposits
- Quaternary Lake Deposits
- Pleistocene Fan Deposits
- Mesozoic and Paleozoic Basement Complex

REGIONAL GEOLOGY

FIGURE 6

Modified from Bortungo and Spittler, 1986.

been as high as 17 inches per year. The potential evapotranspiration (ET) rate is about 71 inches during the summer and averages 83 inches for the entire year (Science Applications International Corporation [SAIC], 1987).

Prevailing winds in the area of GAFB are from the south; however, the strongest gusts are typically from the west. Westerly gusts of 50 miles per hour (mph) or more usually occur in the spring. In the summer evenings, strong southerly winds blow over the San Bernardino Mountains through Cajon Pass. The occurrence of northerly winds increases in the fall and winter months (SAIC, 1987).

2.1.3 Demography and Land Use

GAFB is located within Census Tract 91.02, Regional Statistical Area (RSA) 32B of San Bernardino County. The major cities in RSA 32B include Adelanto and Victorville and the unincorporated communities of Hesperia and Apple Valley. The estimated populations of these cities and communities, according to the 1990 Census, are:

Adelanto	8,517
Apple Valley	46,079
Hesperia	50,418
Victorville	40,674

The Victor Valley area has experienced significant growth in the past decade. From 1980 to 1990, the populations of the major Victor Valley communities have increased as follows (USAF, 1992):

Adelanto	14.7 percent
Apple Valley	12.4 percent
Hesperia	14.1 percent
Victorville	11.1 percent

The major land use activities of the Victor Valley area include residential development, government and commercial services, cement manufacturing, railroad and highway transportation, localized agricultural activities along the Mojave River, and industrial mining in the outlying areas. A major fuels distribution pipeline parallels Air Base Road for half the length of the base, and a high-voltage transmission utility corridor crosses the southeast corner of the base.

2.1.4 Hydrogeology

GAFB is located in the Upper Mojave River Valley Groundwater Basin. Within the OU 1 area, the basin is composed of alluvial sediments which consist of potentially water-bearing sands and gravels and low permeability silts and clays. The depth to bedrock is at least 1,350 feet. Water level and lithology data have been used to identify two distinct water-bearing zones in the study

area: a shallow "Upper Aquifer" and a deeper "Regional Aquifer," separated by a "Middle Clay/Silt Aquitard."

The Upper Aquifer is a 40- to 60-foot-thick zone of saturated, highly to moderately permeable, interbedded silty sands, poorly sorted sands, silts, and clays. Pump test data indicate that these materials have transmissivities ranging from 5,500 to 20,700 gallons per day per foot (gpd/ft). Groundwater elevations within the study area range from approximately 2,724 to 2,704 feet above msl and have a gradient to the northeast of approximately 0.003 ft/ft.

The Middle Clay/Silt Aquitard, consisting of interbedded very low to low permeability clays and silts, is present from approximately 2,670 to 2,640 feet above msl and is approximately 20 to 40 feet thick. The aquitard hydraulically separates the Upper and Regional aquifers but is not continuous north of the base and east of the study area along the Mojave River bluff. However, the aquitard is continuous to the west and southwest as determined by activities at OU 2 and OU 3. The lack of hydraulic communication between the aquifers through the aquitard is supported by a zone of unsaturated moderately permeable materials encountered below the aquitard in regional wells and dry clays within the aquitard in several well borings. To the northeast beyond the lateral edge of the aquitard, however, the Upper Aquifer merges with the Regional Aquifer through downward migration. Groundwater gradients within the Upper Aquifer increase to the east and northeast as the edge of the aquitard is approached.

The Regional Aquifer generally consists of interbedded sands, gravelly sands, and silts with minor caliche beds. Groundwater elevations in the Regional Aquifer within the study area range from 2,587 to 2,582 feet above msl, with a gradient of 0.001 ft/ft to the northeast. The Regional Aquifer is geographically extensive and is hydraulically associated with the Mojave River Aquifer. Several production wells in the site vicinity are screened in the Regional Aquifer. The Mojave River Aquifer is an informal designation for groundwater within unconsolidated coarse sands and gravels spatially associated with the Mojave River. The Mojave River deposits overlie and are interbedded with older Regional Aquifer soils. This unit is relatively transmissive and provides good quality water to regional wells. Potentiometric contours of the Regional Aquifer are perpendicular to the directions of flow in the Mojave River. Groundwater flow in the Mojave River and Regional aquifers are therefore parallel. Adjacent to GAFB, the Mojave River Aquifer gains groundwater flow from the Regional Aquifer.

2.1.5 Surface Water Hydrology

The Mojave River is the major surface drainage of the Victor Valley. The river channel is about 125 miles long, extending from the San Bernardino Mountains in the south to Soda Dry Lake in the northeast. Surface flow occurs principally during heavy storms. In the Upper Mojave River Basin, perennial flow occurs in two locations: (1) approximately 1 mile below the Forks due to the contribution of the perennially flowing Deep Creek; and (2) near Victorville, where flow occurs through two restricted areas, known as the Upper and Lower Narrows. The narrows are formed by a bedrock ridge, which creates a subsurface flow barrier, causing river underflow to rise to the surface. U.S. Geological Survey (USGS) topographic maps and aerial photographs indicate that historically, surface flow continued downstream as far as Bryman, 8

miles north of GAFB. Today, surface flow persists approximately 1 mile below the Lower Narrows, located approximately 2 miles east of GAFB, except during and shortly after heavy rainfall. Regional withdrawal of groundwater apparently has lowered the Mojave River underflow in the vicinity of GAFB.

Daily mean discharge values of the Mojave River through the Lower Narrows during 1990 ranged from 1.6 to 373 cubic feet per second (cfs), with an average discharge of 14.3 cfs (USGS, 1990). Discharge records maintained since 1899 indicate an average discharge of 75.2 cfs, with a maximum discharge of 70,600 cfs recorded March 2, 1938 (USGS, 1992).

Surface water from GAFB drains predominantly to the northeast and east. Runoff from the flightline and the industrial and office areas (including most hazardous waste accumulation points and the hazardous waste storage yard) is directed through roadways, storm drains, culverts, and ditches to the Outfall Ditch on the northeast side of the base. Flow from this drainage ditch reaches the Mojave River only during heavy storms. Runoff from residential areas and the eastern part of the base flows east directly into the Mojave River wash. Much of the southern part of the base drains northward into the industrial and flightline runoff system. The western edge of the base drains westward into the desert (USAF, 1989).

A large, southeast-trending arroyo bisects the northeast section of the base. The arroyo channel is approximately 15 feet wide near the northern base boundary and 100 feet wide where the arroyo discharges into the Mojave River wash. It is fed by the Outfall Ditch from the base, numerous gullies, and a smaller drainage ditch originating from the Fire Training Area. Because they cut through the desert pavement, the arroyos and gullies on the western side of the Mojave River wash collect runoff water and may promote recharge to the subsurface along their channels. Near GAFB the Mojave River has cut a wash approximately 1 mile wide and 200 feet deep into the alluvial fan deposits (JMM, 1988d).

2.1.6 Water Use

Because of the arid conditions of the Upper Mojave River Valley Groundwater Basin in general, and the GAFB area in particular, there are no surface water bodies available for reliable utilization. As a result, water usage analyses conducted by the Mojave Water Agency focus on groundwater withdrawals.

The Mojave Water Agency divides water usage into four categories: domestic, lake-type, agriculture, and miscellaneous. The per capita rate of water demand is currently estimated to be 200 to 285 gallons per day (gpd). Approximately 50 percent of this amount is believed to be consumed and not returned to groundwater storage (SAIC, 1987).

Lake-type water use refers to the region's ponds, lakes, and fish-culture farms, all of which are fed by pumped groundwater. An estimated 75 to 85 percent of this water percolates downward to return to the water table. Evaporation is the most common form of water loss in this category, with a lake evaporation rate of 78 inches per year considered representative for the Upper Mojave River Basin (SAIC, 1987).

Agricultural crops receive water through precipitation or applied water. Alfalfa is the primary agricultural plant in the study area. Consumptive use of applied water (primarily through evapotranspiration) is estimated to range from 3 to 5 acre-feet per year. Other additional water demands in the GAFB and Victorville areas include water use by golf courses, cemeteries, and cement plants or other heavy industry. Within this category, an estimated 50 percent of all groundwater pumped from storage is consumed.

The VVWRA, located northeast of the base, also has two supply wells used for industrial and potable water supplies, although bottled water is supplied for workers at the plant. The VVWRA wells are reported to be screened at 100 to 150 feet below ground surface (bgs) and have pumping capacities of 500 gallons per minute (gpm). The log from a soil boring constructed near the water supply wells shows the top 65 feet of alluvium to consist of silty sands with streaks of sand, silt, and gravel. The groundwater table was measured at 36 feet bgs.

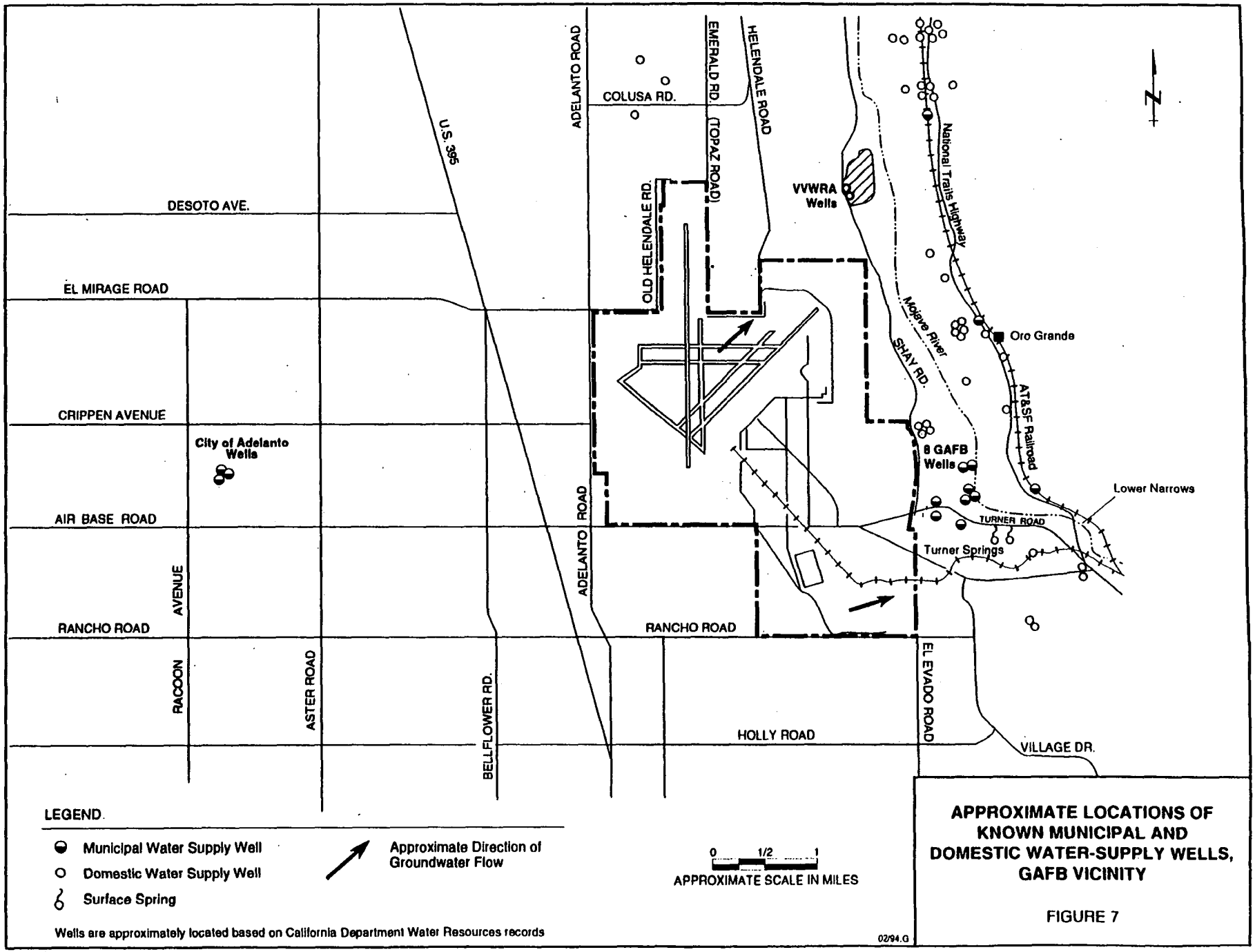
According to the records of the California Department of Water Resources (DWR), four production wells exist southeast of the base. Production capacities of these wells range from 100 to 1,200 gpm. Wells are screened to depths ranging from 500 to 610 feet bgs and may be screened in a deeper and possibly different aquifer system than the monitoring wells installed at GAFB under Phase II of the Installation Restoration Program (IRP).

Eight GAFB municipal water supply wells are located along Turner Road, near the Mojave River below the base golf course and beyond the eastern base boundary. These wells are located on the west side of the Mojave River in Section 30, T6N, R4W, just north of the Lower Narrows. The GAFB wells are 101 to 442 feet deep. Three additional City of Adelanto wells are located on Raccon Avenue west of the base and are 231 to 363 feet deep. GAFB and Adelanto have received licenses from the California DWR to extract a total of 8.34 cfs of groundwater.

Three additional wells located northeast of and across the Mojave River from the GAFB production wells supply water to the town of Oro Grande. All 14 wells are believed to be screened in a deeper aquifer system than that penetrated by the monitoring wells installed at GAFB (Boyle, 1987). At least four wells are also maintained by the Riverside Cement Company in Oro Grande. These wells are 100 to 152 feet deep and are primarily used for industrial applications, although one well is reportedly also used for domestic purposes. There are numerous privately owned domestic, agricultural, and industrial wells along the Mojave River. The approximate locations of known municipal and domestic water-supply wells in the GAFB vicinity are shown on Figure 7.

2.1.7 Plant Life

The most predominant type of vegetation is the creosote bush scrub community which includes creosote bush, cheesebush, burroweed, ricegrass, and Mormon tea. This type of vegetation is typically found in the undeveloped areas of the base. Russian thistle or tumbleweed is often found in the disturbed areas (CH2M Hill, 1982). Riparian vegetation communities, including



APPROXIMATE LOCATIONS OF KNOWN MUNICIPAL AND DOMESTIC WATER-SUPPLY WELLS, GAFB VICINITY

FIGURE 7

cottonwoods, willows, cattail rushes, and sedges, are found along the Mojave River channel, near the golf course and near the old GAFB STP Percolation Ponds.

A biological assessment was conducted in 1989 in the northern portion of the base and an off-base section just north of the northern base boundary. This assessment was done as part of the initial FS for the NEDA (JMM, 1988a). The dominant species found were creosote bush, sweetbush, cheesebush, paperbag bush, and indigo bush, all Mojave Desert creosote bush scrub. Golden cholla cactus, beavertail cactus, and pencil cholla were also found scattered throughout the site. Herbaceous plants included introduced grasses such as abu-mashi and red brome, as well as native grasses and herbs such as Indian ricegrass, spurge, chia, and fiddleneck. Joshua trees occur along the base of the steep slopes in the area (LSA, 1989).

Several sensitive plant species may occur in the area of GAFB. Good habitat exists for several of the plant species; however, only Joshua trees were actually observed during the survey of the area (LSA, 1989). Additionally, the U.S. Fish and Wildlife Service (USFWS) lists three Category-2 species that may be present on GAFB. These are the alkali mariposa lily, barstow woody sunflower, and the desert cymoperus. Category-2 species are those for which existing information is insufficient to warrant listing as endangered or threatened species (USAF, 1989).

2.1.8 Animal Life

Wildlife in the vicinity of GAFB includes both desert and riparian species such as black-tail jackrabbit, cottontail rabbit, and antelope ground squirrel (CH2M Hill, 1982). Seventy-five bird species have been identified in the area, including ravens, hawks, owls, quail, flycatchers, larks, warblers, sparrows, and blackbirds. Other wildlife includes lizards, snakes, pocket mice, and raccoons. There are no fish species known to occur at GAFB. Generally, animal activity is highest in the northern and southern portions of the base where native plants are least disturbed. Animal activity is lowest in the high traffic areas of the base, such as the housing and industrial complex, recreation areas, and the runways (USAF, 1989).

The desert tortoise is the only animal species found on the base that is listed by the USFWS as a threatened or endangered species. Two Category-2 animal species may be present on GAFB: the ferruginous hawk and Mojave ground squirrel (USAF, 1989).

2.2 SITE HISTORY AND ENFORCEMENT ACTIVITIES

The Industrial/Storm Drain and the STP Percolation Ponds were identified in an IRP Phase I Records Search (CH2M Hill, 1982). The TCE plume was first identified during a subsequent Phase II investigation (SAIC, 1985, 1987).

On January 16, 1986, the California Lahontan Regional Water Quality Control Board (RWQCB) adopted the Cleanup and Abatement Order (CAO). The CAO required the USAF to define the extent of TCE contamination in the groundwater beneath the NEDA, submit a plan for remediation, and begin cleanup of the groundwater.

Phase III and Phase IV IRP investigations were conducted for the Industrial/Storm Drain and the TCE plume beneath the NEDA (JMM, 1988a,b,c,d,e,f, 1989, 1990). These investigations included separate FSs for the Industrial/Storm Drain and TCE plume in groundwater beneath the NEDA.

The 1988 FS performed for the NEDA identified a preferred alternative for the remediation of groundwater contamination (predominantly TCE). This alternative included nine extraction wells, an air stripping facility, and reinjection of the treated water into the Regional Aquifer (JMM, 1988a). This alternative was selected using a USGS-developed three-dimensional groundwater model, and analytical data collected by SAIC during the Stage 1 and Stage 2 investigations. However, additional data needs were identified during the performance of the 1988 FS, and further investigation was recommended. A Supplemental Site Characterization was subsequently performed by JMM in 1987 to collect these data (JMM, 1988b).

GAFB was placed on the National Priorities List (NPL) in February 1990. In October 1990, the USAF signed a Federal Facility Agreement (FFA) with the USEPA (Region IX), California Department of Health Services (DHS) (now the Department of Toxic Substances Control [DTSC]), and the RWQCB. The CAO was rescinded and operable units were created with the signing of the FFA.

Investigations were also performed for the Industrial/Storm Drain to identify potential removal and replacement options. Based on the analytical data gathered during the Phase II Investigations conducted by SAIC, as well as the findings presented as part of the Predesign Technical Memorandum (TM) (JMM, 1988f), a storm drain replacement project was planned for the Industrial/Storm Drain. This project would consist of removal and replacement of the East Storm Drain and a portion of the Upper West Storm Drain, abandonment of two sections of the Industrial/Storm Drain system known as the "normal flow" and "high flow" bypass lines, and rerouting of all flow to an existing oil/water separator. As part of the replacement project, the normal and high flow bypass lines were to be cleaned and filled with concrete. Initially, the entire length of the East Storm Drain and Upper West Storm Drain was to be replaced in conjunction with the installation of a basewide pretreatment system. However, because the base was closed in 1992, construction of the basewide pretreatment system was canceled. As a result, the storm drain removal project was altered to include cleaning, rather than removal, of the upper West Storm Drain. The remainder of the West Storm Drain was to be cleaned in place and continue in use as a storm drain.

To ensure the condition of selected portions of the storm drains were such that they could be cleaned rather than removed, a second investigation was performed in June 1989. Portions of the storm drains were videotaped to test the pipe integrity, and sediment samples were collected to verify previously reported results and further define contamination in areas that had exhibited high photoionization detector (PID) readings.

A third field investigation was performed as part of a second TM prepared for Site SD-25 (S-20) (JMM, 1990). This investigation was performed to define the extent of contamination initially detected as part of the sampling conducted for the Predesign TM (JMM, 1988f) in the high flow

bypass and the normal flow portions of the East Storm Drain and portions of the West Storm Drain, and to confirm conclusions based on soil sampling results for which SAIC had missed holding times.

Using the results of all three field investigations at Site SD-25 (S-20), the final storm drain removal project was initiated between October 1989 and May 1991. As part of this project, both the high flow bypass and the normal flow portions of the East Storm Drain were cleaned and filled with concrete, and the removed sediments were handled as designated wastes and disposed off site. The normal flow bypass was rerouted from manhole 199 to manhole 202. The perforated portions of the East Storm Drain were removed and replaced with nonperforated pipe. Approximately 1,500 cubic yards of soil were generated during excavation when the East Storm Drain was removed. All excavated materials, including soil, sediments, and pipe, were disposed off site. Videotapes showed the upper portions of the West Storm Drain to be in good condition; therefore, those sections were cleaned and left in place. The results of the Outfall Ditch sampling were similar to SAIC's findings (JMM, 1990); therefore, it was again determined that no further action was warranted for the Outfall Ditch.

In 1992, seven soil borings were drilled immediately adjacent to the East Industrial/Storm Drain and the Outfall Ditch. This activity confirmed that soil and sediment previously present in the storm drain had been adequately remediated during the pipeline cleaning, removal, and construction of the new reinforced concrete pipe. This activity also confirmed that contamination did not exist below depths previously sampled.

Investigations were performed at the STP Percolation Ponds to evaluate if contamination exists at this site. Sampling of groundwater from monitoring wells located near the percolation ponds occurred in 1985 and 1986 during Phase II of the IRP (SAIC, 1987). Also, two soil borings were drilled to evaluate the condition of the vadose zone. In 1987, an additional investigation was performed including groundwater monitoring and drilling of two additional borings (JMM, 1992a).

In 1992, a third investigation was performed at the STP Percolation Ponds (JMM, 1992a). This investigation was conducted to (1) assess soils within and beneath the STP Percolation Ponds as a potential source area for contaminants, (2) assess the potential for contaminant migration and exposure pathways, including the surface exposure pathway and the potential subsurface migration pathway to groundwater, and (3) provide a means to monitor the effects of effluent discharge to the percolation ponds. This investigation included the installation of four groundwater monitoring wells and the drilling of 11 soil borings. Investigations at the STP Percolation Ponds indicate that the contaminants of concern in the soil are within background concentrations for desert soils, except for elevated nitrate concentrations that are in the top 46 feet of soil.

As a result of a USEPA assessment, and subsequent placement of GAFB on the NPL in February 1990, a new FS (JMM, 1993a) was prepared (1) to summarize and reassess the earlier FS activities performed prior to GAFB being placed on the NPL and (2) to update the documentation of this investigation to current USEPA guidance published in 1988. The USEPA

guidance (Guidance for Conduction Remedial Investigations and Feasibility Studies Under CERCLA) was developed to reflect the new emphasis and provisions of SARA and incorporates aspects of new or revised guidance on technical and management initiatives designed to streamline the RI/FS process (USEPA, 1988a).

The findings and conclusions of this ROD are based on the analysis of OU 1 presented in the final FS Report (JMM, 1993a) and the accompanying Proposed Plan (JMM, 1993b). The technical information supporting each alternative is included in these reports and the RI Report (JMM, 1992a).

2.3 HIGHLIGHTS OF COMMUNITY PARTICIPATION

The Community Relations Plan (CRP) was completed in 1991 for GAFB by International Technologies Corporation following USEPA guidance (IT, 1991). Consistent with the CRP, the USAF established a Technical Review Committee (TRC) which was composed of the USEPA, DTSC, RWQCB, and representatives from adjacent communities. The TRC met on a quarterly basis to provide community representatives with up-to-date information on recent milestone events. In January 1994, GAFB established the Restoration Advisory Board (RAB) which replaced the TRC. The RAB meets on a quarterly basis and the meetings are open to the public. The RAB is designed to act as a focal point for environmental exchange between GAFB and the public.

The RI Report (JMM, 1992a), FS Report (JMM, 1993a), and Proposed Plan (JMM, 1993b) were released to the public and were made available in both the Administrative Record File and in information repositories maintained at the following locations:

- The OL-C/AFBCA Office at GAFB
- The Victorville Branch of the San Bernardino County Library
- The Adelanto Branch of the San Bernardino County Library

The availability of these documents and announcement of the public meeting and public comment period were published in the Victor Valley Daily Press, the Los Angeles Times, the Orange County Register, and the San Bernardino Sun in September 1993. A press release was sent to 20 local newspaper, radio, and television organizations announcing the public meeting and public comment period.

The Proposed Plan was mailed in September 1993 to all parties identified in the CRP, including government officials, media, private organizations, and interested members of the community.

A public comment period was held from September 20 to October 19, 1993. A public meeting was held on October 6, 1993 at GAFB. Representatives from the USAF, USEPA, DTSC, and RWQCB were present at the meeting. The Responsiveness Summary, Section 3.0 of this ROD, contains responses to questions from the meeting and comments submitted by mail.

2.4 SCOPE AND ROLE OF OPERABLE UNIT WITHIN THE SITE STRATEGY

The suspected hazardous waste sites present at GAFB were grouped into three operable units based on the type of waste present and the geographical location (Figure 8). OU 1 consists of three sites: (1) Site SD-25 (S-20), an Industrial/Storm Drain which in the past received industrial waste; (2) Site WP-26 (S-21), the former STP Percolation Ponds; and (3) groundwater beneath and adjacent to the NEDA contaminated with TCE. As no further action has been determined for Site SD-25 and Site WP-26, the remaining role for OU 1 is for treatment of the TCE plume beneath and adjacent to the NEDA.

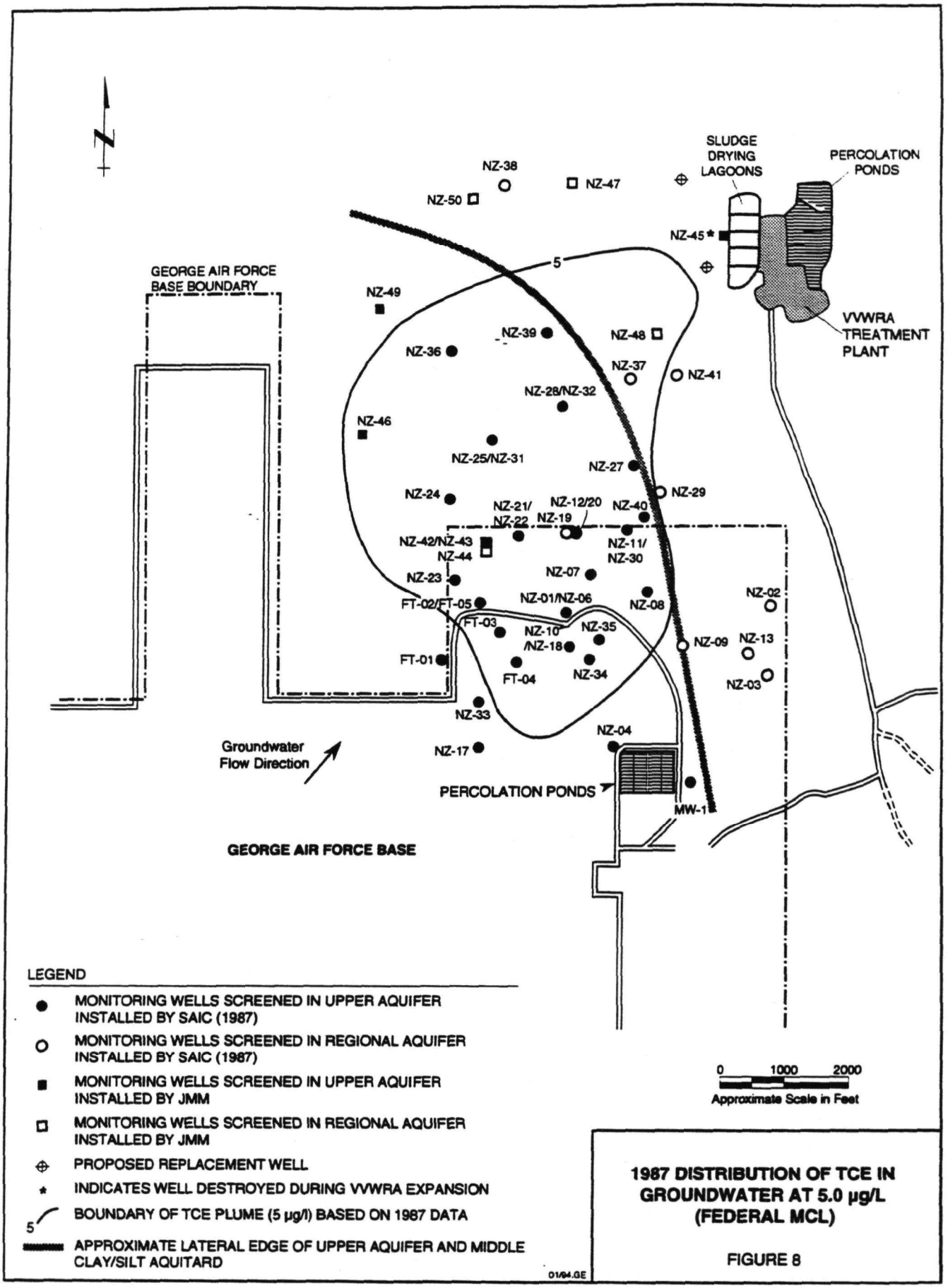
OU 2 consists of the entire Liquid Fuel Distribution System, including five aboveground tanks, two major pipelines, seven fuel pits, and distribution lines. Contamination at OU 2 has resulted from jet fuel (JP-4) releases. OU 3 consists of the 58 remaining IRP sites located throughout GAFB. Contamination potentially found at OU 3 sites relates to activities associated with equipment maintenance; fire training; fuel use and storage; pest control; laboratory, shop, and hospital operations; and old landfill and solid waste disposal. OU 3 includes several sites located in the NEDA, above the TCE plume.

2.5 SUMMARY OF SITE CHARACTERISTICS

This section summarizes the site characteristics at OU 1. Due to the distinct nature of the three sites that comprise OU 1 (groundwater beneath the NEDA, the Industrial/Storm Drain and Outfall Ditch, and the STP Percolation Ponds), the discussions of the sites are presented separately.

2.5.1 Northeast Disposal Area

Based on available data, groundwater beneath the NEDA has been found to exist in two separate aquifers, the Upper Aquifer and the Regional Aquifer. The Upper Aquifer is a 40- to 60-foot-thick zone of saturated, moderately permeable materials interspersed with zones of low-permeability materials. The depth to water in the aquifer varies between 60 and 120 feet bgs. Groundwater elevations in the Upper Aquifer beneath the NEDA range from 2,737 feet msl to the south to 2,711 feet msl north of GAFB. Generally, water levels did not change appreciably in most wells over the period during which water levels were taken (June to December 1987) with the exception of five wells (NZ-07, NZ-08, NZ-11, NZ-31, and NZ-32). Water level changes in these five wells were as much as 3 to 20 feet over the period of the measurements. The reason for these variations is presently not known. The groundwater gradient within the northeast portion of the base is approximately 0.003 ft/ft to the northeast. North of the base, two groundwater flow directions are indicated. The first is towards the northeast with a gradient of 0.007 ft/ft, and the second is towards the east with a gradient of 0.02 ft/ft. Aquifer pump tests conducted in the Upper Aquifer indicate the transmissivity ranges from 5,500 to 20,700 gpd/ft, with a storativity of about $5x10^{-3}$. Slug test data indicate the hydraulic conductivity ranges from 1.20 to 291.72 gpd/ft^2 (JMM, 1992a).



1987 DISTRIBUTION OF TCE IN GROUNDWATER AT 5.0 µg/L (FEDERAL MCL)

FIGURE 8

Groundwater in the Regional Aquifer is present at depths below 2,590 feet msl and is geographically extensive. Groundwater flow in the Regional Aquifer is to the northeast with a gradient of 0.001 ft/ft. This aquifer appears to be hydraulically connected to the Mojave River underflow. Within GAFB and immediately north of the base, the Upper and Regional aquifers are separate units, divided by a clay unit whose top elevation ranges from 2,640 to 2,670 feet msl. Three wells installed within GAFB below this clay unit indicated the existence of dry soil zone between the Upper and Regional aquifers. However, this clay layer disappears north and east of the base and the groundwater merges into one aquifer. A slug test performed in a well screened in the Regional Aquifer indicated the hydraulic conductivity to be about 8.98 gpd/ft^2 (JMM, 1992a).

The investigations conducted at NEDA were primarily to characterize groundwater contamination beneath the site. The groundwater investigations revealed the presence of volatile organic compounds (VOCs). TCE is the primary contaminant of concern, being the most persistent and widespread. A summary of the maximum concentrations of the contaminants detected in the groundwater beneath this site is presented in Table 1. TCE was detected in the Upper Aquifer and in the Regional Aquifer northeast of where the two aquifers merge (Figure 8). Based on this data, contamination of the Regional Aquifer above the MCL appeared to be limited to the northeast off-site area near the Mojave River where groundwater from the Upper Aquifer merges into the Regional Aquifer.

Based on an average concentration of TCE (47.3 $\mu g/l$), the contaminated groundwater in OU 1 is not a RCRA hazardous waste as defined in 22 CCR Section 66261. The source of the TCE contamination is currently unknown. Several waste disposal sites within the NEDA, being characterized separately as part of OU 3 investigations, were identified as potential sources. The OU 3 site primarily suspected is FT-19 (S-5); however, this has not been confirmed.

Within GAFB boundaries, TCE contamination of the Regional Aquifer was confirmed in three wells (NZ-02, NZ-03, and NZ-13), all located in the eastern portion of the base. The TCE concentrations in these wells were, however, below state and federal MCLs. Water level measurements in December 1987 in well NZ-02 indicate the water table is as much as 34 feet above the top of the screen. Since the aquifer does not appear to be confined near this well, it is possible that potential contamination in the well is underestimated.

A large portion of the TCE plume has migrated off site beneath the northern boundary of GAFB. TCE concentrations within most parts of GAFB boundaries are decreasing. Lateral migration of the TCE appears to be toward the north within GAFB boundaries. Off site, two migration pathways, consistent with hydrogeologic findings, are indicated. The first pathway is to the northeast along the arroyo leading towards the Mojave River and the second is to the east immediately north of the base. Because of this lateral migration, TCE concentrations are increasing off site, particularly in the northeast. It is also possible that TCE concentrations are increasing to the east of well NZ-40. However, this cannot be confirmed since there are no monitoring wells in that area. Additional investigations to determine the extent of TCE contamination in this area are planned as part of the Investigation in Support of RD/RA (Section 2.12.2).

TABLE 1

GROUNDWATER DATA SUMMARY, NORTHEAST DISPOSAL AREA

Compound	Number Analyzed	Number Detected	Percent Detects	Detection Limits (µg/l)	Maximum Concentration (µg/l)	Average Concentration (µg/l)	Standard Deviation (µg/l)	Upper-Bound Concentration (µg/l)
Acetone	128	2	1.54		80	46.00	NC	NC
Benzene	130	1	0.77	0.1	0.1	0.10	NC	NC
Carbon Disulfide	53	8	14.81		5	1.05	1.64	1.69
Carbon Tetrachloride	130	1	0.77		0.1	0.08	0.02	0.09
Chloroform	130	32	24.62	0.1	0.6	0.18	0.13	0.23
Dibromochloromethane	130	1	0.77	0.1	1	1.00	NC	NC
1,1-Dichloroethane	130	5	3.85	0.1	1	0.44	0.40	0.57
1,2-Dichlorobenzene	129	1	0.79		0	0.90	NC	NC
1,2-Dichloropropane	130	1	0.77	0.1	0.1	0.10	NC	NC
1,2-Dichloroethane	130	2	1.54	0.1	0.1	0.10	0.00	0.10
c-1,2-Dichloroethene	130	6	4.62	0.1	8.1	0.62	1.82	1.23
t-1,2-Dichloroethene	130	4	3.08	0.1	0.1	0.08	0.02	0.09
MEK	129	1	0.77		1.4	1.40	NC	NC
Methylene Chloride	130	4	3.08	5	0.9	0.36	0.34	0.47
Tetrachloroethene	130	24	18.46	0.1	1.1	0.38	0.71	0.61
Tetrahydrofuran	130	2	1.54		2.3	1.65	NC	NC
Toluene	130	28	21.54	0.5	9	1.41	1.87	2.03
Trichlorobenzene	126	0	0.00		0	NC	NC	NC
1,1,2-Trichloroethane	130	0	0.00	0.1	0	NC	NC	NC
Trichloroethene	130	117	90.00	0.1	310	47.31	69.74	70.42
1,1,2-Trichloro-1,2,2-trifluorethane	1	1	100.00		3	3.00	NC	NC
Trichlorofluoromethane	130	3	2.31	1	1.7	1.43	0.38	1.56
TRPH	32	11	34.38		1.4	0.74	0.29	0.84
Xylenes	130	2	1.54	0.1	0.1	0.08	0.02	0.09

An evaluation of the rate and extent of TCE plume movement was conducted as part of the 1988 RI (JMM, 1988d) as summarized in the 1992 RI (JMM, 1992a). The results of groundwater modeling indicated that the center of the TCE plume would move approximately 1 mile from the northern boundary of the base in 30 years. The plume would move northeasterly around a mound created by the VVWRA Percolation Ponds and discharge into the Mojave River in about 15 years, with a maximum estimated TCE concentration of 10 micrograms per liter (μg/l). The model predicted that the existing VVWRA wells would be slightly impacted by the plume, although concentrations were predicted to remain below 5 μg/l. These wells were, but are not currently used for potable water; therefore, the projected impact was not anticipated to be significant. Recent sampling events that have occurred at the VVWRA wells are discussed in Section 2.12 of this document and the associated references. No other water supply wells are known to exist in the path of the plume.

Based on the 1987 data, the mass of TCE present in the aquifer, within the 5 μg/l isoconcentration contour, was estimated to be approximately 430 pounds. The volume of contaminated water was estimated to be 1.83×10^9 gallons. The apparent area encompassed by the plume has increased since 1986, while the peak concentration has decreased, possibly indicating the occurrence of dispersal and downgradient migration (JMM, 1992a). This portion will continue to attenuate by adsorbing to soil surfaces. The mass that is not removed from the groundwater by attenuation will eventually discharge to the Mojave River.

2.5.2 Industrial/Storm Drain and Outfall Ditch

The remedial actions that have taken place for this site include removal of all contaminated sediments and replacement of the perforated portion of the pipe with nonperforated pipe, as discussed in detail in Section 2.2. Subsequent sampling of soil beneath the East Storm Drain indicated that the concentrations of contaminants were within background levels for GAFB soils as determined through the available data in conjunction with typical desert soil values presented in literature. Therefore, the soils beneath the Industrial/Storm Drain are not considered hazardous.

2.5.3 STP Percolation Ponds

The results of the soil sampling program conducted to evaluate the STP Percolation Ponds have indicated that, with the possible exception of nitrate, the concentrations of the contaminants of concern are within background concentrations for desert soils. Elevated nitrate concentrations are expected since the ponds were previously used for disposal of the STP effluent. These elevated concentrations are limited to the upper 46 feet of soils beneath the ponds. Elevated nitrate concentrations have previously been a subject of concern because the selected remedy for cleanup of the TCE in the groundwater beneath the NEDA includes discharge of treated groundwater to the STP Percolation Ponds (see Section 1.4). Studies of wastewater discharge to the soils of the Upper Mojave River Basin have shown that the potential for transport of nitrates to groundwater is low (USGS, 1993). This may be the result of low mobility in the soils in this area, denitrification in the unsaturated zone, or dilution by vertical mixing with groundwater. The STP Percolation Ponds have not been used since 1980 (JMM, 1992a). Based

on this information, discharge of the treated groundwater to the STP Percolation Ponds is not expected to impact groundwater. However, existing wells around the STP Percolation Ponds will be monitored for nitrates on a quarterly basis.

2.6 SUMMARY OF SITE RISKS

As in Section 2.5, discussion of site risks for the three sites that comprise OU 1 are presented separately. This risk assessment includes both a human health risk assessment and an environmental risk assessment. The purpose of the risk assessment was to provide an evaluation of the risks (both current and future) to human health and the environment posed by present site conditions, assuming no attempt to mitigate or prevent potential exposure. A summary of the carcinogenic risk and hazard indices calculated for OU 1 is presented in Table 2.

The OU 1 risk assessment was performed prior to validation of the available data. The data used for this risk assessment could not all be validated as reported in the Validation Summary Report (JMM, 1993c); however, validated data will be collected to support the conclusions of this risk assessment as part of the ongoing Investigation in Support of Remedial Design/Remedial Action (RD/RA) (Section 2.12).

2.6.1 Northeast Disposal Area

A baseline carcinogenic risk assessment associated with TCE was performed. The highest human carcinogenic risk to the future resident using the groundwater beneath the NEDA is estimated at $9x10^{-5}$ for the combination of water ingestion, dermal contact, and inhalation of volatiles from the groundwater. Since there are no current, completed exposure pathways, cancer risks have not been estimated for current exposure scenarios. This risk level is within the $1x10^{-4}$ to $1x10^{-6}$ (1:10,000 to 1:1,000,000) range established by the NCP but above the $1x10^{-6}$ level set by the State of California (JMM, 1992a).

Hazard index calculations for noncancer risks indicate the benchmark of 1.0 was exceeded at the NEDA for the scenario of future child RME (2.9). However, the probability that an adverse human health effect would occur is quite low given conservative exposure assumptions and the potential toxicity of the VOCs to humans (JMM, 1992a).

An environmental assessment was conducted to assess the potential risks to plants and animals due to the presence of TCE in groundwater beneath the NEDA. Since groundwater beneath the NEDA currently does not reach the surface, surface water is not a current route of exposure to environmental receptors. However, potential construction activities associated with future groundwater remediation could adversely affect plants and animals at the NEDA. Potential environmental receptors include birds, mammals, reptiles, and plants. The Mojave ground squirrel and the desert tortoise are considered to be the most sensitive species identified at GAFB. The desert tortoise is on the Federal Endangered Species List and the Mojave ground squirrel is on the California Endangered Species List.

TABLE 2

SUMMARY OF CANCER RISKS AND HAZARD INDICES FOR OPERABLE UNIT 1

Site / Receptor	Pathway	Cancer Risk		Hazard Index	
		Average	RME	Average	RME
Northeast Disposal Area					
On-and Off-Site Adult Residents, Future					
	Ingestion	9×10^{-6}	1×10^{-5}	1.9×10^{-1}	2.9×10^{-1}
	Inhalation	2×10^{-5}	8×10^{-5}	4.5×10^{-2}	4.1×10^{-1}
	Dermal	1×10^{-7}	4×10^{-7}	3.5×10^{-3}	1.1×10^{-2}
	Total	$\mathbf{3 \times 10^{-5}}$	$\mathbf{9 \times 10^{-5}}$	$\mathbf{2.4 \times 10^{-1}}$	$\mathbf{7.1 \times 10^{-1}}$
On- and Off-Site Child Residents, Future					
	Ingestion	NC	NC	3.5×10^{-1}	5.5×10^{-2}
	Inhalation	1×10^{-5}	3×10^{-5}	9.6×10^{-1}	2.80
	Dermal	3×10^{-7}	4×10^{-7}	1.7×10^{-2}	2.5×10^{-2}
	Total	$\mathbf{1 \times 10^{-5}}$	$\mathbf{3 \times 10^{-5}}$	**1.3**	**2.9**
Percolation Ponds					
Casual Visitor, Current					
	Ingestion	9×10^{-9}	9×10^{-9}	1.0×10^{-4}	1.2×10^{-4}
	Total	$\mathbf{9 \times 10^{-9}}$	$\mathbf{9 \times 10^{-9}}$	$\mathbf{1.0 \times 10^{-4}}$	$\mathbf{1.2 \times 10^{-4}}$
Construction Worker, Future					
	Ingestion	2×10^{-7}	2×10^{-7}	3.0×10^{-2}	3.3×10^{-2}
	Inhalation	9×10^{-7}	4×10^{-6}	3.8×10^{-2}	1.8×10^{-1}
	Total	$\mathbf{1 \times 10^{-6}}$	$\mathbf{4 \times 10^{-6}}$	$\mathbf{6.8 \times 10^{-2}}$	$\mathbf{2.1 \times 10^{-1}}$
On-Site Adult Residents, Future					
	Ingestion	2×10^{-6}	2×10^{-6}	6.4×10^{-3}	7.4×10^{-3}
	Inhalation	6×10^{-8}	8×10^{-8}	3.1×10^{-4}	1.6×10^{-3}
	Total	$\mathbf{2 \times 10^{-6}}$	$\mathbf{2 \times 10^{-6}}$	$\mathbf{6.7 \times 10^{-3}}$	$\mathbf{9.0 \times 10^{-3}}$
On-Site Children Residents, Future					
	Ingestion	NC	NC	6.0×10^{-2}	6.9×10^{-2}
	Inhalation	NC	NC	6.6×10^{-4}	9.2×10^{-4}
	Total	NC	NC	$\mathbf{6.0 \times 10^{-2}}$	$\mathbf{7.0 \times 10^{-2}}$
Industrial/Storm Drain					
Outfall Ditch, Future					
	Dermal	1×10^{-9}	2×10^{-9}	5.5×10^{-6}	1.0×10^{-5}
	Total	$\mathbf{1 \times 10^{-9}}$	$\mathbf{2 \times 10^{-9}}$	$\mathbf{5.5 \times 10^{-6}}$	$\mathbf{1.0 \times 10^{-5}}$
Contruction Worker, Future					
	Ingestion	3×10^{-7}	4×10^{-7}	1.6×10^{-2}	1.9×10^{-2}
	Inhalation	2×10^{-6}	2×10^{-6}	3.9×10^{-2}	4.8×10^{-2}
	Total	$\mathbf{2 \times 10^{-6}}$	$\mathbf{2 \times 10^{-6}}$	$\mathbf{5.5 \times 10^{-2}}$	$\mathbf{6.7 \times 10^{-2}}$

RME - 95 percent upper bound concentration

2.6.2 Industrial/Storm Drain and Outfall Ditch

The highest human carcinogenic risk, $2x10^{-6}$, is associated with a future construction worker scenario for incidental ingestion of soil and inhalation of fugitive dust containing metals. Although the calculated carcinogenic risk is slightly above the level established by the State of California, the detected metal concentrations are within native, background concentrations (JMM, 1992a).

The risk to potential environmental receptors at the Industrial/Storm Drain and Outfall Ditch was estimated to be low due to the low concentration of metals in surface and subsurface soils at the site. The site was not considered suitable habitat for most species (JMM 1992a).

Based on the risk assessment, it was determined that risks for the Industrial/Storm Drain and Outfall Ditch are within acceptable levels; therefore, remediation of this site would not be required.

2.6.3 STP Percolation Ponds

The highest human carcinogenic risk, $4x10^{-6}$, is associated with a future construction worker scenario for incidental ingestion of soil and inhalation of fugitive dust containing metals. Although the calculated carcinogenic risk is slightly above the level established by the State of California, the detected metal concentrations are within native, background concentrations (JMM, 1992a).

The risk to potential environmental receptors at the STP Percolation Ponds was estimated to be low due to the low concentration of metals in surface and subsurface soils at the site. The site was not considered suitable habitat for most species (JMM, 1992a).

Based on the risk assessment, it was determined that risks for the STP Percolation Ponds are within acceptable levels; therefore, remediation of this site would not be required.

2.7 DESCRIPTION OF ALTERNATIVES

The remediation goal of each of these alternatives is to reduce the concentration of TCE in the groundwater beneath and adjacent to NEDA to below the federal MCL of 5 μg/l. Three remedial alternatives that were retained from an analysis of remedial technologies, as part of the FS, are as follows (JMM, 1993a):

Alternative 1	1) No Action with Groundwater Monitoring
Alternative 2	1) Groundwater Monitoring 2) Groundwater Extraction 3) Treatment of Groundwater by Air Stripping 4) Discharge Treated Water to STP Percolation Ponds

5) Discharge of Emissions to the Atmosphere
6) Implementation of Appropriate Deed Restrictions

Alternative 3

1) Groundwater Monitoring
2) Groundwater Extraction
3) Treatment by Air Stripping with Emission Controls
4) Discharge Treated Water to STP Percolation Ponds
5) Implementation of Appropriate Deed Restrictions

2.7.1 Alternative 1 - No Action with Groundwater Monitoring

The no action alternative serves as a baseline against which other alternatives are compared, as required by the NCP for Superfund sites. Under this no action alternative, the TCE plume will be handled in a passive manner. Eight additional monitoring wells will be installed around the perimeter of the plume, and will be sampled quarterly to determine its movement and evaluate potential future impacts on any downgradient supply wells. Eight new monitoring wells will be located in pairs (one shallow [approximately 100 to 120 feet] and one deep [approximately 150 to 180 feet]) along the boundary of the plume, as determined from the latest results of the current quarterly monitoring program.

These eight monitoring wells will be sampled on a quarterly basis and samples will be analyzed for VOCs (USEPA Methods 601 and 602), including both chlorinated hydrocarbons and aromatic hydrocarbons. These analyses were specified on the basis of previous results of groundwater sampling and analysis at the site. Costs of sampling existing wells are not included in this alternative because such sampling is part of an existing program. If future investigations at GAFB indicate the presence of other contaminants at significant levels in the groundwater, the analytical parameters included in the monitoring program will be expanded accordingly. The groundwater monitoring component of Alternative 1 is also included in Alternatives 2 and 3.

The no action alternative will not reduce the risks to human health posed by VOCs in the groundwater beneath the NEDA, and provides no additional protection of human health or the environment.

2.7.2 Alternative 2 - Groundwater Extraction, Air Stripping, and Percolation

Alternative 2 consists of an estimated 19 extraction wells located on and off base, followed by treatment of extracted groundwater using two packed-tower air strippers in series for removal of the VOCs (primarily TCE), and disposal of the treated groundwater to the STP Percolation Ponds. Packed towers are a proven technology and have been selected for this analysis for the purposes of alternative comparison and relative cost analysis; however, other low-profile air stripping processes (such as rotostrippers) are available and would be considered prior to installation of the final system. Quarterly groundwater monitoring would be implemented, as for the no action alternative, to assess the effectiveness of the proposed remediation system. This active plume control alternative is designed to mitigate the advance of the TCE plume towards potential downgradient receptors, while reducing the mass of TCE retained in the

aquifer. The extraction system will ensure that VOC concentrations are reduced to concentrations below the federal MCL for TCE (currently 5 μg/l) and all other contaminants of concern. The groundwater from the extraction wells would be piped to the air stripping facility where TCE concentrations would be reduced to below 2.5 μg/l. The treated water, in turn, would be piped to the STP Percolation Ponds for recharge into the Upper Aquifer. The use of a portion of the treated groundwater for golf course irrigation may be considered in the future. As a temporary measure during startup and shakedown of the treatment facility, treated groundwater would initially be discharged to an arroyo (shown on Figure 9) near the treatment facility.

This alternative would be implemented in two phases. Phase I includes the installation of three on-base and six off-base extraction wells, four on-base and four off-base monitoring wells, gravity collection piping, and an air stripping treatment system. During this phase, the treated groundwater (approximately 260 gpm) will temporarily (approximately 6 months) be discharged to an existing wash near the treatment system. Appropriate precautions will be taken to avoid or minimize the impacts of erosion. Temporary discharge of the treated water will allow for testing and operation of the treatment system while the construction of a permanent recharge/reuse system is being completed. Phase I will also include the installation of an effluent clear well, construction of an effluent transmission pipeline, and rehabilitation of the existing percolation ponds to receive treated groundwater for recharge. Rehabilitation of the percolation ponds may include debris removal, repair of existing pavement and drainage, regrading, and installation of any appropriate fences. The proposed locations of the system components for Phase I are shown on Figure 9. The conceptual design for the effluent disposal system at the STP Percolation Ponds is shown on Figure 10.

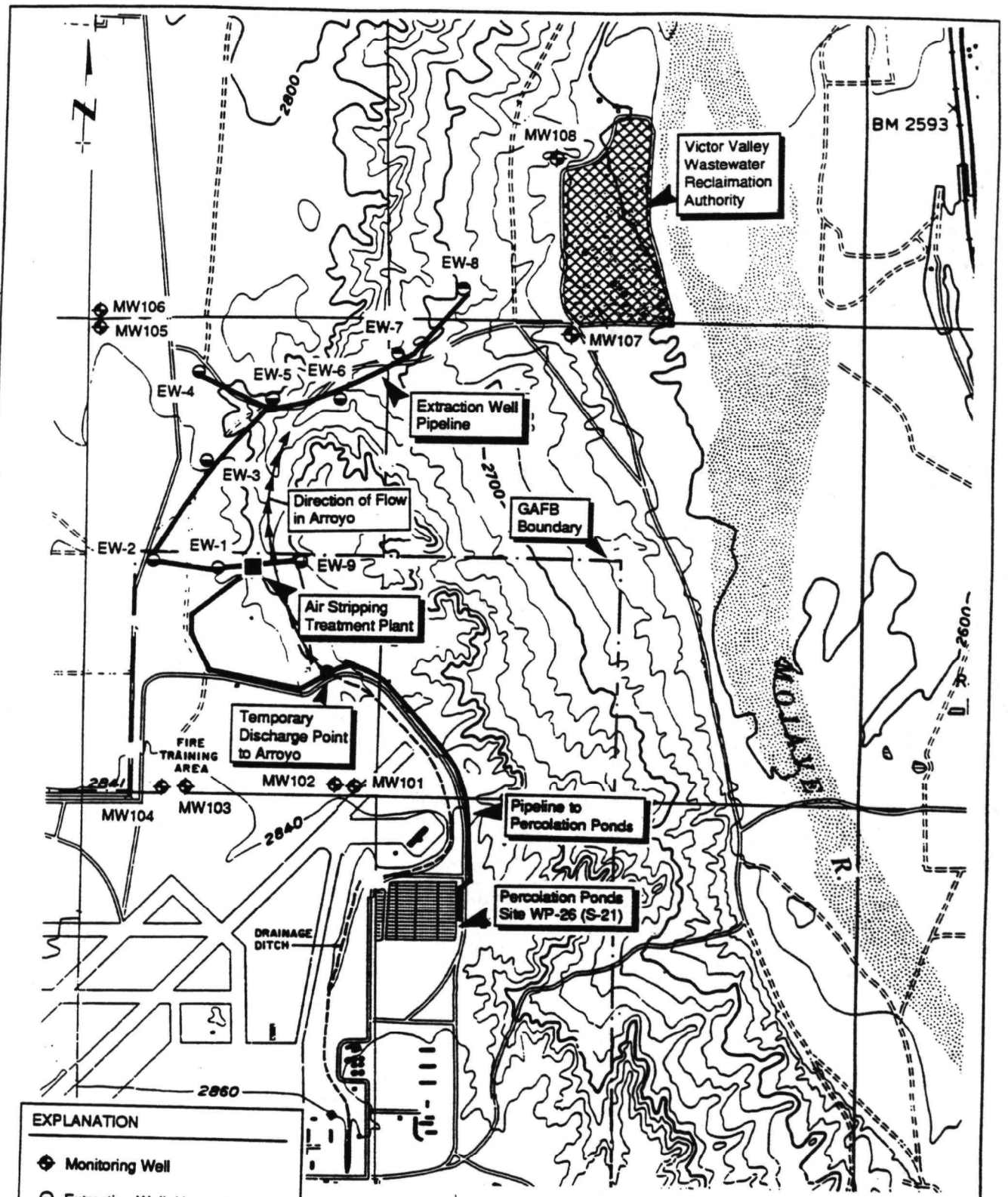
The second phase (Phase II) would occur in about 2 years and would include the installation of an estimated 10 additional extraction wells (nine off-base wells), additional pipeline and roadway, and local power distribution to new wells. The exact number and location of the additional wells would be determined based on the efficiency of the Phase I system and, therefore, are not shown on Figure 9.

Additionally, this alternative would include implementation of deed restrictions, as appropriate, to prohibit use of groundwater until groundwater cleanup levels have been achieved. Prior to sale or transfer of any GAFB property overlying contaminated groundwater beneath the NEDA, the USAF will record any appropriate land use restrictions in accordance with California Health and Safety Code Section 25230 as an institutional control.

2.7.3 Alternative 3 - Groundwater Extraction, Air Stripping with Emission Controls, and Percolation

Alternative 3 is the same as Alternative 2, with the addition of an emissions control system for air stripper off-gas.

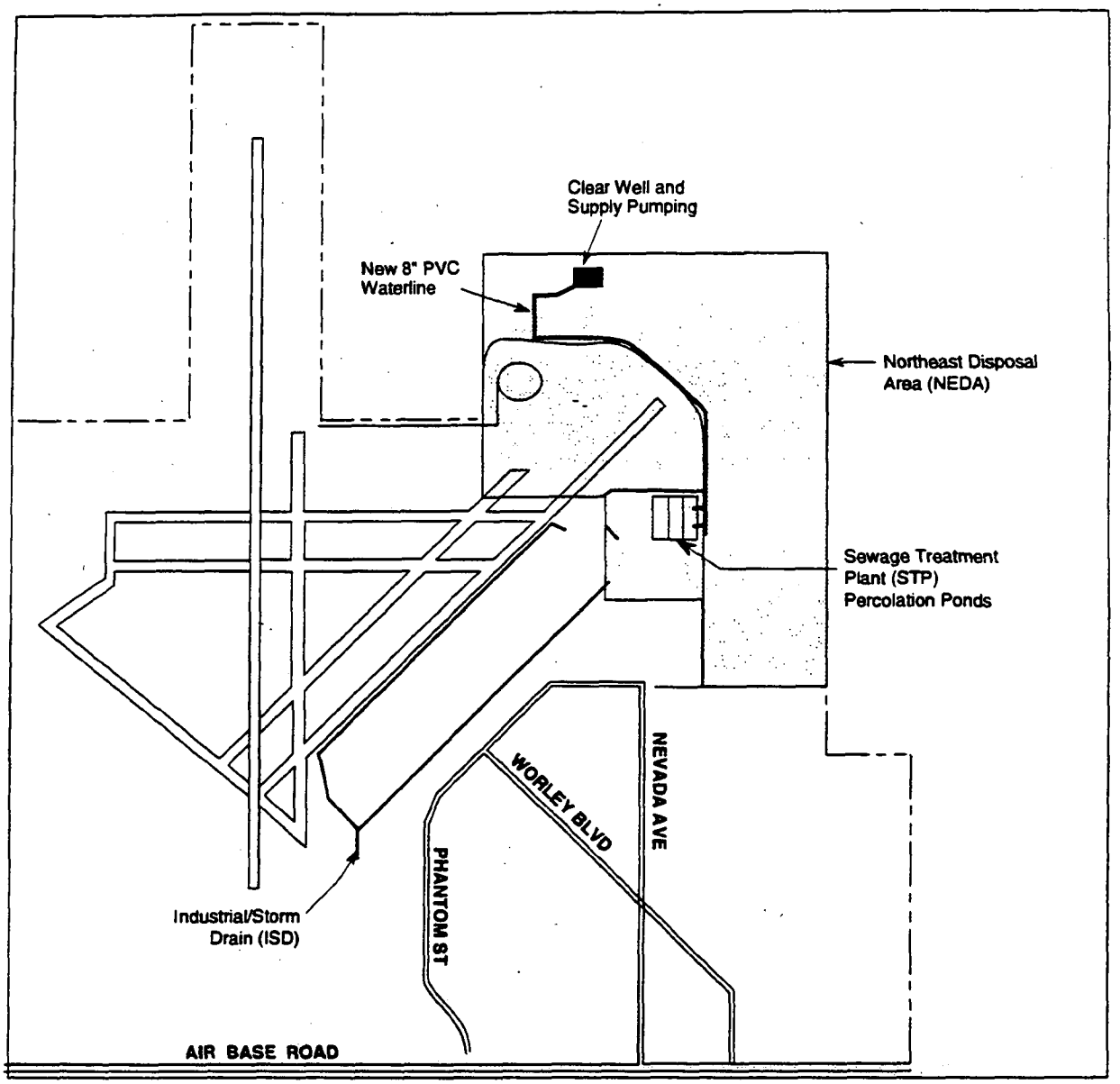
The results of an air emissions health risk assessment indicate that the VOC air emissions from the operation of the strippers for Alternative 2 do not warrant the use of emissions control



Topographic base maps modified from U.S. Geological Survey, Adelanto and Victorville 7.5' quadrangle maps.

CONCEPTUAL DESIGN OF PHASE I OF THE EXTRACTION AND MONITORING WELL SYSTEMS ALTERNATIVES 2 AND 3

FIGURE 9



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0 1600 3200

SCALE IN FEET

CONCEPTUAL DESIGN OF EFFLUENT DISPOSAL SYSTEM ALTERNATIVES 2 AND 3

FIGURE 10

FS.G-12

devices. This conclusion was based on the maximum (worst-case) total population excess cancer burden risk of approximately $1x10^{-6}$ and the maximum individual lifetime excess cancer risk of approximately $6x10^{-9}$ estimated for the air stripper without emissions control. Alternative 2 meets the "threshold" criteria (overall protection of human health and the environment and compliance with applicable or relevant and appropriate requirements [ARARs]); however, the addition of emission controls would provide an additional degree of protection and will be compared to Alternatives 1 and 2 with regard to the "primary balancing" criteria. A detailed discussion of this comparison is presented in Section 2.8.

2.8 SUMMARY OF COMPARATIVE ANALYSIS ALTERNATIVES

The remedial alternatives developed were analyzed in detail using the nine evaluation criteria required by the NCP. These criteria are classified as threshold criteria, primary balancing criteria, and modifying criteria. Threshold criteria are:

(1) Overall protection of human health and the environment
(2) Compliance with ARARs

Primary balancing criteria are:

(3) Long-term effectiveness and permanence
(4) Reduction of toxicity, mobility, or volume through treatment
(5) Short-term effectiveness
(6) Implementability
(7) Cost

Modifying criteria are:

(8) State/support agency acceptance
(9) Community acceptance

The resulting strengths and weaknesses of the alternatives were then weighed to identify the alternative providing the best balance among the nine criteria. Table 3 summarizes this comparison.

2.8.1 Overall Protection of Human Health and the Environment

This criterion is an overall assessment of whether each alternative provides adequate protection of human health and the environment. The evaluation focuses on a determination of the degree to which a specific alternative achieves adequate protection and describes the manner in which site risks are eliminated, reduced, or controlled through treatment, engineering, or institutional measures. The potential for cross-media impacts is also assessed.

Alternative 1: The results of computer modeling for the no action scenario show that the center of the TCE plume will move approximately 1 mile from the northern GAFB boundary in

TABLE 3

SUMMARY OF DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

Alternative	Total Cost [a]	Effectiveness	Technical Feasibility	Reduction of Toxicity, Mobility, or Volume (TMV)	Compliance with State, Federal, and Local Regulations	Health Assessment
1. No Action with continued groundwater monitoring	$631,900	Not Effective	No Technical Limitations	No Reduction in TMV	Does not Comply	Potential for Future Exposure Remains
2. Groundwater Extraction, Air Stripping, and Percolation	$7,864,300	Effective	Easily Implemented	Significant Reduction in TMV for Groundwater	Compliance is Achievable	Potential for Future Exposure Significantly Reduced
3. Groundwater Extraction, Air Stripping, Emission Controls, and Percolation	$9,999,100	Effective	Easily Implemented	Significant Reduction in TMV for Groundwater and Air	Compliance is Achievable	Potential for Future Exposure Significantly Reduced

[a] Shown in 1992 Dollars.

approximately 30 years. This plume is expected to move northeasterly around the mound created by the VVWRA percolation ponds and begin discharging into the Mojave River Aquifer after approximately 15 years at an expected maximum concentration of 10 μg/l. The results of the health risk assessment conducted as part of the RI show potential unacceptable future risk if the plume is not remediated. If a future residential exposure scenario is assumed whereby a water supply production well is placed at the center of the TCE plume, the upper-bound excess cancer risk is estimated to be 3.1×10^{-5}, which is higher than acceptable levels of risk (10^{-6}) established by the California Environmental Protection Agency (Cal-EPA). This calculation assumes consumption of 2 liters per day of TCE-contaminated water by a 70-kg adult, and inhalation of TCE vapors and dermal contact during daily showers for 30 years (exposure from other contaminants was assumed to be negligible, based on a statistical analysis of sampling results). Under the conditions of this hypothetical future residential exposure, the no action alternative does not provide adequate protection of human health and the environment. Because contaminated groundwater would not be available except through future installation of a supply well, the risk to environmental receptors is minimal at this time.

Alternative 2: The extraction and treatment of the contaminated groundwater provides protection to public health and the environment by eliminating the potential for ingestion or inhalation of TCE above acceptable levels from future water supplies. Although results of the conservative groundwater modeling, which assumed no evaporative losses during recharge, indicated that some TCE leakage through the extraction system could occur within 15 years, continued groundwater monitoring will be employed and an appropriate enhancement of the treatment system will be developed as necessary to ensure proper containment of the plume. Therefore, no excess cancer risk via the groundwater pathway is associated with this alternative. As for Alternative 1, the environmental impacts of this alternative are expected to be minor because there would be no contact of wildlife with the extracted groundwater prior to treatment.

A second potential exposure pathway for this alternative is the uncontrolled emission of TCE in stripper off-gas. This route was originally assessed as part of the initial FS, based on an influent TCE concentration of 150 μg/l and a groundwater flow rate of 500 gpm. "Worst-case" and "most probable" estimates of the rate of TCE air emissions were calculated for the proposed air stripping operations at this concentration. These two scenarios were defined as follows (Appendix F, JMM, 1988a):

- The "worst-case" scenario is the highest mass emission rate of contaminants expected during the initial operation of the stripping facility. This rate is assumed to extend for the duration of air stripper operations.

- The "most probable" scenario is the expected emission rate of contaminants from the stripper facility, if the total mass of contaminants emitted from operations are prorated over the life of the facility.

The resulting calculated worst-case and most probable TCE emission rates (based on a 150-μg/l influent) were 4.73×10^{-3} g/sec (0.90 lbs/day) and 1.58×10^{-3} g/sec (0.30 lbs/day), respectively. These emission rates were then used to estimate the risk to the surrounding population based

on an analysis of the long-term average concentration patterns in the atmosphere and the equivalently long-term patterns of the local population distribution. The contribution of benzene and 1,2-dichloroethane (1,2-DCA) was also included in the analysis (JMM, 1988a).

Four categories of risk were considered in this analysis:

- Potential risk to an individual located at the most exposed point (i.e., point of highest ground level concentrations). Maximum concentrations were found to occur at two points 200 meters north and east, respectively, of the proposed stripper location. No residences are located in these areas.

- Potential risk to an individual located at the most exposed existing residence.

- Potential community excess cancer burden, based on consideration of the combined risk to the 43,244 people estimated to live within a 20-kilometer (km) radius of the stripper location (JMM, 1988a).

- Mean individual excess cancer burden for each of the 43,244 individuals living within 20 km of the stripper location.

The results of this analysis, conducted for emissions of TCE, benzene, and 1,2-DCA over a simulated 10-year period, are presented in the 1988 FS report (JMM, 1988a). On the basis of these results, it was concluded that both the maximum individual lifetime cancer risk and the total surrounding excess cancer burden were insignificant and it was not necessary to control VOC emissions from the proposed air stripping system.

Since the 1988 FS analysis, several of the factors considered in the air emission risk analysis have changed, as listed below:

- The inhalation unit risk factor for TCE has increased from 1.3×10^{-6} to 2×10^{-6} $(\mu g/m^3)^{-1}$.

- The estimated average TCE concentration stripper influent has decreased from 150 to 47 $\mu g/l$, based on more recent groundwater monitoring results.

- Additionally, the levels and frequency of detection of benzene, 1,2-DCA, and other VOCs decreased to the point where they were not considered statistically reliable for risk assessment purposes.

- The period of groundwater remediation (and stripper operation) was increased from 10 to 30 years.

Based on these considerations and changes, the original risk calculations were updated to reflect the current understanding of the conditions at the site and the potential treatment scenario.

Based on this reassessment, the maximum lifetime cancer risk for the most exposed individual was estimated to be less than $6x10^{-9}$. Stated another way, the risk to the most highly exposed individual is less than one chance in one hundred million that an individual would develop cancer due to the inhalation exposure of TCE in the ambient air if the individual were to reside at the point of maximum exposure for a 70-year lifetime. The point of maximum exposure is 200 meters east or north of the stripper facility. For comparison, the risk level of concern for the DTSC and the Mojave Air Quality Management District (AQMD) (formerly San Bernardino County Air Pollution Control District [APCD]), which is under the jurisdiction of the California Air Resources Board (ARB), is $1x10^{-6}$ or less than one in one million. The estimated lifetime cancer risk for individuals residing at the "most exposed residence" was found to be two orders of magnitude lower than the risk for the maximum exposure point. The estimated risk for the average residence in the area was an additional two orders of magnitude lower than the "most exposed residence."

The worst-case community excess cancer burden was estimated based on the community population of 43,244 individuals. The excess cancer burden is defined as the number of excess tumors per one million exposed individuals due to exposure to a specified compound. The estimated excess lifetime cancer burden for an individual in the maximum exposed area would be approximately $2x10^{-11}$ (cancer risk per million times the exposed population). The Cal-EPA DTSC has established a benchmark of one excess cancer development in one million exposed individuals as an acceptable risk and the Mojave AQMD has no established benchmark value for an excess cancer burden. The excess cancer burden is well below background levels and should not present an excess risk to any potentially exposed individuals.

Based on the above calculations, the use of gas-phase granular activated carbon (GAC) or catalytic oxidation technologies to control TCE emissions from the proposed air stripper is not considered necessary to protect human health. Additionally, the emission rate of TCE is estimated to be 0.28 lbs/day, based on an influent concentration of 47 μg/l. (Based on expected stripper influent concentrations, the contribution of other VOCs to overall emissions is expected to be negligible.)

Alternative 3: This alternative is as protective as Alternative 2. Although unwarranted by risk assessment considerations, the inclusion of emissions control in the form of gas-phase GAC provides an additional degree of overall protection. In this alternative, TCE groundwater is transferred to GAC which must then be regenerated or properly disposed.

2.8.2 Compliance with ARARs

Pursuant to Section 121 (d) CERCLA, as amended, the remedial actions must attain a degree of cleanup which assures protection of human health and the environment. In addition CERCLA requires that remedial actions meet standards, requirements, limitations, or criteria that are applicable or relevant and appropriate requirements (ARARs). ARARs are of three types: chemical-, action-, and location-specific. Identification and consideration of potential ARARs associated with a site and its remedial action is an ongoing process throughout site characterization and remediation.

An ARAR may be either "applicable" or "relevant and appropriate," but not both. The NCP defines "applicable" and "relevant and appropriate requirements" as follows:

> Applicable requirements means those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental, or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. Only those state standards that are identified by a state in a timely manner, and that are more stringent than federal requirements, may be applicable.
>
> Relevant and appropriate requirements means those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental, or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified by a state in a timely manner, and that are more stringent than federal requirements, may be applicable.

In other words, a requirement is "applicable" when the remedial action or the circumstances at the site satisfy all of the jurisdictional prerequisites of that requirement. Maximum Contaminant Levels (MCLs) and nonzero Maximum Contaminant Level Goals (MCLGs) established for drinking water, while not directly applicable to groundwater cleanups, are potential ARARs when they are relevant and appropriate under the terms of the release. Relevant and appropriate requirements must be complied with to the same degree as if they were applicable, but there is more discretion in this determination and it is possible for only part of a requirement to be considered relevant and appropriate in a given case.

Where no promulgated standards exist for a given chemical or situation, nonpromulgated advisories and guidance ("to-be-considered" materials [TBCs]) issued by federal or state government may be used in determining the necessary level of cleanup for protection of human health or the environment. TBCs do not have the status of potential ARARs; however, in many circumstances they will be considered along with ARARs as part of the site risk assessment and may be used in determining the necessary level of cleanup.

Identification of ARARs and TBCs must be done on a site-specific basis. Neither CERCLA nor the NCP provides across-the-board standards for determining whether a particular remedy will effect an adequate cleanup at a particular site. Rather, the process recognizes that each site will have unique characteristics that must be evaluated and compared to those requirements that apply under the given circumstances.

The contaminant specific ARARs for OU 1 are federal drinking water standards and promulgated State of California drinking water standards which are more stringent than federal standards. Cleanup levels are set at health based levels reflecting current and potential use and exposure. For systemic (noncarcinogenic) toxicants, cleanup levels represent that amount to which humans

could be exposed on a daily basis without appreciable adverse effects occurring during their lifetime. For carcinogens, cleanup levels must fall within a 10^{-8} to 10^{-6} risk range. (NCP, 40 CFR §300.430[e][2][i][A][2]).

Potential drinking water regulations include MCLs for specific contaminants (Section 1412 of the Safe Drinking Water Act, 42 USC §300g-1, National Primary Drinking Water Regulations, 40 CFR Part 141). Maximum contaminant levels are enforceable standards which apply to specified contaminants which the USEPA has determined have an adverse effect on human health. The MCL for TCE is 5 μg/l. Maximum contaminant levels are set at levels that are protective of human health and set close to MCLGs.

A listing of federal and state laws and regulations that are ARARs is provided in Tables 4 through 7.

2.8.2.1 Chemical-Specific ARARs. Chemical-specific ARARs include those environmental laws and regulations that regulate the release to the environment of materials possessing certain chemical or physical characteristics or containing specified chemical compounds. These requirements generally set health- or risk-based concentration limits or discharge limits for specific hazardous substances (USEPA, 1989).

Chemical-specific ARARs are determined by identifying federal and state environmental statutes that are potentially applicable or relevant and appropriate to chemicals found at a particular site. Both ARARs and TBCs are subject to a site-specific risk assessment to ensure exposure levels are within acceptable limits for the protection of human health and other environmental receptors. In some cases, such as multiple exposure pathways or multiple contaminants, a risk assessment may indicate that an ARAR alone is not sufficiently protective and TBCs, including risk-based limits, will be used to establish more stringent clean-up requirements.

Groundwater, included in OU 1, has been impacted by VOC contamination. Specifically, TCE is the contaminant of concern for the groundwater beneath the NEDA. A list of all chemicals found in groundwater at the NEDA is presented in Table 1.

Nonzero MCLGs and MCLs are relevant and appropriate requirements in cases where surface water or groundwater is or may be directly used for drinking water, in which case the MCLs/MCLGs should be met in the surface water or groundwater itself.

Additionally, the Cal-EPA has established numerical criteria (State Action Levels [SALs]) for selected chemicals in drinking water for which state MCLs have not yet been established. While SALs are considered "technically nonenforceable standards," Cal-EPA has established a policy by which any water system not meeting the SALs is required to take corrective action. Although SALs are not promulgated, they could qualify as TBCs under appropriate circumstances.

California has promulgated MCLs for primary VOCs; however, the USEPA has chosen the federal MCL for TCE as the groundwater cleanup standard for OU 1 because the California MCL for TCE is equal to the federal MCL. Accordingly, the ARAR for the final aquifer

TABLE 4

IDENTIFICATION OF *FEDERAL* CHEMICAL-SPECIFIC ARARs

Standard, Requirement, Criteria, or Limitation	Citation	Description	Applicable/ Relevant and Appropriate	Comment	Associated Remedial Alternative
Safe Drinking Water Act	42 USC Sec. 300g				
National Primary Drinking Water Standards	40 CFR Part 141	Establishes Maximum Contaminant Levels (MCLs) and Maximum Contaminant Level Goals (MCLGs) for contaminants in public water systems, based on health, technological, and economic considerations. MCLs and non-zero MCLGs are enforceable standards under the NCP.	No/Yes	Relevant and appropriate for aquifers which are deemed to be potential drinking water supplies. Cleanup standards for OU 1 ground water within the aquifer are the federal and state MCLs (e.g., TCE = 5 ppb).	1, 2, 3

TABLE 5

IDENTIFICATION OF *FEDERAL* LOCATION-SPECIFIC ARARs

Standard, Requirement, Criteria, or Limitation	Citation	Description	Applicable/ Relevant and Appropriate	Comment	Associated Remedial Alternative
Endangered Species Act	16 USC Sec. 1531-1543 40 CFR 6-302(h) 50 CFR Part 200 50 CFR Part 402	Requires that Federal agencies ensure that any action authorized, funded, or carried by the agency is not likely to jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify critical habitat.	• Yes/---	Critical habitats of threatened or endangered species (e.g., the desert tortoise) exist in the vicinity of GAFB, but these habitats would not be adversely affected by any remedial actions for OU 1.	1, 2, 3

TABLE 6

IDENTIFICATION OF *FEDERAL* ACTION-SPECIFIC ARARs

Standard, Requirement, Criteria, or Limitation	Citation	Description	Applicable/ Relevant and Appropriate	Comment	Associated Remedial Alternative
Solid Waste Disposal Act	42 USC Sec. 6901-6987				
Standards Applicable to Generators of Hazardous Waste	40 CFR Part 262	Establishes standards for generators of hazardous waste.	Yes/---	Potentially applicable to remedial alternatives involving treatment facilities which generate hazardous waste (e.g., spent activated carbon).	3
Standards Applicable to Transporters of Hazardous Waste	40 CFR Part 263	Establishes standards which apply to persons transporting hazardous waste within the U.S. if the transportation requires a manifest under 40 CFR Part 262.	Yes/---	Potentially applicable to remedial alternatives involving the transport of hazardous waste (e.g., spent activated carbon).	3
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	40 CFR Part 264	Establishes minimum national standards which define the acceptable management of hazardous waste for owners and operators of facilities which treat, store, or dispose of hazardous waste.	Yes/---	Potentially applicable to remedial alternatives involving the use of activated carbon and its subsequent handling and disposal, as well as air strippers and other miscellaneous facilities which treat, store, or dispose of hazardous waste.	2, 3
Interim Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	40 CFR Part 265	Establishes minimum national standards that define the acceptable management of hazardous waste during the period of interim status and until certification of final closure, or if the facility is subject to post-closure requirements, untial post-closure responsibilities are fulfilled.	Yes/---	Potentially applicable to remedial alternatives involving the use of activated carbon and its subsequent handling and disposal, as well as air strippers and other miscellaneous facilities which treat, store, or dispose of hazardous waste.	3
Land Disposal Restrictions	40 CFR Part 268	Establishes criteria and timetables for the restriction of land disposal of hazardous waste.	Yes/---	Potentially applicable to remedial alternatives involving the land disposal of hazardous waste.	3
Hazardous Waste Permit Program	40 CFR Part 270	Establishes provisions covering basic permitting requirements.	Yes/---	May apply if off-site land disposal of hazardous waste is part of a remedial alternative (i.e., spent activated carbon).	3

TABLE 7

IDENTIFICATION OF *STATE* ACTION-SPECIFIC ARARs
(Page 1 of 2)

Standard, Requirement, Criteria, or Limitation	Citation	Description	Applicable/ Relevant and Appropriate	Comment	Associated Remedial Alternative
State Water Resources Control Board's Nondegradation Policy	State Water Resources Control Board Resolution No. 68-16	Establishes the State Board's policy on maintaining the high quality of California's waters.	Yes/---	Applicable to remedial alternatives involving the discharge of treated water which would eventually reach the ground water. This policy was used, together with the federal and state MCLs, in setting the OU 1-specific cleanup standard for TCE in the treatment effluent discharge.	2, 3
Hazardous Waste Management Regulations	22 CCR, Div. 4.5, Sec. 66260 et seq.	Establishes state regulations governing hazardous waste control; management and control of hazardous waste facilities transportation; laboratories; classification of extremely hazardous, hazardous, and nonhazardous waste.	Yes/---	Potentially applicable to remedial alternatives involving the use of activated carbon and its subsequent handling and disposal, as well as air strippers and other miscellaneous facilities which treat, store, or dispose of hazardous waste.	2, 3
Mojave Air Quality Management District Guideline	Pursuant to Mulford-Carrell Air Resources Act (Health and Safety Code Sections 39000-44563; 17 CCR, Part III)	Will not require emission controls on air strippers as long as TCE emissions remain below 1 lb/day.	Yes/---	Applicable to remedial alternatives which discharge emissions directly to the atmosphere (i.e., airstrippers with no emission controls).	2
Water Quality Control Plan for the Lahontan Region (Basin Plan)	Page I-5-3, item d	Prohibits the discharge of waste water except to the designated disposal sites	Yes/---	Applicable to remedial alternatives involving the discharge of treated or partially treated water.	2, 3
Water Quality Control Plan for the Lahontan Region (Basin Plan)	Page I-5-3, item f	Requires the collection, transport, treatment or disposal facilities to be adequately protected from a 100-year flood.	Yes/---	Applicable to remedial alternatives with treatment facilities.	2, 3

TABLE 7

IDENTIFICATION OF *STATE* ACTION-SPECIFIC ARARs
(Page 2 of 2)

Standard, Requirement, Criteria, or Limitation	Citation	Description	Applicable/ Relevant and Appropriate	Comment	Associated Remedial Alternative
Sources of Drinking Water Policy	State Water Resources Control Board Resolution 88-63	Defines all ground and surface water as existing or potential sources of drinking water unless total dissolved solids are greater than 3,000 ppm, the well yield is less than 200 gpd from a single well, or ground water is reasonable to treat using best management practices or best economically achievable treatment practices.	Yes/---	The identification of the OU 1 aquifers affected by TCE as potential drinking water sources forms the basis for selection of MCLs and SWRCB Resolution 68-16 as specific ARARs to maintain existing high quality waters.	1, 2, 3
Water Quality Control Plan for the Lahontan Region (Basin Plan)	Table 2-1, Beneficial Uses of Ground Waters in Upper Mojave Hydrologic Unit (628.20)	Defines beneficial uses for ground waters beneath GAFB as: municipal, agricultural, industrial service and freshwater replenishment.	Yes/---		1, 2, 3
Porter-Cologne Water Quality Control Act	California Water Code Section 13267	Requires any person discharging waste to submit technical and monitoring reports, considering the need and benefits to be obtained.	Yes/---	Provides the basis for development of reporting, notification, and monitoring programs during the RD/RA phase.	2, 3
Water Quality Control Plan for the Lahontan Region (Basin Plan)	Page I-76, item 2	Requires any person discharging waste to submit technical and monitoring reports, considering the need and benefits to be obtained.	Yes/---	Provides the basis for development of reporting, notification, and monitoring programs during the RD/RA phase.	2, 3

cleanup level will be the federal MCL for TCE. Therefore, the final aquifer cleanup level will be 5.0 μg/l TCE.

Soil in the unsaturated zone is not impacted as a result of groundwater contamination in the Northeast Disposal Area. Therefore, chemical-specific ARARs have not been identified for this medium.

2.8.2.2 Location-Specific ARARs. As defined in the USEPA draft guidance (USEPA, 1988):

> "Location-specific ARARs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they are in specific locations. Some examples of special locations include floodplains, wetlands, historic places, and sensitive ecosystems or habitats."

Endangered species and their habitats are protected by the Endangered Species Act (ESA) (16 USC Sections 1531-1543). The desert tortoise and the Mojave ground squirrel are potentially sensitive, rare, or threatened species within the vicinity of OU 1 which are protected by the ESA. Therefore, the ESA is an ARAR for on-site actions. The proposed remedial actions could affect these species or their critical habitat during invasive installation. The mitigation efforts that would be performed prior to installation of any remediation system would entail inspection of the proposed location (i.e., extraction well or monitoring well location) for endangered species by qualified personnel, and selection of an alternative to eliminate or minimize impacts to these species if their presence is detected.

2.8.2.3 Action-Specific ARARs. Action-specific ARARs are restrictions that define acceptable treatment and disposal procedures for hazardous substances. These ARARs generally set performance, design, or other similar action-specific controls or restrictions on particular kinds of activities related to management of hazardous substances or pollutants, such as Resource Conservation and Recovery Act of 1976 (RCRA) regulations for waste treatment, storage, and disposal. These requirements are triggered by the particular remedial activities that are selected to accomplish a remedy. The type and nature of these requirements is dependent upon the particular remedial or removal action taken at a site. Therefore, different actions or technologies are often subject to different action-specific ARARs.

Drinking water is considered to be the highest beneficial use and remediation to drinking water standards affords the greatest level of protection and cleanup. As required by the California Porter-Cologne Water Quality Act, the Lahonton RWQCB defines the beneficial uses of various water bodies for the Mojave River Basin. Water bodies and their beneficial uses are presented in the Lahonton Basin Plan. The Basin Plan classifies aquifers in the OU 1 area to have "existing or potential beneficial uses as sources of drinking water." This regional plan has been promulgated and portions thereof are ARARs with respect to OU 1. The identification of the beneficial uses of the groundwater at OU 1 serves as the basis for selection of the federal MCL for TCE for the groundwater cleanup and the selection of maximum TCE concentrations for

discharges of effluents into the percolation ponds pursuant to Resolution 68-16 as determined by the dispute resolution process discussed below (Discharge ARARs).

Treatment ARARs:

Use of activated carbon for remediation of VOCs under Alternative 3 could trigger requirements associated with regeneration or disposal of the spent carbon. If the spent carbon is listed waste or a characteristic waste then it is regulated as a hazardous waste under RCRA (42 USC §9601, et seq.) and California's Hazardous Waste Management (HWM) regulations (22 CCR 66262.10 - 66262.57).

Movement of contaminants to new locations would trigger standards applicable to transporters of hazardous waste (RCRA 40 CFR §263). Placement in or on land would trigger land disposal restrictions for the waste (RCRA 40 CFR §268). Additionally, closure for units which store hazardous waste for more than 90 days must be met (RCRA 40 CFR §264.110 - 264.120).

Containers used for storage of contaminated carbon that is classified as a listed or characteristic waste must comply with California HWM regulations (22 CCR 66262.30 - 66262.33). Accumulation of hazardous waste on site for more than 90 days may trigger the requirements set forth in RCRA [40 CFR Part 264] and California HWM regulations (22 CCR 66264).

On-site storage of contaminated carbon can trigger state requirements such as California HWM regulations (22 CCR 66262.10 - 66262.43, and 66264) and municipal or county hazardous material ordinances. If the spent carbon is a hazardous waste, construction and monitoring requirements for storage facilities may also apply (RCRA 40 CFR §262-265 and 270).

Disposal of contaminants can trigger RCRA land disposal restrictions for disposal. If land disposal restrictions are triggered, spent carbon would need to meet treatment standards and RCRA off-site Subtitle C disposal restrictions would also apply.

Alternative 3 may utilize off-site thermal regeneration of the spent carbon. Regeneration of activated carbon, using high-temperature thermal process, is considered "recycling" under both federal RCRA regulations and California hazardous waste regulations. Transportation, storage, and generation of hazardous waste for recycling must comply with requirements of RCRA and California HWM regulations (22 CCR Sections 66262.10 - 66262.57). Performance standards for hazardous waste incinerators can also be requirements for on-site carbon reactivation.

Discharge ARARs:

Surface water is not impacted as a result of groundwater contamination in the NEDA and none of the detailed alternatives includes discharge to surface water. However, Alternatives 2 and 3 include temporary discharge of treated groundwater to a nearby arroyo during startup and shakedown of the treatment facility. Examples of potential chemical-specific ARARs in the event that treatment system effluent were discharged to surface water would include ambient water quality criteria, or nonzero MCLGs and MCLs in cases where surface water may be used

directly for drinking water. However, because of the intermittent nature of this runoff area, with surface flow occurring only during heavy storms, the arroyo has not been considered a surface water.

On October 2, 1992, the RWQCB invoked dispute resolution regarding, in part, effluent discharge levels for TCE at the NEDA. On April 22, 1993, the USEPA Administrator issued a decision finding that the California State Water Quality Control Board's anti-degradation policy (Resolution 68-16) is an ARAR with respect to discharges of TCE at OU 1, and returned the matter to the USEPA Region IX Acting Regional Administrator (Regional Administrator) to determine an appropriate standard for discharges into the percolation ponds at OU 1. Based upon negotiations between the USAF, the State of California, and the USEPA, on July 9, 1993, the Regional Administrator issued a final dispute resolution decision which set the effluent level to be measured from the sampling port at 2.5 μg/l TCE on a median basis with a stated maximum discharge level of 5 μg/l TCE. The decision further stated that the USAF will seek to treat the discharge to attain a level of 0.5 μg/l TCE as measured at the percolation ponds, although such efforts do not constitute an enforceable discharge standard.

The USEPA's Office of Solid Waste and Emergency Response (OSWER) has issued a directive, "Control of Air Emissions from Superfund Air Strippers at Superfund Groundwater Sites," which contains a Statement of Policy regarding the need for emissions controls at such facilities (USEPA, 1989). This directive states that, for strippers located in areas that are nonattainment for ozone, regions should:

> ... be guided by the emission limit goals in the document entitled, "Issues Relating to VOC Regulations Cutpoints, Deficiencies, and Deviations," issued in May 1988 by the Office of Air Quality Planning and Standards (OAQPS) to aid States in revising their State Implementation Plans (SIPs) to incorporate post-1987 ozone attainment strategies. The OAQPS guidance indicates that the sources most in need of controls are those with an actual emissions rate in excess of 3 pounds per hour (lbs/hr) or 15 lbs/day or a potential (i.e., calculated) rate of 10 tons per year (TPY) of total VOCs. The calculated rate assumes 24-hour operation, 365 days per year.

The Mojave AQMD has stated that they will not require emissions controls on the air strippers as long as TCE emissions remain below 1 lb/day. The AQMD has the authority to set this level based on the Mulford-Carrell Air Resources Act (Health and Safety Code Sections 39000-44563; CCR Title 17, Part III).

2.8.2.4 Compliance with ARARs

Alternative 1: The no action alternative does not comply with ARARs. TCE, the contaminant of concern, in the groundwater at concentrations above MCLs would be left unaddressed in this alternative.

Alternative 2: This alternative provides for treatment of groundwater using an air stripper system and discharging treated groundwater to the percolation ponds. ARARs for aquifer clean-up and discharge would be met. The air emission ARAR of 1 lb/day would also be met.

Alternative 3: This alternative meets all of the ARARs that Alternative 2 meets. In addition, ARARs pertaining to the use of GAC would also be met.

2.8.3 Long-Term Effectiveness and Permanence

The purpose of this criterion is to assess the residual risk and the adequacy and reliability of controls associated with a particular alternative. The magnitude of risk resulting from the presence of untreated waste or treatment residuals is assessed with respect to the volume or concentration of residual contaminants.

The second component, adequacy and reliability of controls, assesses the containment systems and institutional controls in place to determine if they are sufficient to ensure that both human and environmental exposure is within protective levels. The long-term reliability of management controls to provide continued protection from residuals is also addressed with regard to (1) the potential need to replace technical components of the alternative, and (2) the potential exposure pathway and resulting risks should the remedial action need replacement.

Alternative 1: Although the current TCE contamination in the groundwater is expected to be below ARARs before it reaches existing production wells, this alternative does not control exposure to contaminated groundwater under an unlimited future land use scenario, nor does it provide a long-term management measure.

Alternative 2: Because this alternative will remove and treat contaminated groundwater to below ARARs, as discussed above, it provides effective and permanent remediation of groundwater. To ensure the successful performance of the extraction system, groundwater will be monitored on a quarterly basis. System enhancement may be employed as necessary if any leakage of TCE from the extraction system capture zone is anticipated. Effluent from the air stripper will be analyzed for VOCs on a monthly basis (based on mass balance calculations using treatment system influent and effluent concentrations), and more frequently during the initial startup and shakedown period.

No treatment residuals, other than the air emissions, are expected for this alternative. Operation of the alternative components is expected to be reliable because they are proven technologies. Effective management will include frequent inspections and maintenance to avoid component failure.

Alternative 3: This evaluation factor is the same as for Alternative 2. All technologies used in this alternative are proven and reliable. Effective management and operation of the facility will ensure that necessary maintenance is provided to prevent component failure. Residual risk is minimal as long as spent carbon is properly handled.

2.8.4 Reduction of Toxicity, Mobility, and Volume through Treatment

Alternatives are assessed to determine the extent to which they permanently reduce toxicity, mobility, and volume (TMV) of the contaminants posing the principal threats at a site. The specific factors considered in this assessment include:

- treatment or recycling process(es) of associated target contaminants and the amount of contaminants to be destroyed or treated;
- degree of expected reduction in the TMV and the degree to which treatment or recycling will be irreversible;
- type and quantity of treatment residuals expected to remain following treatment; and
- whether or not the alternative satisfies the statutory preference for treatment as a principal element.

Alternative 1: This alternative provides no active reduction of the TMV of contaminated groundwater.

Alternative 2: Treatment of contaminated groundwater by air stripping results in the irreversible transfer of contaminants from one media (groundwater) to another (air). However, this transfer reduces the effective toxicity of the stripped TCE by lowering the relative media-related risk. Exposure to TCE at 47 μg/l in the public water supply was determined to pose an unacceptable risk to human health. Although the same mass of contaminant in stripper off-gas did not pose such a risk, the mobility and volume of contaminants in air is actually increased. In summary, this alternative reduces the TMV of contaminants in the media with the potential for greatest risk (groundwater) but does not address the TMV of contamination in the air stripper off-gas.

Alternative 3: This alternative provides a reduction in mobility and volume of TCE by transferring it to a small volume of solid material. The adsorbed TCE can then be destroyed when the carbon is thermally regenerated. Other disposal methods may result in eventual release of the contaminants if improperly implemented. By destroying the contaminants, this treatment method is irreversible.

2.8.5 Short-Term Effectiveness

Alternatives are evaluated with respect to their effects on human health and the environment during implementation of the remedial action. This evaluation addresses protection of site workers and the community during remedial actions, potential environmental impacts, and the time until remedial action objectives are achieved.

Alternative 1: This alternative is expected to take 3 to 4 months to implement (install and sample wells and obtain results of first quarter's sampling). Implementation of the technologies involved would pose no risks to the community. Worker exposure is also expected to be minimal, although potential exposure could occur during installation of monitoring wells. To minimize such exposure, installation and sampling of monitoring wells will be conducted under a site-specific Health and Safety Plan, with appropriate air monitoring and personal protective equipment (PPE). Potential environmental impacts would be related to physical destruction of habitat (e.g., desert tortoise and Mojave ground squirrel burrows) through the use of vehicles and other equipment, during the installation and sampling of monitoring wells.

Alternative 2: Implementation of this alternative is not expected to generate any adverse impacts on the surrounding community and the environment, other than the general nuisances associated with any type of construction. Erosion will be kept to a minimum using appropriate grading and other controls. Given the relatively remote location of the extraction and treatment system, such impacts are expected to be minimal. Worker exposure is also expected to be minimal; although potential exposure could occur during installation of the extraction wells. To minimize such exposure, installation and sampling of extraction and monitoring wells will be conducted under a site-specific Health and Safety Plan, with appropriate air monitoring and PPE. With the exception of physical impacts, as described for Alternative 1, environmental impacts are expected to be negligible because wildlife will not contact contaminated groundwater prior to treatment and air emissions are low. The system is proposed assuming a 30-year duration.

Alternative 3: This evaluation factor is the same as for Alternative 2.

2.8.6 Implementability

This criterion has three components: (1) technical feasibility, (2) administrative feasibility, and (3) availability of services and materials. Each alternative is assessed on the basis of factors within these three categories.

The assessment of the administrative feasibility of a particular remedial alternative is based on the number and complexity of activities needed to coordinate with other offices and regulatory agencies during preparation and implementation of the alternative. Factors that are considered in the assessment of technical feasibility include:

- potential for problems associated with construction and operation of an alternative;
- reliability of an alternative and its components;
- ease of undertaking additional remedial action, if needed; and
- ability to monitor the effectiveness of the remedy and evaluate the risks of exposure should monitoring be insufficient to detect a failure.

The availability of services and materials is to be considered. This includes such items as off-site treatment, storage or disposal capacity, equipment, and specialists.

Alternative 1: Installation of monitoring wells in the Upper Aquifer and collection and analysis of groundwater samples are standard, proven technologies which readily comply with the criteria for implementability. These criteria include ability to construct and operate the technology; reliability of the technology; ease of undertaking additional remedial actions; ability to monitor effectiveness of the remedy; ability to obtain approval from other agencies; coordination with other agencies; availability of off-site treatment, storage, and disposal services; availability of necessary equipment and specialists; and availability of prospective technologies. Since the technologies are generally availabie and sufficiently demonstrated, difficulties with construction, technical problems, or availability of equipment are expected to be minimal. Only minimal disposal services would be required. The installed monitoring wells would provide data that would be valuable to any additional remedial actions that may be required. However, close coordination with the three major regulatory agencies (USEPA, Lahontan RWQCB, and DTSC) will be required because of the unique and overlapping interests and mandates of each agency.

Alternative 2: Installation of extraction wells and an air stripping system for this alternative are standard, proven technologies which readily comply with the criteria for implementability. These criteria include ability to construct and operate the technology; reliability of the technology; ease of undertaking additional remedial actions; ability to monitor effectiveness of the remedy; ability to obtain approval from other agencies; coordination with other agencies; availability of off-site treatment, storage, and disposal services; availability of necessary equipment and specialists; and availability of prospective technologies. Since the technologies are generally available and sufficiently demonstrated, difficulties with construction, technical problems, or availability of equipment are expected to be minimal. Only minimal disposal services would be required. Discharge of treated groundwater is expected to be achieved on base. Enhancing the system through additional extraction wells or retrofitting the system with emission controls would be easily accomplished.

Alternative 3: This evaluation factor is the same as for Alternative 2.

2.8.7 Cost

Both capital costs and operation and maintenance costs are considered for each alternative, with a target accuracy of -30 to +50 percent. Capital costs include both direct (e.g., equipment) and indirect (e.g., contingency allowances) costs. Costs are presented on a present-worth basis over a period of 30 years, with a discount rate of 10 percent. Detailed cost analysis is presented in the FS (JMM, 1993a).

Alternative 1: Costs of this alternative are limited to installation and development (eight wells), and 30 years of quarterly sampling and analysis, report preparation, and minor maintenance, for a total present worth of $631,900, in 1992 dollars (assuming a discount rate of 10 percent).

Alternative 2: The 30-year present worth in 1992 dollars of Alternative 3 (Phases I and II) is $7,864,300. This assumes a discount rate of 10 percent.

Alternative 3: The 30-year present worth in 1992 dollars of Alternative 3 (Phases I and II), including emissions control (GAC), is $9,999,100. This assumes a discount rate of 10 percent.

2.8.8 State Acceptance

This assessment considers the technical and administrative issues and concerns the state or support agency may have regarding each of the alternatives. Final application of this criterion will occur in the approved ROD.

Alternative 1: It is likely that the state and community would not accept this alternative because it does not actively control existing groundwater contamination.

Alternative 2: This alternative provides for cleanup of the groundwater to below drinking water standards. This state has conditionally approved this alternative pending the submittal of a work plan for an Investigation in Support of RD/RA to fully define the dimensions of the TCE plume beneath the NEDA. Details of the ongoing Investigation in Support of RD/RA study and the proposed schedule of activities is presented in Section 2.12.

Alternative 3: This alternative would be at least as acceptable to the regulatory agencies as Alternative 2, due to the inclusion of an added level of protection in the form of emissions control.

2.8.9 Community Acceptance

This assessment evaluates the issues and concerns of the public regarding the proposed alternatives. A Community Relations Plan (CRP) was prepared to address community concerns and provide a forum for the exchange of information on OU 1 and other sites (IT, 1991). As part of this plan, public participation is encouraged throughout all phases of design and remediation.

Alternative 1: It is likely that the community would not accept this alternative because it does not actively control existing groundwater contamination.

Alternative 2: This alternative provides for cleanup of the groundwater to below drinking water standards. One potential area of concern may be with respect to stripper emissions, despite the expected low VOC emission rates. Alternative 3, which includes emissions controls, may be viewed by some individuals as providing a desired additional measure of security and more adequately addresses the reduction in TMV of contaminants. After the release of the Proposed Plan, which presented Alternative 2 as the preferred remedy, the community did not express any significant objection during the public meeting or public comment period discussed in Section 2.3.

Alternative 3: This alternative would be at least as acceptable to the community as Alternative 2, due to the inclusion of an added level of protection in the form of emissions control.

2.9 THE SELECTED REMEDY

This section provides a description of the preferred alternative for remediation of groundwater contamination at the NEDA based on the detailed evaluation of alternatives presented in the FS (JMM, 1993a). This section includes the basis for selection of a preferred alternative, a description of the preferred alternative, and a cost analysis.

2.9.1 Selection of the Preferred Alternative

The objectives of the selected remedial action for the TCE plume in the Upper Aquifer beneath the NEDA at GAFB are as follows:

- To prevent exposure to contaminated groundwater that poses a risk of greater than $1x10^{-6}$.
- To reduce the TCE contamination in the groundwater beneath the NEDA to below the federal MCL of 5 μg/l.
- To reduce the TCE in treated groundwater effluent to meet the enforceable levels of 2.5 μg/l TCE on a median basis with a maximum discharge level of 5 μg/l TCE, as measured at the effluent sampling port of the treatment system (Table 8). Furthermore, seek to treat the discharge to attain a level of 0.5 μg/l TCE as measured at the percolation ponds. Although such efforts do not constitute an enforceable discharge standard, the USAF may make minor modifications, as necessary, in an effort to reach this goal.
- To eliminate or reduce the potential for further migration of the existing TCE plume in the groundwater.
- To provide a conceptual design for a preferred alternative which will be expandable to remediate an aquifer volume greater than that assumed for this study, if required, based on the results of future monitoring.

The preferred alternative that best meets these objectives is Alternative 2, which consists of on- and off-base Upper Aquifer groundwater extraction with an estimated 19 wells, followed by treatment of extracted groundwater by two packed-tower air strippers, discharge of emissions directly into the atmosphere, and recharge of the treated extracted groundwater to the Upper Aquifer via percolation. Additionally, this alternative would include implementation of deed restrictions as appropriate, prior to sale or transfer of land overlying contaminated groundwater, to prohibit use of the groundwater until groundwater cleanup levels have been achieved.

TABLE 8

GROUNDWATER DISCHARGE TREATMENT STANDARDS

Constituent	Standard for Discharge into STP Percolation Ponds Based on State Board Resolution 68-16 (Concentrations in μg/l)[a]		Standard for Aquifer Cleanup is the Federal MCL
	Median	Maximum	Federal MCL
Trichlorethylene (TCE)	2.5	5.0	5.0
pH	6.5 < pH < 8.5		

[a] The USAF will seek to treat the discharge to attain a level of 0.5 μg/l TCE as measured at the percolation ponds. This level is a nonenforceable goal. The USAF may make minor modifications, as necessary, to operate the treatment system at the maximum efficiency in an effort to reach the goal.

The extraction system will be implemented in two phases; the performance of the nine wells installed as part of the first phase will be used to determine the location and operation of an estimated 10 additional wells. This phased approach will allow the necessary flexibility to implement and complete remediation in an effective manner. The initial nine wells will extract the majority of the plume and will slow the advance of the rest of the plume. Additional wells will then extract the remaining portion of the plume. The estimated number of additional wells is based on assumptions made during the feasibility study and the actual number and placement of additional wells will be decided based on the performance of the Phase I system and the results of the Investigation in Support of RD/RA (see Section 2.12.2). Additional wells will be added as needed up to a total extraction rate of 500 gpm.

Removal of TCE from the contaminated groundwater and simultaneous removal of other detected VOCs will be achieved by the packed tower air stripping process. Because the treated water will be recharged to the Upper Aquifer, stringent treatment goals must be met by the air stripping process. Therefore, two packed towers will be operated in series to ensure attainment of the required removal efficiency, with a substantial safety factor. Recharge of treated groundwater will occur at the STP Percolation Ponds, upgradient of the plume. A sprinkler irrigation system will be used to ensure even distribution of treated groundwater. However, the USAF may opt to store the effluent in an open top tank at the STP Percolation Ponds and use a portion of the effluent for irrigation of the golf course. If the effluent is used for irrigation, the TCE concentration must meet the discharge levels stated above.

This proposed combination of control measures should capture all of the currently estimated TCE plume having concentrations above MCLs (currently 5 μg/l for TCE) in the Upper Aquifer. The air stripping process will be capable of removing TCE to below 2.5 μg/l (the enforceable discharge level) even if the peak influent concentration of TCE combined from all extraction wells is the highest concentration detected during monitoring (310 μg/l), an unlikely occurrence.

The preferred alternative will satisfy the remedial action objectives (RAOs). The concentrations of TCE in stripper effluent are projected to be well below expected regulatory requirements for recharge of treated groundwater. VOC air emissions are projected to be well within the AQMD required action levels. Quarterly groundwater monitoring will be performed to assess the performance of the overall extraction, treatment, and discharge system.

Since the selected remedy does not contemplate on-site disposal of hazardous wastes, no such action-specific ARARs were selected. Hazardous wastes could consist of screenings, sludges, and other solids generated during construction, operation, and maintenance of the treatment system. Off-site disposal of such wastes will be performed in accordance with federal, state, and local laws, regulations, and ordinances. However, these requirements would not be considered ARARs under CERCLA, as ARARs apply only to on-site activities.

The USEPA and the RWQCB have scheduled discussions to resolve whether sections arising under Chapter 15 of Title 23 of the California Code of Regulations ("Chapter 15") are ARARs and, if so, the scope and interpretation of Chapter 15. Consequently, the parties have not determined whether or not Chapter 15 is an ARAR for the purposes of this ROD. The USAF,

USEPA, and the RWQCB have agreed, however, that the USACE will sample drillings, cuttings, and similar wastes to determine whether such wastes are hazardous wastes as defined in 22 CCR Section 66300 or designated wastes as defined in 23 CCR Section 2522. If such sampling indicates that the wastes are hazardous wastes, the hazardous wastes will be discharged only to Class I waste management units. If such sampling indicates that the wastes are designated wastes, such designated wastes will be discharged only to Class I or Class II waste management units.

Moreover, the selected remedy (1) does not contemplate discharge to surface waters, and such discharge is prohibited, and (2) prohibits the bypass or overflow of untreated or partially treated waste. The RD/RA Work Plan will provide for alternative discharge options in the event the discharge capacity becomes insufficient to handle the treated effluent. These alternative options will be used only on a temporary basis.

The detailed implementation of the selected remedial action will be performed by the USAF in consultation with the regulatory agencies during the RD/RA phase, at which time the USAF will develop reporting, notification, and monitoring programs. The monitoring program shall include sufficient monitoring (both in terms of frequency and test methods employed) to evaluate the effectiveness of the remedial action and ensure that the effluent discharge standards adopted herein are being met.. The USAF shall, at a minimum, include the following in the RD/RA phase: locations of the extraction and performance monitoring wells, estimated extraction and discharge rates, proposed operational procedures, proposed contingency plan for the extraction, treatment and discharge system in the event of power outage and/or mechanical failure, geologic well logs and well development data sheets for all available extraction, and performance monitoring wells proposed for the OU 1 groundwater treatment system. The operational procedures shall reflect that the groundwater treatment system will not be operated in excess of its design capacity without the prior approval of the regulatory agencies. The OU 1 groundwater treatment system will be designed for contaminant removal and hydrologic control of the TCE plume.

2.9.2 Detailed Description of the Preferred Alternative

The selected remedy consists of an estimated 19 groundwater extraction wells installed in the Upper and Regional aquifers, followed by treatment of the extracted groundwater using two air stripping towers in series, and recharge of treated groundwater at the former STP Percolation Ponds.

2.9.2.1 Extraction and Monitoring Well System. The extraction and monitoring system was designed to be implemented in two phases. The first phase, already implemented, includes installation of three on-base and six off-base extraction wells. Extraction wells are constructed of carbon steel casing and slotted stainless steel screen. Submersible pumps are constructed of stainless steel with flow capacities ranging from 25 to 30 gpm and total dynamic head capacities ranging from 110 to 330 feet.

If the monitoring results indicate the need, up to 10 additional extraction wells of similar design will be installed for a potential total of 19 extraction wells. Installation of the additional wells will be dependent on the monitoring results obtained during the implementation of the first phase. The responsible consultant will make recommendations to GAFB regarding the need for, and location of, any additional extraction wells. Final decisions will require approval from the appropriate regulatory agencies.

The nine wells installed in the first phase are located along the shoulder area of an existing unimproved roadway that follows the western slope of the desert arroyo. Because the total distance between all extraction wells will exceed 6,000 linear feet (LF), the existing roadway was improved to provide all-weather access to the wells for maintenance purposes.

The extracted water from the wells is pumped through a transmission pipeline buried adjacent to the improved roadway to the air stripping treatment plant located on the base. The PVC transmission pipeline varies in diameter from 2 inches furthest from the treatment plant to 8 inches entering the treatment plant. All piping is buried in a shallow trench (3 feet) to avoid freezing problems during the winter and to avoid possible disruption due to vandalism or accidental collisions with vehicles on or off the base. The submersible pumps are stainless steel and will be used as dedicated pumps for the duration of the remediation. These pumps are sized to provide sufficient total dynamic head (hydraulic head) to deliver the groundwater to the treatment plant.

Process controls are installed on all extraction wells, including a one-way valve on the well head and an automatic shutoff switch for the pump. This switch is wired to the main control center, located in close proximity to the air stripping facility. The automatic shutoff is wired into the process control in a manner such that the failure of the air blower (which provides forced air to the packed towers) will cause the pumps in each extraction well to shut off automatically.

Eight monitoring wells have been installed at locations with existing access or locations where access was gained for the extraction well system. Therefore, no additional improvements were required for installation of the monitoring wells. In subsequent phases of the remediation, existing monitoring wells will be identified that will aid in monitoring the progress of the remediation as the size of the plume decreases. A monitoring plan will be included as part of the RD/RA.

2.9.2.2 Air Stripping System. A contractor-designed and constructed air stripping system was installed at the bottom of a drainage gully approximately 585 feet east of an existing north/south roadway leading from the new fire training area oil/water separator and 30 feet south of the property boundary. This site provides a base elevation for each tower of approximately 2,808 feet above msl. This site reduces the visibility of the treatment system, but required good site grading and drainage to prevent erosion of the loose soils in this area.

The treatment system includes two fiberglass towers that may be operated in series or in parallel, depending on the magnitude of influent concentrations. Each tower has a height of 30 feet and

contains approximately 20 feet of polyethylene packing material. Water is introduced at the top of the tower and is allowed to trickle down through the packing at a maximum rate of 500 gpm.

Additional facilities were also installed to provide an operational air stripping tower system. The ancillary equipment includes a power transformer, motor control center, 500-gpm centrifugal pump, 2,000-standard cubic feet per minute (scfm) blowers, buried 8-inch-diameter influent yard piping, buried power distribution conduits, buried stormwater culverts, and flexible pavement for all-weather access around the treatment facilities. A chemical feed system was installed for the addition of sodium hexametaphosphate (SHMP) and a sodium hypochlorite solution. (The addition of SHMP will alleviate clogging by preventing precipitation of carbonates and iron oxides inside the tower, while the addition of sodium hypochlorite will prevent clogging by biological growth.) Continuous chlorination will be monitored to minimize residue chlorine in the treated water. The specific monitoring program will be included as part of the RD/RA. Other accessories such as inlet piping, outlet piping, air ducting, access manholes, nozzles, air louvers, doors, lights, and platforms have been included to provide a complete operational unit.

2.9.2.3 Effluent Disposal System. The present conceptual design for the effluent disposal system includes a new pump station at the treatment facility and transmission pipeline to connect the treatment plant to the abandoned STP Percolation Ponds (Figure 10). During design, a percolation test will be performed in the ponds to determine how much acreage is required for percolation. The results of this test will form the basis for detailed design criteria.

Residual nitrates are present beneath the percolation ponds at levels that could potentially impact groundwater. Therefore, a groundwater monitoring plan is being prepared that will monitor and assess the potential impacts of the nitrates present in the percolation ponds. Background water quality, including nitrates, will be established prior to use of the ponds by sampling from existing monitoring wells located along the perimeter of the ponds. After use of the percolation ponds begins, wells will be sampled regularly to determine if recharge to the percolation ponds adversely affects nitrate concentrations in the groundwater. If groundwater is impacted by the nitrates present, the treatment system would be temporarily discharged to a nearby arroyo until another suitable recharge method has been selected. A future discharge location may be the golf course as a portion to the treated groundwater may be used for irrigation.

2.9.3 Cost Analysis

A preliminary detailed cost estimate has been prepared for Alternative 2 (Table 9). The estimated capital cost for all items required for implementation of the alternative is approximately $3,255,100. Yearly O&M costs, which include general maintenance, materials, labor, energy, and chemicals, and monitoring, are estimated to be $394,300 per year. Using the expected lifetime of the remediation system of 30 years and an interest rate of 10 percent, the estimated present worth of Alternative 2 is approximately $7,864,300.

TABLE 9

PRELIMINARY COST ESTIMATE, PREFERRED ALTERNATIVE

Item/Description		Cost (1992 Dollars)
Goundwater Treatment System		
Extraction Wells (19)		$626,010
Piping From Wells to Stripper		$190,990
Tower, Blower, Process Piping		$111,690
SHMP Feed System/Control Building		$13,960
Concrete Pad		$2,230
Utilities		$97,480
Controls and Panel		$2,230
Monitoring Wells (8)		$199,300
Dedicated Bailers (8)		$1,790
Percolation Pond Recharge		
Clear Well		$22,340
Supply Pumps		$17,870
Venturi Meter		$5,030
Control Valve		$4,470
Backflow Valve		$2,790
Cinder Block Building		$22,520
Valve Pit		$5,580
Miscellaneous		$8,940
Instruments and Controls		$8,940
Telemetry		$37,970
Electrical		$10,050
Paving, Grading, Fencing		$16,750
Connection to Existing Pipe		$8,380
Surge Tank		$20,100
Transmission Pipe		$732,670
	Item Subtotal	**$2,170,080**
Contingency @ 25 % of subtotal		$542,520
Contractor's OH&P @ 25 % of subtotal		$542,520
Total Construction Costs	**Subtotal**	**$3,255,120**
Engineering at @ 9 % of construction costs		$292,960
Engineering During Construction @ 9 % of construction costs		$292,960
GAFB General and Administration (assumed at @ 9 % of capital costs)		$292,960
GAFB Community Relations (lump sum)		$13,400
Total Initial System Costs		**$4,147,400**
Total 30 year Operations and Maintenance Costs		$3,716,920
TOTAL ESTIMATED 30 YEAR PROJECT BUDGET COSTS (a)		**$7,864,320**

(a) Assuming a discount rate of 10%.

2.9.4 System Implementation

To date, Phase I of the installation of Alternative 2 at the NEDA has been completed. This phase of construction consisted of the installation of nine extraction wells, eight monitoring wells, transmission piping, an influent wet well, an air stripping system (two packed towers in series), an effluent clearwell, and a pipeline with a distribution system for treated groundwater to the STP Percolation Ponds. A treatability study is currently being performed to assess the performance of the system in different operating modes and to determine the best long-term operating mode. The treatability study was initiated in December 1991 and has been conducted intermittently since that time. During the treatability study, effluent water is temporarily being discharged to the arroyo. The nine individual pumps are pumping at rates between 5 and 45 gpm. The combined flow rate from the extraction wells averaged approximately 200 gpm when all the wells were operational. A portion of the treated water is returned to the influent wet well to maintain a steady flow at 500 gpm into the air stripper tower(s). Average influent concentrations vary from 12 to 37 μg/l. However, influent samples were collected from the influent wet well and therefore include recycled effluent water, because an influent sampling port was not installed by the contractor. Installation of an influent sampling port is currently planned to enable accurate influent concentration measurements. Effluent concentrations from the treatment system, run with one tower and some recycled water, have been below detection limits, with the exception of a one time detected concentration of 15 μg/l TCE in January 1993. This occurred just prior to the system being shut down to correct a biofouling problem.

A groundwater monitoring plan is being prepared to assess any impacts of recharging treatment system effluent via the STP Percolation Ponds. If any negative impacts resulting from discharge to the percolation ponds are observed, treated groundwater will be temporarily discharged to the arroyo until further recharge methods can be assessed. The future (Phase II) system implementation will include installation of an estimated 10 additional extraction wells, additional pipelines, access roadways, and power distribution to new wells.

2.10 STATUTORY DETERMINATIONS

The selected remedy satisfies the statutory requirements of Section 121 of CERCLA, as amended by SARA, in that the following five mandates are attained:

- The selected remedy is protective of human health and the environment, will decrease site risks, and will not create short-term risk nor have cross-media consequences;

- The selected remedy complies with federal and state requirements that are applicable or relevant and appropriate to the remedial action such as chemical-specific ARARs, chemical-specific clean-up standards, and action-specific ARARs;

- The selected remedy is cost-effective in its fulfillment of the nine CERCLA evaluation criteria through remediation of the contaminated groundwater in a reasonable period of time;

- The selected remedy utilizes permanent solutions and alternative treatment technologies or resource recovery technologies, to the maximum extent practical;

- The selected remedy satisfies the preference for treatment as a principle element.

2.10.1 Protection of Human Health and the Environment

Attainment of clean-up levels will assure that the levels of the contaminants of concern in the groundwater at OU 1 will not exceed drinking water standards. Alternative 2 uses engineering controls in the form of a groundwater extraction and treatment system to remove contaminated groundwater form the aquifer. The extraction of contaminated groundwater will significantly reduce the threat of exposure to residents. The implementation of this remedy will not create any short-term risk nor any negative cross-media aspects.

2.10.2 Compliance with ARARs

All ARARs will be met by the selected remedy. The remedy will achieve compliance will chemical-specific clean-up standards. Action-specific ARARs will be met for the discharge of groundwater. None of the anticipated actions or construction is expected to have a detrimental impact on endangered species.

2.10.3 Cost Effectiveness

The USEPA, the USAF, and the State of California believe that the selected remedy fulfills the nine criteria of the NCP and provides overall effectiveness in relation to its cost. Alternative 2 has a total capital cost of approximately $3,255,100 and an approximate annual O&M cost of $394,300. The total net present worth is $7,864,300, based on a 30-year estimate for the time required to cleanup OU 1.

2.10.4 Utilization of Permanent Solution and Alternative Treatment (or Resource Recovery) Technologies to the Maximum Extent Possible

The selected remedy represents, to the maximum extent to which permanent solutions and treatment technologies can be used, a cost-effective manner for remediating OU 1. The remedy selected provides the best balance of long-term effectiveness and permanence; reduction of TMV through treatment; short-term effectiveness; implementability and cost-effectiveness. By discharging the treated water to the percolation ponds, the groundwater resource is conserved.

2.10.5 Preference for Treatment as a Principle Element

Contaminants of concern in the groundwater will be extracted and treated using air-stripping. Therefore, this remedy satisfies the statutory preference for remedies that employ treatment which permanently and significantly reduces the TMV of hazardous substances as a principle element.

2.11 DOCUMENTATION OF SIGNIFICANT CHANGES

There are no significant changes in this ROD from the Proposed Plan.

2.12 CURRENT INVESTIGATION STATUS

As mentioned, as a result of a USEPA assessment and subsequent placement of GAFB on the NPL in February 1990, a new FS (JMM, 1993a) was prepared to summarize and reassess the earlier FS activities performed prior to GAFB being placed on the NPL and to update the documentation of this investigation to current USEPA guidance (USEPA, 1988).

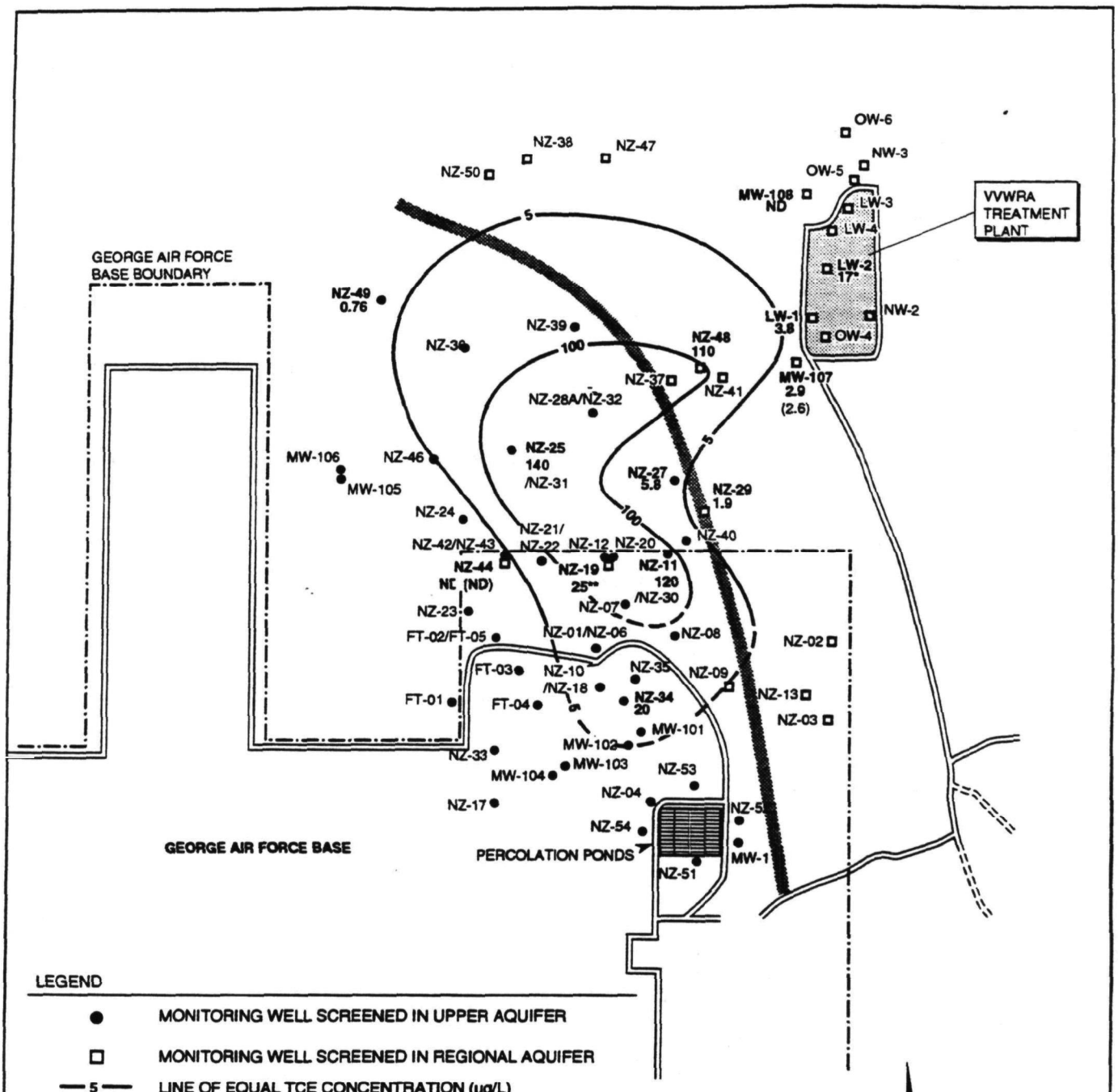
The preferred alternative described in this ROD is based on meeting the RAOs identified during the 1988 FS (JMM, 1988b), as summarized in the 1993 FS (JMM 1993a). The findings of the final FS report and the accompanying proposed plan (JMM, 1992b) were used to develop this ROD. The technical information supporting each alternative is included in these reports and the RI (JMM, 1992a). Data gaps identified in the RI report were used to develop a work plan for an Investigation in Support of RD/RA at OU 1.

2.12.1 Additional Investigations

Subsequent to the installation of Phase I of the selected remedy (Alternative 2), additional investigations have taken place at OU 1. These investigations include the following:

- Baseline groundwater sampling (rounds 1 and 2) (JMM, 1992b,c)
- Treatability Study (in progress)
- Installation of four groundwater monitoring wells around the STP Percolation Ponds and four rounds of sampling (Montgomery Watson, 1994a)
- Installation and sampling of 30 wells as part of RI investigations for OU 3 (Montgomery Watson, 1994b)
- Interim groundwater sampling of 13 wells (Montgomery Watson, 1994c)

Figure 11 presents the base map showing the TCE plume beneath the NEDA using the most recent groundwater data, collected in July 1993 (Montgomery Watson, 1994c). Thirteen wells were sampled during this interim groundwater monitoring event. The maximum concentration



NORTHEAST DISPOSAL AREA
TCE CONCENTRATIONS IN THE UPPER AND REGIONAL AQUIFERS JULY 1993

FIGURE 11

detected was 140 μg/l in well NZ-25. The configuration of the plume beneath OU 1 remained similar to that observed during the 1987 sampling and that of the February 1992 baseline sampling (JMM, 1992c). TCE appeared to be present in the Regional Aquifer only beyond the edge of the aquitard where groundwater from the two water-bearing zones merge (northeast of the base) (Montgomery, 1994c).

2.12.2 Investigation in Support of RD/RA

An ongoing Investigation in Support of RD/RA has been underway at OU 1 since October 1993. The focuses of this study are to better define of the site hydrogeology and groundwater contamination to expedite cleanup activities for the dissolved TCE plume in the groundwater beneath the NEDA, and to address the data gaps identified during the OU 1 RI. Additionally, the study will reassess the RAOs in consideration of risk based cleanup levels, MCLGs, and the results of the recent dispute resolution determining cleanup and discharge levels. Specific activities associated with this investigation are summarized as follows:

- Well Evaluation. Evaluation of base-owned monitoring wells will be performed including a literature search, physical inspection, and down-hole geophysical logging of questionable wells.

- Well Abandonment. Based on the well evaluation, approximately 25 wells will be abandoned, to optimize the number of wells to be used for long-term groundwater monitoring.

- Well Installation. An additional 12 groundwater monitoring wells will be installed to fill data gaps determined during previous OU 1 investigation activities, including the well evaluation.

- Aquifer Testing. Aquifer tests will be performed to gain a better understanding of the aquifer parameters in both the Upper and Regional aquifers for subsequent modeling input.

- Groundwater Modeling. Existing geotechnical data and data collected during the Investigation in Support of RD/RA field effort will be used in a groundwater flow/fate and transport model to predict the fate and transport of TCE in the groundwater beneath the NEDA.

- Long-term Monitoring Plan. A long-term groundwater monitoring plan will be prepared, including any new wells, and will recommend the frequency of sampling for each well.

- Groundwater Sampling. The long-term groundwater monitoring program will be initiated by conducting sampling as specified in the plan. A total of 50 wells (including newly installed wells) will initially be sampled.

- Investigation in Support of RD/RA Report. An Investigation in Support of RD/RA Report will be prepared to present the results of the Investigation in Support of RD/RA field effort.

- Risk Assessment. A baseline risk assessment will be performed, based on all existing data, to characterize the risks to receptor populations. Results will be presented in the Investigation in Support of RD/RA Report.

- Alternative Evaluation Report. Using the results of the baseline risk assessment and the Investigation in Support of RD/RA Report, an Alternative Evaluation Report will be prepared to address the TCE contamination beneath the NEDA. This report will present a detailed screening of alternatives for continued remedial action for the TCE plume beneath the NEDA to ensure capture of the plume.

A current schedule for document submittal for the Investigation in Support of RD/RA is presented in Table 10. The results of this investigation, in conjunction with the results of the Phase I Treatability Study and future groundwater monitoring will be used to determine if further system enhancement will be required to ensure that the final OU 1 RAOs for reducing the concentrations of contaminants in the groundwater beneath the NEDA are achieved.

TABLE 10

DOCUMENT SUBMITTAL SCHEDULE

Investigation in Support of RD/RA Documents	Draft	Comment Due	Draft Final	Final
Investigation in Support of RD/RA Report	16-Jan-95	15-Feb-95	15-Apr-95	15-May-95
Alternatives Evaluation Report	16-Jan-95	15-Feb-95	15-Apr-95	15-May-95

3.0 RESPONSIVENESS SUMMARY

3.1 OVERVIEW

The public comment period for the proposed plan began on September 20, 1993 and ended on October 19, 1993. A public notice summarizing the Proposed Plan, and announcing the public comment period and public meeting was printed in the Victor Valley Daily Press, the Los Angeles Times, the Orange County Register, and the San Bernardino Sun at the start of the public comment period. A press release was sent to 20 local newspapers, radio, and television organizations also summarizing the Proposed Plan and announcing the public meeting.

At the public meeting, which was held on October 6, 1993 at GAFB, questions and comments were received from the audience related to the Proposed Plan. A transcript of the public meeting minutes has been included in the Administrative Record. During the public comment period, written comments were received from the State of California Department of Fish and Game.

Judging from the comments received, the community accepts the USAF's preferred remedial alternative for addressing the groundwater contamination beneath the NEDA and adjacent off-base areas.

3.2 BACKGROUND ON COMMUNITY INVOLVEMENT

In an effort to involve nearby communities, GAFB has held press conferences and provided press releases following meetings with regulatory agencies regarding OU 1. Additionally, a member of the Victorville City Council was a member of the technical review panel during select meetings about key issues of the OU 1 project.

In November 1987, GAFB provided information about environmental concerns at the base as part of the "GAFB Community Days" activities. In 1988, a repository of information for public review was established at the GAFB library. In early 1990, similar repositories were established at the Adelanto and Victorville public libraries. Administrative files for the project are maintained at the GAFB Air Force Base Conversion Agency located in Building 321. In October 1992, GAFB held an informational open house to discuss the environmental cleanup program and visit the potentially contaminated sites.

In July 1991, GAFB established a TRC that consisted of members of the community and local agencies and governments. The TRC met on a quarterly basis. In January 1994, GAFB established the Restoration Advisory Board (RAB) which replaced the TRC. The RAB is designed to act as a focal point for environmental information exchange between GAFB and the public. The RAB will meet quarterly and meetings are open to the public.

3.3 SUMMARY OF COMMENTS RECEIVED DURING THE PUBLIC COMMENT PERIOD

Comments received during the GAFB OU 1 public comment period on the final FS and Proposed Plan are summarized below. The comment period was held from September 20, 1993 to October 19, 1993. The comments are presented in the order in which they were received.

Public Meeting

1. A citizen would like to know what was the maximum concentration of TCE detected in the plume.

   Air Force Response: The maximum concentration detected in the TCE plume was 580 μg/l in monitoring well NZ-40 that was sampled in February 1992.

2. A citizen would like to know how the decisions were made regarding the use of air strippers related to air emissions.

   Air Force Response: As stated in the ROD and the FS, the decision not to provide for emission controls are based on a risk assessment. It was determined that emission from the air strippers would not present an excess risk to any potential exposed individuals. The Mojave AQMD has provided guidance that allow for the lack of emission controls if the estimated emission rate of TCE is below 1.0 lbs/day. The estimated emission rate of TCE for the OU 1 air stripper is 0.28 lbs/day.

3. A citizen questioned the selection of air strippers as the best available technology and suggested charcoal filters.

   Air Force Response: Based on the detailed analysis performed in the FS, it has been determined that the best available technology for the project is air stripping. Air stripping is a proven technology and treatability studies at GAFB indicate that this technology effectively remediate TCE at these levels.

4. A citizen suggested the use of a slurry wall to prevent plume migration.

   Air Force Response: The depth of the TCE plume is greater than 100 feet below ground surface, therefore the use of a slurry wall is deemed infeasible for this project.

5. A citizen would like to know whether the plume has migrated to the VVWRA facility north of the base.

Air Force Response: TCE has been detected in samples collected from wells at the VVWRA facility. Based on interpretation of the most recent groundwater data collected at OU 1, it is interpreted that the TCE detected at the VVWRA facility is not part of the OU 1 plume. However, this interpretation in not conclusive. This question is being addressed as part of the ongoing Investigation in Support of RD/RA.

6. A citizen questioned the knowledge of the extent of the aquitard that separated the Upper and Regional aquifers.

Air Force Response: The current interpretation of the areal extent of the aquitard that separates the Upper and Regional aquifers is that the aquitard hydraulically separates the aquifers but is not continuous north of the base and east of the study area along the Mojave River bluff. However, the aquitard is continuous to the west and southwest as determined by activities at OU 2 and OU 3. This question is also being addressed as part of the ongoing Investigation in Support of RD/RA.

7. Mary Scarpa, Mayor of Adelanto would like to know why the STP percolation ponds were selected for effluent discharge.

Air Force Response: The percolation ponds were selected as the effluent discharge point because the ponds will provide excellent infiltration of water that would aid in aquifer recharge.

8. A citizen would like to know the extent to nitrate contamination at the percolation ponds and the potential for nitrate leaching.

Air Force Response: As stated it the RI and ROD, elevated concentrations of nitrates exist at the percolation ponds to a depth of 46 feet below ground surface. Groundwater in this area is in excess of 100 feet below ground surface. Elevated concentrations of nitrates are expected because the ponds were previously used for the STP effluent. Based in a study of the wastewater discharge to the soils of the Upper Mojave River Basin (USGS, 1993), discharge of treated groundwater to the percolation ponds is not expected to impact groundwater. However, existing wells around the percolation ponds will be monitored for nitrates on a quarterly basis.

9. A citizen would like to know the volume of effluent to be discharged to the STP percolation ponds.

Air Force Response: The current design for the remediation system at OU 1 would produce effluent discharge rate at a of 500 gallons per minute.

10. A citizen questioned the use of data collected at Site 21, the Industrial/Storm Drain, by SAIC.

Air Force Response: The data that was used in decision making and the conclusions presented in the ROD are based on data collected subsequent to the collected by SAIC. The West Storm Drain was cleaned in place. Sections of the East Storm Drain were cleaned, and the perforated piping were replaced with nonperforated pipe. Soils underlying the perforated piping were also excavated and disposed of appropriately. Subsequent confirmation sampling of the soil beneath the Industrial/Storm Drain indicated that the chemical concentrations were at background levels. All of these activities occurred after the collection of data by SAIC.

Written Comments

1. The State of California Department of Fish and Game is concerned about the effect this project may have on nearby ecosystems. The Department of Fish and Game has commented that this project meet guidelines set forth in the California Environmental Quality Act (CEQA). The Department of Fish and Game has suggested that the Final Environmental Impact Statement (EIS) for this project address specific issues that are summarized as follows:

   a) The effect that this project would have on overdraft of the Mojave River;

   b) An assessment of the flora and fauna within and adjacent to the project area;

   c) A discussion of impacts expected to adversely affect biological resources, with specific measures to offset such impacts; and

   d) A range of alternatives to ensure a complete evaluation including those that would minimize impacts to sensitive biological resources including alternative locations.

   The Department of Fish and Game also commented that if the project has the potential to adversely affect species of plants or animals listed under the California Endangered Species Act (CESA), a CESA-Memorandum of Understanding must be obtained. The Department commented that they oppose the elimination of watercourses and /or the channelization or conversion to subsurface drains.

   Air Force Response: The DTSC conducted an initial study and has determine that no potential significant environmental impacts are likely to occur form implementation of the proposed project. The potential minor effects have been

identified and mitigation measures have been provided to reduce them to insignificant levels. In September 1992, the DTSC issued a Mitigated Negative Declaration (Cal EPA, 1991) for this project. Therefore, this project does not fall under CEQA guidelines.

In March 1992, the USAF issued a EIS on the entitled "Disposal and Reuse of George Air Force Base, California." Included in this EIS is a discussion of potentially affected environments including biological and water resources. Several other studies have been performed including a 1991 report entitled "Biological Survey of George Air Force Base" (SAIC, 1991) that provides baseline biological conditions in particular for federally or state protected species. Prior to activities that might impact sensitive biological resources, a biological survey is conducted and activities are modified to minimize any adverse impact. For example, prior to construction of the now operating remediation system at OU 1 a biological assessment was performed (LSA, 1989) that identified impacted vegetation and wildlife. Mitigation measures were recommended and implemented during the construction phase. All ARARs, including those related to the protection of the biological resources, will be complied with at the appropriate time. This project does not effect watercourses, surface drains, or wetlands.

3.4 REMAINING CONCERNS

Concerns that the USAF was unable to address during remedial planning activities include the following:

- What is the nature or the aquitard separating the Upper and Regional aquifers?
- Can the fate and transport model better predict plume movement?
- Can the eastern edge of the plume be better defined for its lateral extent?

To address these concerns, the USAF has begun an investigation to better define the site hydrology and groundwater contamination and to expedite cleanup activities for the dissolved TCE plume. Specific activities associated with the above concerns include:

- Installation of 12 groundwater monitoring wells to fill data gaps;
- Aquifer testing to gain a better understanding of the aquifer parameter for both the Upper and Regional aquifers; and
- Developing a new groundwater model to better understand the nature of groundwater movement, the fate and transport of TCE in the groundwater, and the risks associated with OU 1.

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APPENDIX A

ADMINISTRATIVE RECORD

(On file at GAFB Environmental Programs Office
Contact: Air Force Base Conversion Agency
Department of the Air Force
OL-C/AFBCA, Building 321
George AFB, California 92394-5000)

APPENDIX B

RESPONSE TO AGENCY COMMENTS

DRAFT ROD COMMENTS/RESPONSES

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, Ca. 94105-3901

December 7, 1993

Ms. Denise Caron
Chief, Environmental Programs
AFBDA/OL-C, Building 321
George Air Force Base, CA 92394-5000

Dear Ms. Caron:

We have reviewed the draft Record of Decision (ROD) for Operable Unit 1 and are providing the following comments.

If you have any questions please contact me at (415) 744-2409.

Sincerely,

Brian Swarthout
Remedial Project Manager

cc: Jay Cass, RWQCB
Emad Yemut, DTSC
Greg Little, MW
Sarabjit Singh, URS

Printed on Recycled Paper

U.S. Environmental Protection Agency
comments on the
draft Record of Decision
for Operable Unit 1

General Comments

1. The selected remedy should not be limited to "up to 19" extraction or eight new monitoring wells. These numbers can be given as estimates based on a conceptual design, however the Remedial Design will need to give a more detailed justification of the number of wells necessary to remediate the plume and monitor its effectiveness. The cleanup standard of 5 ug/l is the main factor that will determine the number of wells needed. During design implementation of the groundwater cleanup it may be concluded that more wells are needed to ensure that the cleanup standard is effectively achieved. The ROD can not put an upper limit on the number of wells that will be necessary for groundwater remediation.

2. The ARARs section should include a tabular presentation of the State and Federal ARARs. This table can be used as the foundation for developing an agreement on ARARs. An example table is attached at the back of the comments.

3. The responsiveness summary must be included in the draft final ROD. In order to allow for sufficient review of the comments and Air Force responses, EPA would prefer that the summary be submitted for review in draft form prior to submittal of the draft final ROD.

Specific Comments

1. Section 1.4 Description of the Remedy

The selected remedy should not be limited to "up to 19" extraction or eight new monitoring wells. These numbers can be given as estimates based on a conceptual design, however the Remedial Design will need to give a more detailed justification of the number of wells necessary to remediate the plume and monitor its effectiveness. The cleanup standard of 5 ug/l is the main factor that will determine the number of wells needed. During design implementation of the groundwater cleanup it may be concluded that more wells are needed to ensure that the cleanup standard is effectively achieved. The ROD can not put an upper limit on the number of wells that will be necessary for groundwater remediation.

2. Section 2.1 Site Name, Location, and Description

Paragraph 3. State the contaminants of concern for the STP Percolation Ponds.

3. Section 2.1.6 Water Use

Paragraph 7 says that seven GAFB wells and three Adelanto wells are located along Turner Road. What type of wells are these?, drinking water supply, industrial water supply, etc.

4. Section 2.5.1 Northeast Disposal Area

This section should describe all known or suspected sources of contamination if any are known. If none are known than say so.

5. Section 2.5.1 Northeast Disposal Area

Paragraph 3. The fourth sentence begins with " Within the deep portion of the Upper Aquifer,..". Since this is the first reference of the deep portion of the Upper Aquifer, the document should explain how it is defined. This information should also be presented in Section 2.1.4 Hydrogeology.

6. Section 2.5.1 Northeast Disposal Area

Paragraph 3. The last sentence in this paragraph say that contamination from the North East Disposal Area does not pose an immediate threat to any potential receptors. This statement is incorrect since the groundwater contamination of in this area has already threatened the supply wells at VVWRA. Please make the appropriate changes.

7. Section 2.5.1 Northeast Disposal Area

Paragraph 4. The first sentence is confusing. It first states that the three wells are "within GAFB boundaries" and than states that they are "all located to the east of the base." This sentence should be corrected so that it more clearly describes the location of the wells.

8. Section 2.5.1 Northeast Disposal Area

Paragraph 4. The last sentence of this paragrapn states that "TCE measured in the Regional Aquifer is unrelated to the TCE plume observed in the Upper Aquifer" in the area of NZ-02, NZ-03, and NZ-13. This statement is vague and should be expanded upon. If it is not related to the Upper Aquifer than to what is the TCE in the Regional Aquifer related.

9. Section 2.5.2 Industrial/Storm Drain and Outfall Ditch

Since no further action are expected at this site, the first sentence of this section should be expanded to briefly explain what remedial actions were taken.

10. Section 2.5.3 STP Sewage Treatment Ponds

The Air Force should expand the rationale for no further action

at this site, by stating that based on the levels of contamination in the soil, groundwater is not expected to be impacted by nitrates.

11. Section 2.7 Description of Alternatives

This section should describe the portions of the treatment system that have already been installed.

12. Section 2.7.2 Alternative 2 - Groundwater Extraction, Air Stripping and Percolation

The second half of the paragraph states that if portions of the plume escape, "it is expected that VOC concentrations reaching downgradient receptors would decrease through dispersion..." The approach described in this sentence is not acceptable. The purpose of the cleanup is to capture the entire plume and not to allow it to escape. The mechanisms contributing to "dispersion" have not been demonstrated and should not be considered part of the remedial action.

13. Section 2.7.3 Section 2.7.2 Alternative 2 - Groundwater Extraction, Air Stripping with Emission Controls, and Percolation

The question of whether air emission controls will be needed should be expanded. Other factors beside risk may contribute to the need to install air emission controls. For example, the San Bernadino County Air Pollution Control District (AFCD) requirement of 1 lb/day (cited on page 2-34) may drive the decision. Compliance with this ARAR should be discussed.

14. Section 2.8.2.3 Action Specific ARARs

Discharge ARARs. Last Sentence. The discussion on complying with San Bernadino County APCD ARARs should be expanded to cite the specific regulation that limits emissions and how the Air Force will ensure that it will be complying with these ARARs.

15. Section 2.9.1 Selection of the Preferred Remedy

This section should include a discussion of the no action decisions for Sites S-20 and S-21. The discussion of Site S-20 should include mention of the soil removal actions that have been taken at these sites.

Attachment A

The following comments were provided by Danita Yocom, Assistant Regional Council, USEPA Region 9 for the draft Record of Decision for Operable Unit 1, George Air Force Base, California

1. Section 2.8.2 Compliance with ARARs.

Delete the first sentence in the paragraph and substitute with the following:

"Pursuant to Section 121(d) CERCLA, as amended, remedial actions must attain a degree of cleanup which assures protection of human health and the environment. In addition, CERCLA requires that remedial actions meet standards, requirements, limitations or criteria that are applicable or relevant and appropriate (ARARs)."

Delete the second sentence in the second paragraph (re USEPA draft guidance and the "proposed" NCP) and substitute with the following:

"The NCP defines "applicable requirements" and "relevant and appropriate requirements" as follows:"

In the second line of each definition (i.e. "applicable requirements" and "relevant and appropriate requirements"), delete the phrase "environmental protection." In the third line of each definition, delete "federal or State law" and substitute with "federal environmental or state environmental or facility siting laws". At the end of each definition add the following: "Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable."

2. Section 2.8.2.1 Chemical-Specific ARARs.

The ROD should specify which requirements are the chemical-specific ARARs for the contaminants of concern in OU-1. Here, the State standard for TCE (the State MCL) is not more stringent than the federal standard, and therefore we are selecting the federal standard.

With respect to Secondary Drinking Water Standards (SDWS), has the State established how the SDWS are enforceable? Also, what is the point of compliance? If the point of compliance is at the tap, the SDWS are probably not ARARs.

At an appropriate place prior to the discussion of the specific ARARs, add the following:

"The contaminant specific ARARs for OU-1 are federal drinking water standards and promulgated State of California drinking

water standards which are more stringent than federal standards. Cleanup levels are set at health-based levels reflecting current and potential use and exposure. For systemic (noncarcinogenic) toxicants, cleanup levels represent that amount to which humans could be exposed on a daily basis without appreciable adverse effects occurring during their lifetime. For carcinogens, cleanup levels must fall within a 10 -4 to 10 -6 risk range. [NCP, 40 CFR §300.430(e)(2)(i)(A)(2)]"

"Potential drinking water regulations include MCLs for specific contaminants [Section 1412 of the Safe Drinking Water Act, 42 USC §300g-1, National Primary Drinking Water Regulations, 40 CFR part 141]. Maximum contaminant levels are enforceable standards which apply to specified contaminants which U.S. EPA has determined have an adverse effect on human health. The MCL for TCE is 5 ppb. Maximum contaminant levels are set at levels that are protective of human health and set close to Maximum Contaminant Level Goals (MCLGs)."

"California has promulgated MCLs for primary volatile organic compounds, however, the U.S. EPA has chosen the federal MCL for TCE as the groundwater cleanup standard for OU-1 because the California MCL for TCE is equal to the federal MCL."

Delete the first sentence in the third full paragraph on page 2-30, as it is not relevant to the remedy. Delete the last sentence in the third paragraph.

Delete the first and second sentences in the fourth full paragraph on page 2-30, unless the State establishes that its Secondary Drinking Water Standards are enforceable for groundwater.

Delete the first full paragraph on page 2-31. As the portion of the dispute regarding final aquifer cleanup levels under 92-49 was withdrawn by the State, the decision did not establish the final aquifer cleanup level. The dispute established a cleanup level for discharges to percolation ponds, which should be discussed under the section regarding action-specific ARARs.

3. <u>Section 2.8.2.2 Location-Specific ARARs.</u>

I recall that the FS for OU-3 stated that the Endangered Species Act (ESA) was not an ARAR at the site. An ARAR determination for the ESA would be the same for all operable units. Has the Air Force consulted with the U.S. Fish and Wildlife Service (FWS) as proposed by CERCLA Compliance with Other Laws Manual II (1989)? If the FWS determines that the endangered species is not present, then the ESA is not an ARAR. If a determination is made that the endangered species or its habitat will not be affected, the ROD should so state. If the endangered species or its habitat will be affected, the ROD must state what mitigation measures will be taken. Therefore, the discussion of the ESA needs to be revised pending further consultation.

Revise the last paragraph on page 2-31. If the desert tortoise and/or its habitat is in the vicinity of OU-1, the paragraph should read as follows:

"Endangered species and their habitats are protected by the Endangered Species Act [16 U.S.C. Sections 1531-1543]. The desert tortoise is a potentially sensitive, rare, or threatened species within the vicinity of the operable unit which is protected by the ESA. Therefore, the ESA is an ARAR for on-site actions. The proposed remedial actions would not [would?] affect the species or its critical habitat. [If the remedial actions would affect the species or its critical habitat,: "The following mitigation measures will be taken:" The mitigation measures also should be described briefly in the description of the selected remedy.]

4. Section 2.8.2.3 Action-Specific ARARs.

Treatment ARARs.

Delete the third full paragraph on page 2-33 as it is a location specific ARAR which has already been addressed in Section 2.8.2.2.

Discharge ARARs.

As the discussion of the dispute will have been deleted under the chemical-specific ARARs section, the background of the dispute should be moved to the section regarding the discharge to the percolation ponds. The paragraph should read as follows:

"On October 2, 1992 the Regional Water Quality Control Board, Lahontan Region (RWQCB) invoked dispute resolution regarding, in part, effluent discharge levels for TCE into the percolation ponds in the NEDA. On April 22, 1993 the USEPA Administrator issued a decision finding that the California State Water Quality Control Board's anti-degradation policy (Resolution 68-16) is an ARAR with respect to discharges of TCE at OU 1, and returned the matter to the USEPA Region IX Acting Regional Administrator (Regional Administrator) to determine an appropriate standard for discharges into the percolation ponds at OU 1. Based upon negotiations between the USAF, the State of California and USEPA, on July 9 1993 the Regional Administrator issued a final dispute resolution decision which set the effluent level to be measured from the sampling port at 2.5 mg/l TCE on a median basis with a maximum discharge level of 5 mg/l TCE. The decision further stated that the USAF will seek to treat the discharge to attain a level of 0.5 mg/l TCE as measured at the percolation ponds, although such efforts do not constitute an enforceable discharge standard."

5. Section 2.8.4 Reduction of Toxicity, Mobility and Volume through Treatment.

In the first sentence of the first paragraph, insert the word "permanently" before the word "significantly".

6. Section 2.8.6 Short-term Effectiveness.

Are there any proposals to mitigate potential impacts on habitat. Also, are the Mojave ground squirrels an endangered species? If so, they should be mentioned in the ARARs discussion of the Endangered Species Act.

7. Section 2.9.1 Community Acceptance.

In the first full paragraph on page 2-44, delete the word "goal" and substitute with "standard". This change should be made in any other place in the text where an enforceable cleanup level is described. The word goal should only be used if the number is not enforceable, as with the discharge into the percolation ponds.

8. Section 2.10 Statutory Determinations.

In the second bullet, delete "for discharge of treated effluent to the former STP percolation ponds" as that is not a statutory mandate.

1000-0840/0-3 1-

Memorandum

To: Emad Yemut
Site Mitigation Branch, Base Closure Unit
Department of Toxic Substances Control
245 West Broadway, Ste 350
Long Beach, CA 90802

Date Dec. 1, 1993

Jehiel W. Cass → TAB 12-1-93

From: Jehiel Cass (619) 241-7408 Fax (619) 241-7308
California Regional Water Quality Control Board
Lahontan Region
Victorville Branch Office
15428 Civic Drive, Suite 100
Victorville, CA 92392-2359

Subject: REGIONAL BOARD STAFF COMMENTS - DRAFT RECORD OF DECISION (ROD), OPERABLE UNIT ONE (OU-1), GEORGE AIR FORCE BASE (GAFB), SAN BERNARDINO COUNTY

Introduction

Regional Board staff have reviewed the Draft OU-1 ROD and have a number of comments.

Summary of Regional Board Staff Comments

The ROD must address a number of Regional Board concerns.

- Substantive waste discharge requirements and an outline of future actions must be included, as agreed by the parties. There must be a time schedule for submittal of documents relating to TCE plume definition, plume containment and Phase II extraction wells.

- The ROD must reflect current site conditions, even if the most recent ground water information was not used in developing the selected remedy.

- The section discussing ARARs must be clarified to clearly show what are potential ARARs and what ARARs will apply to the selected remedy.

- The ROD should clearly indicate in the opening sections that Phase I of the selected remedy is essentially complete using the 1988 FS conclusions.

General Comments

1. Include Language Agreed to During RPM Conference Call

The ROD must be written in accordance with the agreement made during the Remedial Project Manager (RPM) conference call of September 13, 1993. The RPMs agreed that the Substantive Waste Discharge Requirements for OU-1, ROD Addendum, dated September 1, 1993, prepared by Regional Board staff would not be included with the ROD.
The RPMs agreed that the draft ROD would contain substantive waste discharge requirements and an outline of actions to be performed as a part of the Remedial Design/Remedial Action process. A time schedule for document submittals must be included. For instance, data gaps in the TCE plume definition and Phase II extraction wells for plume containment must be resolved as described in the Remedial Investigation/Feasibility Study (RI/FS).

Regional Board staff are aware that US EPA, Region IX, the Department of Toxic Substances Control, the State Water Resources Control Board, the Central Valley Regional Water Quality Control Board, and the Air Force are developing language for a Castle AFB ROD that may apply, in part, to GAFB. This Regional Board staff have not been involved in specific discussions for Castle AFB, however we will favorably consider specific language as it may apply to GAFB.

Please refer to the following for specific substantive waste discharge requirement items to be included in the ROD:

- Items A.1 - A.5.a, B.1 - B.4, C.2 - C.4, D.2, D.6, D.9 - D.12 from a Regional Board handout (RPM meeting, September 1, 1993) entitled Substantive Waste Discharge Requirements for Land Disposal, Operable Unit One (OU-1), George Air Force Base.

- Items 1. (all) and 3. (all) from Regional Board letter dated October 2, 1992 entitled Specific State Applicable or Relevant and Appropriate Requirements (ARARS) for Operable Unit One (OU-1), George Air Force Base (GAFB). In addition, include references from enclosure 1 of that letter to the following: the Basin Plan, SWRCB 68-16, Article 5, Chapter 15, Title 23, Cal. Code or Regs, and DWR Bulletin 74-90 and 74-81.

Specific Comments

2. Page 1-2, Section 1-4, Description of Selected Remedy

Please add to the fourth bullet that temporary discharge is now occurring to the arroyo and future discharge to the golf course is allowed.

3. Page 2-11, Section 2.2, Site History and Enforcement Activities

This section should indicate that Cleanup and Abatement Order (CAO) No 6-86-3 was adopted by the Regional Board on January 16, 1986. It required the Air Force to define the extent of trichloroethene (TCE) contamination in the ground water beneath the northeast disposal area (NEDA), submit a plan for remediation and begin cleanup of the ground water. This CAO was the impetus for the 1988 Feasibility Study. CAO 6-86-3 was rescinded when the Federal Facilities Agreement was signed.

4. Figure 8, Distribution of TCE in Groundwater

Please revise this figure as follows:

a. show the most recent (1992) ground water information for each well.

b. revise the plume configuration to reflect the most recent data.

c. show the monitoring wells installed around the percolation ponds.

d. show the southeastern plume edge with a notation to indicate it is undefined.

e. show the approximate edge of the aquitard separating the upper and regional aquifers.

f. show data from each aquifer zone (upper and lower).

5. Page 2-17, Section 2.5.1, Northeast Disposal Area

a. 2nd paragraph, The text states that "(VOCs) are the major contaminants of concern, with TCE being the most persistent and widespread". The text should specifically state what the Contaminants of Concern are. We suggest that TCE be listed as being over the remediation goal, nitrate be listed as potentially affecting groundwater quality downgradient of the disposal location, and all other compounds that were detected be listed but indicate they are at insignificant concentrations. Refer to the final Remedial Investigation report, page 5-6 for the other constituents detected.

Terms should be consistent throughout the document. The term "chemicals of concern" is used on page 2-51, Section 2.10.5.

b. 2nd paragraph, Figure 8 does not show where the two aquifers merge as indicated.

c. 2nd paragraph, Please delete or reword the last sentence in this paragraph; "Contamination at this location currently does not pose an immediate threat to any potential receptor". This is in conflict with the State's policy to view ground water as a resource to protect, preserve and restore for present and potential future users, rather than a pathway of potential exposure to existing

receptors. The existing TCE contamination is a violation of the Basin Plan.

Additionally, domestic water production wells at the Victor Valley Waste Water Reclamation Authority (VVWRA) may have detectable concentrations of TCE from the leading edge of the OU-1 plume. Because of this reason, VVWRA purchases bottled water for employees. Water from these wells are used for operations at VVWRA. The well drawdown will still influence the TCE plume movement.

6. Page 2-17, Section 2.5.1, Northeast Disposal Area, 3rd paragraph

The last sentence, which states that "it is believed that the TCE measured in the Regional Aquifer is unrelated to the TCE plume observed in the Upper Aquifer" is puzzling. The TCE concentrations measured in the regional aquifer along the main advance of the plume (NZ-48, MW-107) is related to the TCE in the upper aquifer.

The highest TCE concentration measured in the NEDA ground water to date is 580 ug/l in MW-40. This well is slightly down gradient, but predominately cross-gradient of NZ-02, NZ-03 and NZ-13. Because the TCE plume is undefined in the area to the east of MW-40, it would be premature to state the conclusions made in the text.

7. Page 2-18, Section 2.5.1, Northeast Disposal Area, 2rd paragraph

a. The text states that the rate and extent of TCE plume movement was evaluated as part of the 1992 RI report. This is incorrect. The 1992 RI repeated the results of work performed in the 1988 RI.

b. The ROD should state that the results of the transport model will have to be verified as part of the Remedial Design. The lithology and ground water flow assumptions used in the 1988 analysis should be revised to include current information.

c. The text states that the estimated mass of TCE in the aquifer is 430 pounds. The actual mass is probably greater. The statement should be removed from the ROD or qualified to indicate that the mass estimates were made using isocontours greater than 5 ug/l. Concentrations less than 5 ug/l were discounted. Additionally, the currently observed highest TCE concentration (MW-40) was not used to estimate the mass of TCE.

d. The text states that the peak concentration of TCE has decreased. This is incorrect. We understand the peak observed TCE concentration to be 580 ug/l (NZ-40, 1992); the last time wells in the NEDA were sampled.

8. Page 2-19, Section 2.5.3, STP Sewage Treatment Ponds

The text refers to a nitrate migration study being conducted by the USGS. Under separate cover, a copy of the final report was sent to GAFB. Please refer to it for specific conclusions. The report title is Potential for Ground-Water Contamination From Movement of Wastewater Through the Unsaturated Zone, Upper Mojave River Basin, California, Water Resources Investigation Report 93-4137.

9. Page 2-22, Alternative 2-Groundwater Extraction, Air Stripping, and Percolation, 1st paragraph

The text states "Should portions of the plume escape capture by the extraction system, it is expected that VOC concentrations reaching down gradient receptors would decrease through dispersion to concentrations below the federal MCL for TCE". The text should be revised. The ROD must include a requirement to maintain hydraulic control of the plume in accordance with SWRCB Resolution 68-16 to prevent further spread of pollution. Allowing portions of the plume to migrate beyond the existing configuration is unacceptable and would be a violation of state policy.

10. Page 2-22, Alternative 2-Groundwater Extraction, Air Stripping, and Percolation, 2nd paragraph

This paragraph is misleading. Most of the components referred to as part of Phase I are installed now. Temporary discharge has occurred to the arroyo since December 1991, about two years. The text should describe the operating system realistically. Definite dates for submittal of the Phase II work plans should be included. The last sentence indicates that proposed locations of Phase I components are shown on Figure 10. The components shown on Figure 10 are existing, not proposed.

11. Figure 9, Conceptual Design of Extraction and Monitoring Wells

This figure is misleading. It should be revised to note what facilities are completed as part of Phase I and what facilities are proposed (or necessary) for Phase II. To better illustrate the proposed remedy, we suggest another figure be included to show all proposed Phase II well locations (see final FS, Figure 5-1). The figure should clearly indicate that the locations may be modified as necessary to maximize plume containment and capture, based upon a future capture zone analysis and review of Phase I treatability study data.

12. Table 1, Summary of Detailed Analysis of Remedial Alternatives

The proposed remedy cost for alternative 2 is projected at $7,864,300. Projected remedial costs for Operable Unit 2 scenarios are much higher. Cost is a factor in choosing a remedy. Please provide a cost comparison analysis statement that would indicate what confidence should be placed in the cost estimates. This is an important task because the ultimate choice of remedial options for all GAFB sites will involve considerable public expenditure.

13. Table 2, Chemical-Specific ARARs and TBCs For Detected Compounds, Northeast Disposal Area

This table, referenced on Page 2-30, second paragraph, last sentence is confusing and misleading. The reference states "A list of all chemicals found in groundwater at the NEDA is presented in Table 2, along with their respective potential ARARs".

a. The ROD concerns itself primarily with TCE (Page 2-17, second paragraph). The text and table must indicate the maximum concentrations and extent of all "detected compounds" in the NEDA. This information is necessary to

conclude that TCE is the primary Contaminant of Concern. Regional Board staff agree that TCE is the primary Contaminant of Concern.

b. The table must indicate if the values are for in-situ aquifer cleanup levels, treated water effluent levels or both.

c. The table must include natural background water quality for both the area affected by the TCE plume and the receiving waters beneath the percolation ponds. This information is necessary for determining how to incorporate SWRCB Resolution 68-16 criteria.

d. The table must include values that would reflect taste and odor values as required by the Basin Plan.

e. The table must indicate which of the values will apply to the site. We suggest that the table be modified to show all potential ARARs and clearly labeled to indicate that the list is for "potential" ARARs only. The text should have two additional sections, following section 2.8.1 for ground water cleanup and treated water effluent chemical-specific ARARs. The reader then will not be confused to think that the values shown in the table are chosen to apply to OU-1. See comment no's. 14.c. and 14.d., below.

f. The table must include nitrate (see comment 5, above) and the results of the dispute resolution process (see comment 14, below).

14. Page 2-31, section 2.8.1, Chemical Specific ARARs, 1st paragraph

a. The text discusses the dispute resolution process and specific values resulting from the process. We suggest that Section 2.8.1 be limited to generic discussions regarding potential ARARs, including the dispute resolution process. Table 2 should be modified to include specific values that resulted from the dispute resolution process. The last sentence of paragraph 1 should be moved as indicated below.

b. This section must include reference to the Water Quality Control Plan for the Lahontan Basin (Basin Plan). The beneficial uses of ground water in the affected area must be listed (Basin Plan page I-2-4. area 628.20, Upper Mojave).

c. New Section 2.8.2.1.1, Chemical-Specific ARARs for Final Aquifer Cleanup, should be added. This section would discuss what the final aquifer cleanup values must be. The last sentence of the 1st paragraph, Page 2-31 should be moved here.

d. New Section 2.8.2.1.2, Chemical-Specific ARARs for Treated Effluent, should be added. This section would discuss what the treated water effluent values must be. The last paragraph of Page 2-33 and 1st full paragraph of Page 2-34 should be moved to here.

15. Page 2-32, Section 2.8.2.3, Action-Specific ARARs, Treatment ARARs:, 2nd paragraph on page

The text refers to Alternatives 3b and 4b. There are only alternatives 1, 2, and 3 under consideration.

16. Page 2-33, Section 2.8.2.3, Action-Specific ARARs, Treatment ARARs:, 2nd full paragraph on page

The text states that the "selected remedy will utilize off-site thermal regeneration of spent carbon". This is incorrect. The selected remedy uses air stripping.

The ROD must state that "designated" waste must be disposed in a manner that complies with Water Code Section 13173 and Section 2522, Title 23, Cal. Code of Regs. While federal CERCLA requirements regulate only "hazardous" substances, California regulates other waste that could affect water quality including "designated" waste.

17. Page 2-33, Section 2.8.2.3, Action-Specific ARARs, Discharge ARARs

See Comment 14, above.

18. Page 2-43, Section 2.9.1, Selection of the Preferred Alternative, second to last sentence of 2nd full paragraph

Please modify the following sentence to include:

" The estimated number of additional wells is based on assumptions made during the FS and the actual number and placement of additional wells will be decided based on the performance of the Phase I system and the results of additional investigations to define the TCE plume."

19. Page 2-43, Section 2.9.1, Selection of the Preferred Alternative, last sentence on page

The sentence "This recharge will enhance operation of the extraction system, as it will prevent excessive drawdown and will act to flush adsorbed TCE from aquifer materials" should be removed or qualified. During the dispute resolution process, Regional Board staff questioned to what degree recharge to the Old Sewage Treatment Plant Percolation Ponds would affect the TCE plume. For additional information see items numbered 3.b and 5, attachment 11 to the May 13, 1993 letter from the State Water Resources Control Board to US EPA, Region 9.

20. Page 2-46, Section 2.9.2.2, Air Stripping System, last paragraph

The text indicates that sodium hexamethaphosphate is added to prevent precipitation and sodium hypochlorite is added to prevent biological growth in the air stripping towers. These compounds are to be continuously monitored to "minimize" residual chlorine in the treated water.

Please indicate what minimum chlorine levels will remain to prevent formation of trihalomethanes (THMs) in the ground water.

21. Page 2-48, Section 2.9.4, System Implementation, last paragraph

The text states that "Data gaps identified in the RI report (JMM, 1992) will be used to develop a work plan for supplemental investigations at OU-1." The ROD must include a summary of the data gaps identified and include a schedule for conducting additional investigations. This work has been verbally agreed to by the Air Force for some time, however no formal schedules have been proposed.

22. Page 2-51, Section 2.10.5, Preference for Treatment as a Principle Element

See comment 5, above.

If you have any questions please call Jehiel Cass at (619)241-7408 or Cindi Mitton at (619)241-7413.

jc12/ou1drod.mem

STATE OF CALIFORNIA — ENVIRONMENTAL PROTECTION AGENCY

1868.0640/6.340

PETE WILSON, Governor

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

Region 4
245 West Broadway, Suite 350
Long Beach, CA 90802-4444
(310) 590-4868

December 2, 1993

Ms. Denise Caron
Air Force Base Disposal Agency
OL-C/AFBDA, Building 321
George Air Force Base, California 92394-5000

Dear Ms. Caron:

DRAFT RECORD OF DECISION (ROD), OPERABLE UNIT 1, GEORGE AIR FORCE BASE (GAFB), CALIFORNIA.

The Department of Toxic Substances Control (Department) has completed the review of the above subject document, dated October 1993.

The Air Force should incorporate the State's comments into the ROD. Enclosed are the Department's and the Lahontan Regional Water Quality Control Board's general and specific comments.

If you have any questions or concerns, please contact me at (310) 590-4915.

Sincerely

Emad Yemut

Emad B. Yemut
Region 4 Base Closure Unit
Base Closure Branch

Enclosures

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1868.0040/6.3.10

GEORGE AIR FORCE BASE

Record Of Decision, Operable Unit 1

GENERAL COMMENTS

1. All parties involved in the cleanup of George Air Force Base (GAFB) acknowledge that certain significant portions of the TCE plume remain undefined both in the North and Northeast where the Upper and Regional Aquifers merge. The State's position is that without the knowledge of the gross dimensions of the plume, both in the Upper and Regional Aquifers, the preferred alternative constructed and operational since December 1991 will not ensure the complete capture of the plume and expedite the cleanup. A language should be included in the Operable Unit 1 (OU1) Record of Decision (ROD) that reflects the situation and identifies the data gaps. THe Air Force (AF) should include a deadline for the submittal of the Workplan for implementing the additional investigation at OU1 to completely defining the TCE plume and filling the data gaps identified during the RI/Fs study.

2. The AF should clarify that Deed Restrictions will be part of the preferred alternative. The State believes that prior to sale or transfer of any of GAFB property overlying the contaminated groundwater plume, the AF should record a land use restriction in accordance with California Health and Safety Code Section 25230 as an institutional control to prohibit installation of wells until the groundwater standards have been achieved. The AF should provide notice of this restriction in any purchase, lease, or other agreement relating to that property.

3. The ARARs section is confusing and incomplete. The AF should identify the ARARs for each alternative in a tabulated form . The AF should conduct a comparative analysis of compliance with chemical-specific ARARs, location-specific ARARs, and action-specific ARARs for each alternative. then, the text will highlight the major ARARs.

SPECIFICS COMMENTS

1. **Section 1.2, Statement of Basis and Purpose**
page 1-1

Provide the year when CERCLA and SARA were enacted; 1980 for CERCLA and 1986 for SARA. Also, include the section of CFR that complies with this action: " 40 Code of Federal Regulations, (CFR) Part 300".

2. **Description of The Selected Remedy, Section 1.4**
page 1-2

The State believes that the selected groundwater remedy should include " **Deed restrictions**" as one of the major components of the selected remedy.
The text also states that" groundwater treatment using two air stripping towers". The AF should also clarify that there will be direct discharge of emissions from the air strippers to the atmosphere, because the emissions are in compliance with air quality ARARs.

3. **Statutory Determinations, Section 1.5**
page 1-2

The Air Force should include an estimate of the remedy duration to achieve cleanup standards. The Air force should also state that the 5 year review will be conducted on an ongoing basis to ensure that the remedy continues to provide adequate protection of human health and the environment, because the groundwater remedy will result in hazardous substances remaining onsite until the cleanup standards are met.

4. **Signatures, Section 1.6**
page 1-3

Please change the signature block for the Department of Toxic Substances Control to the following:

Anthony J. Landis
DSMOA Technical Program Manager
State of California
Department of Toxic Substances Control

5. **Distribution of TCE in Groundwater at 5 ppb, Figure 8**

The figure shows the boundary of TCE plume (5ppb) based on 1987 data; the TCE plume boundary should be based on current available data. This figure should show that the plume has impacted the VWRA wells. The figure should also show the data gaps to the north and northeast. It should differentiate between wells screened in the upper aquifer and wells screened in the regional aquifer.

6. **Northeast Disposal Area, Section 2.5.1**
page 2-16

The third paragraph of page 2-17 states that " given the easterly direction of groundwater flow near wells NZ-02, NZ-03, and NZ-13,it is believed that the TCE measured in the Regional Aquifer is unrelated to the TCE plume observed in the Upper Aquifer". This statement is not adequate and should be deleted. The State's understanding of this matter which is based on Remedial Investigation documents provided by the Air Force, is that the contamination has migrated off base in a north-easterly direction and has impacted the Regional Aquifer. The Upper and Regional Aquifers merge in the vicinity of well NZ-40 which is screened in the regional aquifer with a 580 ppb TCE.
It is our understanding that the Air Force agreed to characterize the full extent of TCE contamination in the regional aquifer emanating from George AFB. The AF agreed on conducting additional investigations to fill the data gaps identified in the operable unit 1 Remedial Investigation. The AF should provide the State with a submittal date for the additional investigations Workplan, and should clarify this issue in the ROD.

7. **Northeast Disposal Area, Section 2.5.1**
page 2-18

The second paragraph states that " It is expected that the existing VVWRA wells will be slightly impacted by the plume, although concentrations are predicted to remain below 5 ppb". We already know that some of VVWRA wells are impacted by the plume, please correct this paragraph to reflect that.

8. **STP Sewage Treatment Ponds, Section 2.5.3**
page 2-19

This section should include a clarification that the AF will monitor the groundwater quarterly for nitrate from existing wells around the STP percs ponds.

9. **Summary Of Site Risks, Section 2.6**
page 2-19

Even though the primary contaminant of concern at OU1 is TCE, the AF should include the 9 additional compounds that are also present and detected at OU1: Benzene, Carbon Tetrachloride, Chloroform, 1,1-dichloroethane(1,1-DCA), 1,2-dichloroethane(1,2-DCA), cis-1,2-dichloroethane, 1-2-dichloropropane, methylene chloride, and tetrachloroethene(PCE).

Furthermore, 1,1-DCA and 1,2-DCA, in anaerobic conditions, will undergo dehydrohalogenation to form Vinyl Chloride. Vinyl Chloride, like benzene is a known human carcinogen, and has a maximum concentration level of 0.5 ppb per State of California MCLs. The MCL for benzene is 1 ppb.

The AF should include these chemicals of concern in a tabulated form. Information on frequency of detection, maximum concentration, and mean concentration should also be included in this table. The State believes that the AF should monitor for these compounds and for Vinyl chloride in addition to TCE.

10. **Summary of Site Risks, Section 2.6**
page 2-19

The AF should include a clarification that the data used to prepare the baseline risk assessment was collected during the OU1 RI, that all the RI data have been validated , and that the quality is acceptable to support the recommendation of this ROD.

11. **Northeast Disposal Area, Section 2.6.1**
page 2-19

Include a summary table of carcinogenic and noncarcinogenic risk, and indicate if the risk is acceptable for the different scenarios considered.

12. **Northeast Disposal Area, Section 2.6**
page 2-19

Even though section 2.6, summary of site risks states that the risk assessment includes both human health risk assessment and an ecological risk assessment, no ecological risk is presented in the subsections. Please include a section on ecological risks and identify any State or Federal threatened or endangered plant species or other ecological receptors.

13. **Description of Alternatives, Section 2.7**
page 2-20

The AF should clarify that the technical information supporting each alternative and the future risk assessment associated with implementation of a remedial action is included in the final OU 1 FS.
This section should also include an estimate of the volume of contaminated groundwater in the upper aquifer. The cumulative carcinogenic risk to human health from groundwater from ingestion, and inhalation of airborne VOCs while showering should be included.

14. **Description of Alternatives, Section 2.7**
page 2-20

The AF should states and clarifies if " the contaminated groundwater is either a Resource Conservation and Recovery Act (RCRA) listed waste or RCRA characteristic waste as defined in Title 22 California Code of Regulations (CCR) Section 66261; or whether groundwater contaminants are listed wastes or if the groundwater exhibit corrosivity, ignitability, reactivity, or toxicity characteristics (Title 22 CCR Section 66261.24).

15. **Alternative 1, No Action With Groundwater Monitoring, Section 2.7.1, page 2-21**

Please clarify that this alternative is required for consideration by the NCP, that this alternative will not comply with relevant and appropriate federal and state MCLs established in the National Primary Drinking Water Standards [40 CFR section 141.61(a)] and Drinking Water Primary Standards [Title 22 CCR Division 4 section 64444.5], and that this no action alternative will not reduce the risk to human health posed by the VOCs in groundwater.

16. **Alternative 2- Groundwater Extraction, Air Stripping, and Percolation, Section 2.7.2, page 2-21**

The AF should include Deed Restrictions as part of this alternative. The State believes that prior to sale or transfer of any of George AFB property overlying the contaminated groundwater plume, the AF should record a land use restriction in accordance with California Health and Safety Code Section 25230 as an institutional control to prohibit installation of wells until the groundwater standards have been achieved. The AF should provide notice of this restriction in any purchase, lease, or other agreement relating to that property. A clarification of this matter should be included as part of this section.

17. **Alternative 2- Groundwater Extraction, Air Stripping, and Percolation, Section 2.7.2, page 2-21**

The main components of this alternative should be presented in a tabulated form. This alternative's main components consists of : 1) Deed restriction , 2) Groundwater monitoring, 3) Groundwater extraction, 4) Treatment by air stripping, 5) Direct discharge of emission to atmosphere, if emissions are in compliance with air quality ARARs, 6) Discharge of treated water to STP percs ponds for recharge into the Upper Aquifer.

18. **Alternative 2- Groundwater Extraction, Air Stripping, and Percolation, Section 2.7.2, page 2-21**

The State believes that the AF should compare the air stripping alternative 2 to a different alternative such as Carbon Adsorption, because the only difference between alternative 2 and alternative 3 is the addition of the Air emission control system which the AF should include as part of alternative 2, if they are not in compliance with air quality ARARs.

19. **Alternative 2- Groundwater Extraction, Air Stripping, and Percolation, Section 2.7.2, page 2-22**

The text states that "The second phase would occur in about 2 years and would include the installation of up to 10 additional wells (nine off-base wells), additional pipeline and roadway, and local power distribution to new wells". We believe that the locations and number of wells should be based on the additional investigation that the AF agreed to implement to define the full dimensions of the plume in the Upper and Regional Aquifers.

20. **Alternative 2- Groundwater Extraction, Air Stripping, and Percolation, Section 2.7.2, page 2-22**

The AF should identify the ARARs for each alternative in a tabulated form and include them in this section. The AF should include a comparative analysis of compliance with chemical-specific ARARs, location-specific ARARs, and action-specific ARARs for each alternative. Then the text should highlight the major ARARs.

21. **Overall Protection of Human Health and the Environment page 2-26**

The Text states that " The estimated average TCE concentration stripper influent has decreased from 150 to 47 ppb, based on more recent groundwater monitoring results"; however, a clarification to this matter should be added. The TCE plume is moving outside the base boundary; as such the TCE concentration is decreasing inside the base boundary and increasing outside the base boundary. Therefore, the average influent concentration may increase when the additional investigation is conducted to characterize the full extent of the plume in the upper and regional aquifers, and when the additional 10 or more extraction wells are installed.

22. **Overall Protection of Human Health and the Environment page 2-27**

The text states that" Additionally, the levels and frequency of detection of benzene, 1,2-DCA, and other VOCs decreased to the point where they were not considered statistically reliable for risk assessment purposes", this may be true for the present conditions; however, when the additional investigation is implemented and the full dimensions of contamination is characterized this may change. As such, the AF should monitor for these products (see comment number 9), and for byproduct of degradation since the remediation will take an estimated 30 years to complete.

23. **Compliance with ARARs, Chemical-specific ARARs, Section 2.8.2.1 page 2-29**

The AF should consider the " **National Emission Standards for hazardous Air Pollutants-NESHAPs(40 CFR Section 61.63, Section 61.92, Section 61.102, and Section 61.348)**. The air stripping remedial alternative should comply with this relevant and appropriate ARAR. If, at the present time, NESHAPs are not applicable because groundwater is not at least "10% volatile hazardous air pollutants by weight"; the AF should comply with the substantive requirements of this ARAR.

24. **Location -specific ARARs, Section 2.8.2.2 page 2-31**

The State believes that " **RCRA Location Standards (Title 22 CCR Chapter 14 Section 66264.18)**" is a relevant and appropriate ARAR. The facility should not be constructed within 200 ft of an earthquake fault and, if it is located within the 100-year floodplain, it should be designed, constructed, operated and maintained to prevent washout of waste.

25. **Action-specific ARARs, Section 2.8.2.3 page 2-32**

The State believes that: **Tank Systems (Title 22 CCR Section 66264.190 - 66264.199)** is a relevant and appropriate substantive requirements that should be incorporated into the design and operation of the tanks used to store groundwater.

Miscellaneous Units (Title 22 CCR Section 66264.600 - 66264.603). The air stripping towers should be located, designed, constructed, operated, maintained, and closed in a manner that ensures protection of human health and the environment (e.g., prevention of releases) and should comply with the relevant and substantive requirements for miscellaneous treatment unit.

Transportable Treatment Unit (title 22 CCR Section 67450). the air stripping tower is considered a fixed treatment unit. The State believes that the operation of the air stripping tower should comply with applicable substantive requirements for fixed treatment units, including discharge of treated effluent and treatment at site of waste generated.

26. State Acceptance, Section 2.8.8
page 2-41

The State conditionally approved the OU#1 FS. This approval was conditioned on the AF submittal of a workplan for the additional investigation to define the full dimensions of the TCE plume. This ROD should incorporate a statement to that fact, it should also include a submittal date for the phase II additional investigation study.

The State believes that the AF should monitor for any increase in VOCs emission from the air stripper that may cause an unacceptable risk to human health and the environment. Documentation should be provided to the State, USEPA and the local APCD on a yearly basis.

27. Community Acceptance, Section 2.8.9
page 2-41

The AF should state that the Proposed Plan was presented to the community and discussed at a public meeting, and provide a brief summary of the community concerns. The AF should clearly state if the community accepted this alternative in general, or if they have major concerns.

28. The Selected Remedy, Section 2.9
page 2-42

This section should state that the selected remedy was completed based on the 1988 FS conclusion.

29. Selection of the Preferred Alternative, Section 2.9.1
page 2-43

The text states that " The preferred alternative that best meets these objectives is alternative 2, which consists of on and off-base Upper Aquifer groundwater extraction with 19 wells, followed by treatment of extracted groundwater by two packed-tower air strippers, and recharge of the treated extracted groundwater to the Upper Aquifer via percolation".

The AF should also state that Deed Restriction will be part of the selected remedy. Deed restrictions should be placed on any George AFB property that overlies the VOC plume prior to sale or transfer to prohibit the installation of water wells in areas that still contain VOCs above cleanup standards.

The AF should also state that the emissions from the air stripping towers will be discharged directly to the atmosphere, if emissions are in compliance with air quality ARARs.

30. **Selection of the Preferred Alternative, Section 2.9.1**
page 2-43

The Text states that " The estimated number of additional wells is based on assumptions made during the feasibility study and the actual number and placement of additional wells will be decided based on the performance of the phase I system.". The text should clarify that additional investigation will be implemented at OU1 to define the full extent of contamination in the upper and regional aquifers, and based on this study the locations and number of additional extraction wells will be determined.

31. **Cost Analysis, Section 2.9.3**
page 2-47

The AF should present the estimated total cost in a tabulated form. The total cost should include a breakdown of the direct/indirect capital cost, annual/periodic cost (life of 30 years), and a cost summary.

RESPONSE TO USEPA COMMENTS
DRAFT RECORD OF DECISION, OPERABLE UNIT 1
GEORGE AIR FORCE BASE

General Comments

1. The text has been modified as appropriate to indicate that the 19 extraction wells and 8 monitoring wells are estimates; however, the exact number will be based on system (Phase I) efficiency.

2. Potential ARARs and TBCs have been presented in tabular form (Tables 4 through 10).

3. The Responsiveness Summary has been included in the Draft Final ROD as Section 3.0.

Specific Comments

1. Section 1.4 Description of Alternatives
   See response to General Comment 1 above. The text has been modified accordingly.

2. Section 2.1 Site Name

   The text has been modified accordingly. Additionally, the RI (JMM, 1992) has been cited where appropriate.

3. Section 2.1.6 Water Use

   The text has been modified to indicate that the wells referenced are municipal supply wells.

4. Section 2.5.1 Northeast Disposal Area

   The text has been revised to state that the source of TCE is currently unknown; however, several OU 3 sites have been identified as potential sources.

5. Section 2.5.1 Northeast Disposal Area

   References to the deep portion of the Upper Aquifer have been removed from the text.

6. Section 2.5.1 Northeast Disposal Area

   The sentence referenced has been removed from the text.

7. Section 2.5.1 Northeast Disposal Area

   The text has been modified to clarify that the wells referenced are located in the eastern portion of the base.

8. Section 2.5.1 Northeast Disposal Area

   The sentence referenced has been removed from the text.

9. Section 2.5.2 Industrial/Storm Drain and Outfall Ditch

The text has been modified to state that the remedial actions that have taken place have included removal of all contaminated sediments and replacement of the perforated portion of the pipe with nonperforated pipe as detailed in Section 2.2 (Site History and Enforcement Activities).

10. Section 2.5.3 STP Percolation Ponds

Section 2.5.3 has been revised substantially to clarify that groundwater is not expected to be impacted by nitrate and that quarterly monitoring of the wells around the STP percolation ponds will be performed.

11. Section 2.7 Description of Alternatives

This section is intended to provide a brief description of potential alternatives which were evaluated during the FS process (JMM, 1993). However, Section 2.9.2 (Detailed Description of the Preferred Alternative) presents details of the portion of the system (Phase I) which has already been installed.

12. Section 2.7.2 Alternative 2 - Groundwater Extraction, Air Stripping, and Percolation

The text has been modified to state that the extraction system will ensure that VOC concentrations are reduced to below federal MCLs. The reference to dispersion has been removed.

13 Section 2.7.2 Alternative 2 - Groundwater Extraction, Air Stripping, and Percolation

Section 2.7 is intended to summarize the alternatives that were evaluated in the FS (JMM, 1993). The text has been modified to reference Section 2.8, where a detailed comparison of the alternatives is presented, including compliance with ARARs as presented in Section 2.8.2. Additionally, Section 2.8.1 presents a discussion of calculations showing that with a 47 µg/l influent concentration (expected to be less) the emission rate of TCE is estimated to be 0.28 lbs/day.

14. Section 2.8.2.3 Action-Specific ARARs

The reference to San Bernardino County APCD has been changed to cite the Mulford-Carrell Air Resources Act (Health and Safety Code Sections 3900-44563) as regulated by the Air Resources Board and enforced under CAC, Title 17, Part III. The text in Section 2.8.3 (Long-term Effectiveness and Permanence) has been expanded to clearly state that VOC emissions will be monitored based on influent and effluent concentrations from the treatment system. Note that this monitoring has been occurring for the ongoing Treatability Study and the calculated mass of VOCs emitted has been well below the San Bernardino County APCD stated limit of 1 lb/day. Emissions will continue to be monitored in this manor.

15. Section 2.9.1 Selection of the Preferred Remedy

RESPONSE TO USEPA COMMENTS
DRAFT RECORD OF DECISION, OPERABLE UNIT 1
GEORGE AIR FORCE BASE

This section presents a discussion of the preferred remedy for the groundwater beneath the NEDA at GAFB; however, Section 2.5.2 has been modified to state that the remedial actions that have taken place have included removal of all contaminated sediments and replacement of the perforated portion of the pipe as detailed in Section 2.2 (Site History and Enforcement Activities). Section 2.6 has also been expanded to state that the risk assessment supports the conclusion of no further action for the Industrial/Storm Drain and Outfall Ditch, and the STP percolation ponds. Additionally, Section 2.2 has been expanded to clarify that the technical information supporting the conclusions presented in this ROD is included in the RI (JMM, 1992) and FS (JMM, 1993a) reports.

Attachment A, Reviewer: Danita Yocom, Assistant Regional Council, USEPA Region 9

1. Section 2.8.2 Compliance with ARARs

   The text has been modified accordingly.

2. Section 2.8.2.1 Chemical Specific ARARs

   All changes recommended in this comment have been made to the text.

3. Section 2.8.2.2 Location-Specific ARARs

   The text has been modified accordingly, including a discussion the mitigation efforts would include inspection of the proposed installation location (i.e., extraction well or monitoring well location) for endangered species by qualified personnel and selection of an alternate location if the presence of these species is detected.

4. Section 2.8.2.3 Action-Specific ARARs

   Treatment ARARs. The referenced paragraph has been removed from the text.

   Discharge ARARs. The text has been modified accordingly.

5. Section 2.8.4 Reduction of Toxicity, Mobility and Volume through Treatment

   The text has been modified accordingly.

6. Section 2.8.5 Short-term Effectiveness

   See response to Attachment A, Comment 3. Discussion of mitigation of potential impacts on sensitive habitat are now presented in Section 2.8.2.2. The Mojave ground squirrel is also included in this discussion.

7. Section 2.9.1 Community Acceptance

   The text has been modified accordingly.

8. Section 2.10 Statutory Determinations

   The text has been modified accordingly.

RESPONSE TO LRWQCB COMMENTS
DRAFT RECORD OF DECISION, OPERABLE UNIT 1
GEORGE AIR FORCE BASE

General Comments

1. Section 2.12 has been added to the text of the ROD which presents an outline of activities to be performed, as well as a schedule of submittals, for the Investigation in Support of RD/RA currently underway.

   Specific substantive discharge requirements will be included in the Remedial Design. However, language from the ROD prepared for Castle AFB which addresses this issue has as been included as appropriate in Section 2.9.1 (Selection of Preferred Remedy).

Specific Comments

2. Section 1.4 Description of Selected Remedy

   The text has been modified accordingly.

3. Section 2.2 Site History and Enforcement Activities

   The text has been modified accordingly.

4. Figure 8

   a. Although Figure 8 is included to present the data that was available when the 1988 FS analysis was performed, an additional figure (Figure 11) has been added to the document to present the most recent information regarding TCE distribution in the groundwater. The title of Figure 8 has been revised to clarify that it presents 1987 data.

   b. See response to Comment 4 (a) above.

   c. See response to Comment 4 (a) above. Only the wells available during the 1987 sampling events are presented on this figure; however, the wells around the percolation ponds are presented on Figure 11.

   d. See response to Comment 4 (a) above. Section 2.12 has been added to the text which discusses the data gaps and presents the most current groundwater data (Figure 11) with an indication that the southeastern edge of the plume is undefined.

   e. The figure has been revised accordingly.

   f. Discussion of separate "zones" within the Upper Aquifer has been removed from the text.

5. Section 2.5.1 Northeast Disposal Area

   a. The text has been modified to clearly state that TCE is primary contaminant of concern. Discussion of the "significance" of other detected compounds is presented in subsequent sections (i.e., based on the risk assessment). A list of the maximum concentrations of the contaminants of concern detected in the groundwater at the NEDA are now presented in Table 1.

Nitrate has not proven to be a contaminant of concern for the groundwater beneath the NEDA. Concern over nitrate has arisen as a result of proposed use of the STP percolation for discharge of treated groundwater as part of the preferred alternative. Therefore, the discussion of the STP percolation ponds (Section 2.5.3) has been revised substantially to clarify the rationale that nitrate is not expected to pose a threat to human health. Additionally, the monitoring wells around the percolation ponds will be monitored on a quarterly basis. Discharge can be discontinued if it is deemed that elevated nitrates are occurring due to this discharge.

The text has been revised to consistently use the terminology of "contaminants of concern."

b. Figure 8 has been revised to show the approximate location of the lateral edge of he Upper Aquifer.

c. The sentence referenced has been removed from the text.

6. Section 2.5.1 Northeast Disposal Area

The sentence referenced has been removed from the text.

7. Section 2.5.1 Northeast Disposal Area

a. The appropriate reference has been cited and the text has been modified to indicate that the 1992 RI summarizes previous work.

b. The intent of this section, and this ROD, is to summarize the conclusions of the 1992 RI and 1993 FS reports which summarized previous work (i.e., 1988 RI/FS) and were based on previous data. As agreed upon in the RPM meetings and presented in the approved Final 1993 FS, new data will not be incorporated here and will be presented separately as part of the ongoing Investigation in Support of RD/RA. Section 2.12 (Current Investigation Status) has been added to the text of the ROD which summarizes activities that have occurred to date, as well as the scope of the Investigation in Support of RD/RA, which includes additional modeling. The text in has been revised to reference appropriate previous documents and clarify that the results are based on these earlier modeling efforts.

c. See Comment 7 (b). The intent of this section, and this ROD, is to summarize the conclusions of the 1992 RI and 1993 FS reports which summarized previous work (i.e., 1988 RI/FS) and were based on previous data. As agreed upon in the RPM meetings and presented in the approved Final 1993 FS, new data will not be incorporated here and will be presented separately as part of the ongoing Investigation in Support of RD/RA. Section 2.12 (Current Investigation Status) has been added to the text of the ROD to clearly state what activities have occurred to date.

d. See response to Comment 7 (b) and (c).

8. Section 2.5.3 STP Percolation Ponds

USGS Water-Resources Investigations Report 93-4137 has been referenced in the ROD and referred to as appropriate in Section 2.5.3.

9. Section 2.7.2 Alternative 2 - Groundwater Extraction, Air Stripping, and Percolation

The text has been modified to state that the extraction system will ensure that VOC concentrations are reduced to below federal MCLs. The reference to dispersion has been removed. Discussions regarding SWRCB Resolution 68-16 are presented in Section 2.8.2.3 (Action-Specific ARARs).

10. Section 2.7.2 Alternative 2-Groundwater Extraction, Air Stripping, and Percolation

Section 2.9.2 (Detailed Description of the Preferred Alternative) presents a discussion of the system that has been installed to date. Section 2.7 (Description of Alternatives) is intended to summarize the Alternatives evaluated in the in the 1988 RI/FS, as summarized in the 1993 Final FS which conformed to the guidance set forth in the Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (USEPA, 1988).

11. Figure 9

See response to comment 10. This figure, and the section in which it is presented, is intended to show the system proposed for the Alternatives 2 and 3 that were presented in the 1993 Final FS. However, Section 2.9.2 presents a detailed discussion of the system which has been installed to date. Additionally, Section 2.1.2 (Current Investigation Status) has been added to the document to summarize the investigation activities that have occurred since the installation of Phase I of the treatment system and the ongoing Investigation in Support of RD/RA the focus of which is to provide data to modify Phase II to maximize plume containment and capture. Sufficient data is not available at this time to present locations of Phase II well locations with any accuracy. The text throughout the document has been modified to clarify that the 1993 FS presents technical backup for alternatives evaluated, which presented the referenced figure showing best guess Phase II well locations based on data available at that time.

12. Table 1 Summary of Detailed Analysis of Remedial Alternatives

More detailed cost estimation will be performed as part of the Remedial Design. Table 1 (now Table 3), and the section in which it is presented, is intended to summarize the comparison of alternatives presented in the 1993 Final FS which conformed to the guidance set forth in the Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (USEPA, 1988). Costs presented were not intended as a remedial design but as best estimates for comparison of proposed alternatives.

13. Table 2 (now Table 11)

a. The maximum detected concentrations for all compounds have been added to the table, as reported in the RI (JMM, 1992). Additionally, Table 1 has been

added to the document to give a detailed summary of groundwater data available for the 1988 RI/FS.

b. A footnote has been added to Table 2 (now Table 11) which states that the federal MCL of 5 µg/l is the chemical-specific ARAR for the final aquifer cleanup level and the action-specific ARAR for treated effluent discharge is 2.5 µg/l TCE on a median basis, with a maximum discharge level of 5 µg/l.

c. Section 2.12 has been added to the text of this ROD to clearly state what activities have occurred since the 1988 RI/FS. Background water quality data is currently being assessed as part of the STP percolation pond monitoring activities (discharge to the ponds has not begun); additionally, background water quality data is being assessed as part of the ongoing OU 3 investigations as well as the Investigation in Support of RD/RA. However, the intent of this ROD is to present the conclusions summarized in the 1992 RI and 1993 FS reports which summarized previous work (i.e., 1988 RI/FS) and were based on previous data. As agreed upon in the RPM meetings, this new data will not be incorporated here and will be presented separately as part of the Investigation in Support of RD/RA.

d. Taste and odor values are secondary drinking water standards which are not ARARs in this case.

e. The table has been modified to clarify it presents potential chemical-specific ARARs. Tables 4 through 10 have been added to the document which list all potential federal and state ARARs for the compounds detected at the NEDA. The text has been modified to clearly state that the federal MCL for TCE is the ARAR for final aquifer cleanup.

See response to Comments 13 (b) above. The discussion of the results of the dispute resolution process, which affected the discharge ARARs, is now located in Section 2.8.2.3 (Action-Specific ARARs) where it is most appropriate. Section 2.8.2.1 has been simplified to clearly state the final aquifer cleanup value of 5 µg/l as a chemical-specific ARAR.

f. The table presents the contaminants of concern for the groundwater contamination beneath the NEDA. Nitrate has not proven to be one of these contaminants. Concern over nitrate has arisen as a result of proposed use of the STP percolation for discharge of treated groundwater as part of the preferred alternative. Therefore, the discussion of the STP percolation ponds (Section 2.5.3) has been revised substantially to present the rationale that nitrate is not expected to pose a threat to groundwater. Additionally, the monitoring wells around the percolation ponds will be monitored on a quarterly basis. Discharge can be discontinued if it is deemed that elevated nitrates are occurring due to this discharge.

The table has been footnoted to present the results of the dispute resolution process (see Comment 13 [b] above).

14. Section 2.8.2.1 Chemical Specific ARARs

a. The text in Section 2.8.2.1 has been modified as to be more generic. The dispute resolution discussion, which resulted in 2.5 µg/l discharge levels on a median basis, is now presented in 2.8.2.3 (Action-Specific ARARs). Table 2

(now Table 11) has been footnoted to present the results of the dispute resolution process (see Comment 13 [b] and [f] above).

b. The Basin Plan is now presented in Table 7 (Identification of Potential State Chemical-Specific ARARs). This table states that use of MCLs as a remedial standard would cleanup groundwater to its highest beneficial use (i.e., drinking water).

c. The discussion of the results of the dispute resolution process, which affected the discharge ARARs, is now located in Section 2.8.2.3 (Action-Specific ARARs) where it is most appropriate. Section 2.8.2.1 has been simplified to clearly state the final aquifer cleanup value of 5 µg/l as a chemical-specific ARAR.

d. See response to 14 (c) above. The discussion of the results of the dispute resolution process has been clarified; however, it is an action-specific ARAR and is presented in Section 2.8.2.3 as such.

15. Section 2.8.2.3 Action-Specific ARARs

The text has been corrected to state Alternative 3.

16. Section 2.8.2.3 Action-Specific ARARs

The text has been revised to state the Alternative 3, which includes emission controls using GAC, could use off-site thermal regeneration of spent carbon.

Additionally, a paragraph has been added to state that although contaminated groundwater is not classified as a RCRA hazardous waste, subsequent disposal without treatment may impact groundwater; therefore, it is considered a California "designated" waste, as defined by Title 23 CCR. Consequently, the remedial alternative must treat contaminated water to minimize impacts to beneficial uses of groundwater prior to discharge. The OU 1 dispute resolution process determined appropriate treatment and discharge levels.

17. Section 2.8.2.3 Action-Specific ARARs

See response to Comment 14 above.

18. Section 2.9.1 Selection of the Preferred Alternative

The text has been modified accordingly.

19. Section 2.9.1 Selection of Preferred Alternative

The sentence in question has been removed from the text.

20. Section 2.9.2.2 Air Stripping System

The text has been modified to indicate that specific details of the monitoring program will be included in the RD/RA.

21. Section 2.9.4 System Implementation

The schedule of additional investigations and a summary of ongoing Investigation in Support of RD/RA activities is now presented in Section 2.12 (Current Investigation Status).

22. Section 2.10.5 Preference for Treatment as a Principle Element

The text has been revised accordingly.

RESPONSE TO DTSC COMMENTS
DRAFT RECORD OF DECISION, OPERABLE UNIT 1
GEORGE AIR FORCE BASE

General Comments

1. The schedule of additional investigations and a summary of ongoing Investigation in Support of RD/RA activities is now presented in Section 2.12 (Current Investigation Status).

2. The text of this ROD has been modified where appropriate to clarify that deed restrictions will be part of the preferred alternative.

3. Tables 4 through 10 have been added to the document which present potential federal and state ARARs. The text throughout the section has been revised to clarify which ARARs will apply.

Specific Comments

1. Section 1.2 Statement of Basis and Purpose

   The text has been modified accordingly.

2. Section 1.4 Description of the Selected Remedy

   The text has been modified accordingly.

3. Section 1.5 Statutory Determinations

   The text has been modified accordingly.

4. Section 1.6 Signatures

   The text has been modified accordingly.

5. Figure 8

   The approximate location of the lateral edge of the Upper Aquifer has been added to the figure. A distinction has been made between wells screened in Upper and Regional Aquifers. The intent of this section, and this ROD, is to summarize the conclusions of the 1992 RI and 1993 FS reports which summarized previous work (i.e., 1988 RI/FS) and were based on previous data. As indicated in the legend of Figure 8, the plume presented is based on 1987 data. Presentation of current data in Figure 8 would be misleading. However, Section 2.12 has been added to the text of this ROD which summarizes activities which have occurred to date as well as the scope of the ongoing Investigation in Support of RD/RA which includes installation of 12 wells to address the data gaps to the north and northeast. Figure 11 has been included in this Section 2.12 which presents the most recent groundwater sampling results in light of recent activities.

6. Section 2.5.1 Northeast Disposal Area

   The sentence referenced has been removed from the text. See response to Comment 5 above. Section 2.12 has been added to the text which discusses the scope of the ongoing Investigation in Support of RD/RA and presents a schedule these activities.

7. Section 2.5.1 Northeast Disposal Area

The text has been modified to clearly state that the discussion is presenting the predictions of the model performed for the 1988 FS analysis. The reader is directed to Section 2.12 and associated references which discuss the recent sampling events that have occurred at the VVWRA.

8. Section 2.5.3 STP Percolation Ponds

The text has been modified accordingly.

9. Section 2.6 Summary of Site Risks

A table (Table 1) has been added to Section 2.5.1 of the document which lists the maximum concentrations, frequency of detection, and mean concentration of detected compounds based on the data available for the 1988 RI/FS. A monitoring plan will be included as part of the RD/RA.

10. Section 2.6 Summary of Site Risks

A statement has been added to the text to state that the OU 1 risk assessment was performed prior to validation of the available data. The data used for this risk assessment could not all be validated, as reported in a Validation Summary Report (JMM, 1993c); however, validated date will be collected to support the conclusions of this risk assessment as part of the ongoing Investigation in Support of RD/RA (Section 2.12).

11. Section 2.6.1 Northeast Disposal Area

A summary table (Table 2) has been added to the document which presents the cancer risk and hazed index calculations.

12. Section 2.6.1 Northeast Disposal Area

A discussion of the environmental risk assessment, identifying endangered species that may be affected, has been added to the text.

13 Section 2.7 Description of Alternatives

The text in Section 2.2 (Site History and Enforcement Activities) has been modified to clarify that technical information supporting each alternative is presented in RI (JMM, 1992) and the FS (JMM, 1993). A summary table (Table 2) has been added to the document which presents the cancer risk and hazed index calculations including ingestion, inhalation, and dermal exposure to contaminants.

The estimated volume of contaminated water has been added to Section 2.5.1 (Northeast Disposal Area).

Section 2.7 is intended to summarize the alternatives that were evaluated in the Final FS (JMM, 1993). However, Section 2.6 (Summary of Site Risks) discusses the risks associated with OU 1.

14 Section 2.7 Description of Alternatives

The text in Section 2.5.1 has been modified to state that the contaminated groundwater in OU 1 is not a RCRA hazardous waste as defined in 22 CCR Section 66261. Based on the reported average TCE concentration of 47 µg/l, the contamination is well below the Maximum Concentration of Contaminants for the Toxicity Characteristic (using TCLP procedure) of 0.5 mg/l. Additionally, this value is well below the soluble threshold limit concentration (STLC) of 204 mg/l for TCE.

15. Section 2.7.1 No Action With Groundwater Monitoring

The text has been modified to state the No Action alternative is included, as required by the NCP, for comparison against other alternatives and will provide no additional protection of human health or the environment. Section 2.8.1 (Overall Protection of Human Health and the Environment) provides additional discussion of this issue.

16. Section 2.7.2 Alternative 2 - Groundwater Extraction, Air Stripping, and Percolation.

A discussion of appropriate deed restrictions has been added to Section 2.7.2.

17. Section 2.7.2 Alternative 2 - Groundwater Extraction, Air Stripping, and Percolation

The main components of each alternative has been presented in tabular form at the beginning of Section 2.7. Deed restrictions have been included in this list.

18 Section 2.7.2 Alternative 2 - Groundwater Extraction, Air Stripping, and Percolation

The intent of this ROD is to present the conclusions of the 1992 RI and 1993 FS reports which summarized previous work (i.e., 1988 RI/FS) and were based on previous data. The Final 1993 FS, which conformed to the guidance set forth in the Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (USEPA, 1988), and provides technical support for these alternatives, was approved by the regulatory agencies. Comparison of additional alternatives at this juncture would mean performing a new FS. However, different treatment alternatives may be considered as a result of the findings of the ongoing Investigation in Support of RD/RA now presented in Section 2.12.

19. Section 2.7.2 Alternative 2 - Groundwater Extraction, Air Stripping, and Percolation

The text has been modified to indicate that the proposed 10 wells is an estimate, the exact number and location to be determined based on the efficiency of the Phase I system.

20. Section 2.7.2 Alternative 2 - Groundwater Extraction, Air Stripping, and Percolation

Tables 4 through 9 have been added to the document which present potential federal and state ARARs. The text throughout the section has been revised to clarify which ARARs will apply.

21. Section 2.8.1 Overall Protection of Human Health and the Environment

The intent of the discussion is to present the conclusions of the 1992 RI and 1993 FS reports which summarized previous work (i.e., 1988 RI/FS) and were based on previous data. The text throughout the document has been modified where appropriate to clarify this point. Section 2.12 (Current Investigation Status) has been added to the document which describes the scope of ongoing Investigation in Support of RD/RA. Part of the focus of this study is to reassess the RAOs and determine if system enhancement would be required. Additionally, a monitoring plan will be included as part of the RD/RA.

22. Section 2.8.1 Overall Protection of Human Health and the Environment

See response to Comment 21 above.

23. Section 2.8.2.1 Chemical-Specific ARARs

Under NESHAPS, there are no emission standards for TCE or air strippers; therefore, this would not be ARAR.

24. Section 2.8.2.2 Location-Specific ARARs

This ARAR has been incorporated into Table 8 (Identification of Potential State Location-Specific ARARs).

25. Section 2.8.2.3 Action-Specific ARARs

Requirements for Tank Systems, Miscellaneous Units, and Fixed Treatment Units are covered under 22 CCR Section 66260 et seq., which is summarized in Table 9 (Identification of Potential State Action-Specific ARARs).

26. Section 2.8.8 State Acceptance

The text has been modified to reflect the state's conditional approval of Alternative 2. Additionally, it references Section 2.12 (Current Investigation Status) which provides a schedule for the Investigation in Support of RD/RA. The text in Section 2.8.3 (Long-term Effectiveness and Permanence) has been expanded to clearly state that VOC emissions will be monitored based on influent and effluent concentrations from the treatment system. Note that this monitoring has been occurring for the ongoing Treatability Study and the calculated mass of VOCs emitted has been well below the San Bernardino County APCD stated limit of 1 lb/day. Emissions will continue to be monitored in this manor.

27. Section 2.8.9 Community Acceptance

The text has been modified to reflect the current status that after the release of the Proposed Plan, which presented Alternative 2 as the preferred remedy, the community did not express any significant objection during the public meeting or public comment period.

28. Section 2.9 The Selected Remedy

The text has been modified to indicate that the detailed evaluations of alternatives are presented in the FS (JMM, 1993) (which brought the 1988 RI/FS up to date with current CERCLA guidance and summarized previous work). Terminology which implied that recent monitoring data was incorporated in this analysis has been removed.

29. Section 2.9.1 Selection of the Preferred Alternative

The text has been modified accordingly.

30 Section 2.9.1 Selection of the Preferred Alternative

The text has been modified accordingly.

31. Section 2.9.3 Cost Analysis

The tabulated costs for the preferred alternative have been presented as Table 12. Section 2.8.7 now references the FS (JMM, 1993) for detailed cost analysis.

DRAFT FINAL ROD COMMENTS/RESPONSES

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, Ca. 94105-3901

February 17, 1994

Ms. Denise Caron
Chief, Environmental Programs
AFBDA/OL-C, Building 321
George Air Force Base, CA 92394-5000

Dear Ms. Caron:

We have reviewed the draft final Record of Decision for Operable Unit 1 and are providing the attached comments. These comments were prepared by Danita Yocom of EPA's Office of Regional Council.

If you have any questions please contact me at (415) 744-2409.

Sincerely,

Brian Swarthout
Remedial Project Manager

cc: Jay Cass, RWQCB
Emad Yemut, DTSC
Greg Little, JMM

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

February 17, 1994

MEMORANDUM

Subject: Draft Final Record of Decision ("ROD") for OU-1 at George Air Force Base ("GAFB")

From: Danita D. Yocom, Assistant Regional Counsel

To: Brian Swarthout, Regional Project Manager

This memorandum summarizes my comments on the above-referenced draft final ROD.

I have a few general comments with respect to applicable or relevant and appropriate requirements ("ARARs") in the ROD. First, the tables which identify ARARs for the alternative remedies should correspond to the narrative portion of the ROD which describes why such environmental laws are ARARs with respect to the alternative remedies discussed in the ROD. The tables are not a substitute for a narrative discussion of the ARARs. I understand that there may have been some confusion as to what Tables 4 through 10 were to include, and that therefore, the tables show potential ARARs from the RI/FS. The tables for the final ROD should only reflect ARARs which apply to the three alternatives considered in the ROD. Enclosed as attachment A is a list which summarizes the ARARs discussed in the narrative.

This leads to my second comment which regards the inclusion of additional ARARs in the draft final ROD. As any ARARs analysis requires specific consideration of the manner in which a proposed ARAR applies to the particular circumstances at a site, the NCP requires that ARARs be identified in a timely manner. Given that federal facilities are under considerable time pressure to complete decision documents for cleanup, it is inappropriate to raise additional ARARs for inclusion at this time as ARARs often raise complex, and sometimes contentious, issues regarding interpretation of the law in question.

For example the draft final ROD (in section 2.8.2.3, at page 2-37) adds Title 23 as an ARAR with respect to contaminated groundwater. I understand that EPA and the State are discussing whether Chapter 15 of Title 23 is an ARAR at other federal facilities, and that such discussion also includes issues regarding the scope and interpretation of 23 CCR §2511(d). In

particular, the Regional Board is asserting, inter alia, that if the limitations on the exclusion in §2511(d) are present, all requirements of Chapter 15 must be implemented; this would include cleanup to background. Naturally, the results of these discussions would affect the implementation of Chapter 15 at OU-1.

Additional information is needed in order to determine (i) whether a designated waste is present at OU-1, (ii) whether the exclusion in §2511(d) applies, and (iii) if the circumstances at OU 1 come within either section, the interpretation of the requirements imposed by either section. For example, what constitutes a "designated waste"? Is it groundwater or extracted groundwater? If extracted groundwater is a designated waste, does it remain a designated waste after treatment? If there is a designated waste, how will 23 CCR §2522(b) (the requirement that designated waste be discharged into Class I or Class II waste management units) affect the remedial alternatives? (E.g. would new percolation ponds be constructed?) Would such designation have any other impacts on the way in which the alternatives are implemented? How is the classification of certain media as designated waste to be read in conjunction with 23 CCR §2511(d)?

In light of the numerous issues which must be addressed, we do not have sufficient time to adequately address this issue. I suggest deleting the language at page 2-37 and adding at the end of the ARARs section the following language:

"In its comments to the draft ROD, the State requested that the Air Force include 23 CCR §2522, which relates to designated wastes, as an ARAR in the ROD. The Air Force, EPA and the State acknowledge that EPA and the State have scheduled discussions to resolve whether sections arising under Title 23 of the California Code of Regulations are ARARs and, if so, the interpretation of such sections. The Air Force, EPA and the State agree that while 23 CCR §2522 will not be listed as an ARAR in the ROD for reasons relating to timeliness, the Air Force agrees to implement the remedy in conformance with the determinations made in such forum in order to meet assure that the remedy is protective.

Finally, please be advised that, while I referred to the State's comments in interpreting additions to the text, I did not respond to the State's comments which were attached as appendices. Consequently, my comments do not address issues that the State raised in their comments which were not addressed in the text of the ROD.

Attachment A
ARARs Identified in the Narrative Portion of the ROD.

(A) Chemical Specific ARARs.

(1) Federal:

Safe Drinking Water Act/Federal MCLs/MCLGs (42 USC §300g; 40 CFR Part 141). Relevant and appropriate.

(B) Location Specific ARARs.

(1) Federal:

Endangered Species Act. Applicable.

(C) Action Specific ARARs.

(1) Federal:

RCRA 40 CFR 263. Relevant and appropriate.

RCRA 40 CFR 264.110 -264.120. Relevant and appropriate.

RCRA Subtitle C (off-site disposal). Relevant and appropriate.

(2) State:

22 CCR 66262.30 - 66262.33. Relevant and appropriate.

22 CCR 66264. Relevant and appropriate.

22 CCR 66262.10 - 66262.57 Relevant and appropriate.

Resolution 68-16. Relevant and Appropriate. While the Porter-Cologne Act is not the ARAR, it could be listed in the citation to Resolution 68-16 as the authorizing statute. The Basin Plan may also be added as a citation to this ARAR.

Mojave AQMD Rules enacted pursuant to the Mulford-Carrell Air Resources Act (Health and Safety Code §39000-44563; Title 17, part III). Relevant and Apropriate. There should be a cite to the Mojave AQMD rule that exempts air strippers from emission controls so long as the TCE emission remain below 1lb. per day. The rule is the ARAR and the Act is the authorizing statute. The Rule (with citation) should appear in the standard column and Mulford-Carrell may appear in the in the citation section as the authorizing statute.

State of California

Memorandum

To: Emad Yemut
Department of Toxic Substances Control

Date: Feb. 17, 1994

Curt Shipley for

Jehiel Cass, Associate WRCE

From: California Regional Water Quality Control Board
Lahontan Region
Victorville Branch Office
15428 Civic Drive, Suite 100
Victorville, CA 92392-2359
(619) 241-6583

Subject: COMMENTS ON DRAFT FINAL RECORD OF DECISION (ROD), OPERABLE UNIT ONE (OU-1), GEORGE AIR FORCE BASE, SAN BERNARDINO COUNTY

Regional Board staff has completed review of the draft final ROD. Montgomery Watson, consultants to George AFB, did an excellent job in addressing our comments on the draft ROD.

Attached you will find a short list of items that Board staff believe are necessary to make the ROD technically correct and adequately incorporate State Applicable or Relevant and Appropriate Requirements.

enc: Attachment A

cc: Gordon Mannings, Montgomery Watson
Denise Caron, GAFB
Brian Swarthout, US EPA

Attachment A

Draft Final Record of Decision, OU-1
Regional Board Staff Comments
Annotated Edition Page References

1. Page 2-19, 3rd par, "These wells [redacted] are not now used for potable water"

   This is necessary to indicate to the reader that the production wells at Victor Valley Waste Water Treatment Plant are intended to be potable water wells. Board staff understand that bottled water is currently purchased for employees.

2. 2-19, 4th par, "TCE present in the aquifer [redacted] was estimated"

   This is necessary for the reader to understand that the total estimate of TCE mass in the aquifer may be greater.

3. Figure 9, add to Title box:

   [redacted]

   The reader should understand that more extraction wells are planned, but not shown.

4. Table 9, add to reflect page 2-37 statement:

Waste Disposal to Land Regulations	23 CCR, Sec. 2510 et seq.	Establishes state regulations governing disposal of waste to land, includes criteria for designated waste	applicable to any waste disposed to land such as well cuttings etc.

   The potential list of Applicable or Relevant and Appropriate Requirements (ARARs) should reflect the document. See page 2-37 and comment 9, below.

5. Table 10, reverse the last two items in the description column.

   These two statements are in reverse order from what was intended.

6. Table 11, add to footnote g, the following sentence (or something like it):

   [redacted]

   The ROD must indicate that part of the US EPA Regional Administrators decision regarding the dispute was that the system must be operated to the maximum extent feasable without adding new treatment equipment to achieve the goal.

7. Table 12, see item 6, above. Add the same footnote.

8. Page 2-49, second bullet, add something like: "minor modifications may be necessary if the goal can not be met."

9. Page 2-51, add after 1st par.:

[redacted]

This is necessary to fully address our comments on the draft document that all non-hazardous waste disposed, resulting from either investigations or remediation will be disposed in accordance with State requirements.

10. Add to the appropriate section that receiving water quality will be determined for the permanent disposal site prior to permanent disposal.

This requirement was previously agreed to by the Air Force.

jc13/rodcom.not

MEMORANDUM

To: Denise Caron, George AFB
Brian Swarthout, US EPA IX
Emad Yemut, DTSC
Gordon Manning, Montgomery Watson

From: Jehiel Cass, Regional Board JWC

Date: February 25, 1994

Subject: George Air Force Base, Operable Unit One ROD

US EPA, Region IX and Lahontan Regional Board staff have completed discussions regarding appropriate language for the final OU-1 ROD.

We believe that the attached changes should be made to the ROD. Page numbers refer to the annotated version of the draft final ROD. The ROD should be finalized for signature.

If necessary, a conference call may be arranged on Monday to discuss the changes.

jc13/ou1roda

Additions to Record of Decision, Table 7, (Revised 2/25/94)

Standard, Criteria, etc.	Citation	Description	Comment
Water Quality Control Plan for the Lahontan Region (Basin Plan)	Page I-5-3, item d	Prohibits the discharge of waste water except to the designated disposal sites.	Applicable to remedial alternatives involving the discharge of treated or partially treated water.
Water Quality Control Plan for the Lahontan Region (Basin Plan)	Page I-5-3, item f	Requires the collection, transport, treatment or disposal facilities to be adequately protected from a 100-year flood.	Applicable to remedial alternatives with treatment facilities.
Sources of Drinking Water Policy	State Water Resources Control Board Resolution 88-63	Defines all ground and surface water as existing or potential sources of drinking water unless total dissolved solids are greater than 3,000 ppm, the well yield is less than 200 gpd from a single well, or ground water is unreasonable to treat using best management practices or best economically achievable treatment practices.	The identification of the OU-1 aquifers affected by TCE as potential drinking water sources forms the basis for selection of MCLs and SWRCB Resolution 68-16 as specific ARARs to maintain existing high quality waters.
Water Quality Control Plan for the Lahontan Region (Basin Plan)	Table 2-1, Beneficial Uses of Ground Waters in Upper Mojave Hydrologic Unit (628.20)	Defines beneficial uses for ground waters beneath George AFB as: municipal, agricultural, industrial service and freshwater replenishment	
Porter-Cologne Water Quality Control Act	California Water Code Section 13267	Requires any person discharging waste to submit technical and monitoring reports, considering the need and benefits to be obtained.	Provides the basis for development of reporting, notification and monitoring programs during the RD/RA phase.
Water Quality Control Plan for the Lahontan Region (Basin Plan)	Page I-7-6, item 2		

jc13/ou1rodta

FEB-25-1994 17:32 FROM RWQCB REGION 6B TO 9151097533412 P.03

Insert in the Section 2.8.2.3 of the ROD

Drinking water is considered to be the highest beneficial use and remediation to drinking water standards affords the greatest level of protection and cleanup. As required by the California Porter-Cologne Water Quality Act, the Regional Quality Control Board Lahonton Region defines the beneficial uses of various water bodies for the Mojave River Basin. Water bodies and their beneficial uses are presented in the Lahonton Basin Plan. The Basin Plan classifies aquifers in the OU-1 area to have "existing or potential beneficial uses as sources of drinking water". This regional plan has been promulgated and portions thereof are ARARs with respect to OU 1. The identification of the beneficial uses of the groundwater at OU 1 serves as the basis for selection of the federal MCL for TCE for the groundwater cleanup and the selection of maximum TCE concentrations for discharges of effluents into the percolation ponds pursuant to Resolution 68-16 as determined by the dispute resolution process.

Remove the first paragraph in Section 2.8.2.3 under treatment ARARs which begins "Although the contaminated groundwater at OU-1 is not classified..."

Insert as the first complete paragraph on page 2-51.

EPA and the State have scheduled discussions to resolve whether sections arising under Chapter 15 of Title 23 of the California Code of Regulations ("Chapter 15") are ARARs and, if so, the scope and interpretation of Chapter 15. Consequently, the parties have not determined whether or not Chapter 15 is an ARAR for the purposes of this ROD. The Air Force, EPA and the State have agreed, however, that the Air Force will sample drillings, cuttings and similar wastes to determine whether such wastes are hazardous wastes as defined in 22 CCR Section 66300 or designated wastes as defined in 23 CCR Section 2522. If such sampling indicates that the wastes are hazardous wastes, the hazardous wastes will be discharged only to Class I waste management units. If such sampling indicates that the wastes are designated wastes, such designated wastes will be discharged only to Class I or Class II waste management units.

RESPONSE TO USEPA COMMENTS
DRAFT FINAL RECORD OF DECISION, OPERABLE UNIT 1
GEORGE AIR FORCE BASE

General Comments

Tables presenting potential ARARs have been revised such that only specific ARARs mentioned in the text have been included.

The USEPA and the Lahontan RWQCB have not resolved whether sections arising under Title 23 CCR are ARAR for OU 1. Therefore, the paragraph in question (Section 2.8.2.8, first paragraph in Treatment ARARs) has been removed from the text and the language presented by the Lahontan RWQCB (February 25, 1994) has been incorporated.

RESPONSE TO LRWQCB COMMENTS
DRAFT FINAL RECORD OF DECISION, OPERABLE UNIT 1
GEORGE AIR FORCE BASE

1. The text has been modified to state that the wells "were, but are not currently used for potable water."

2. The text has been modified accordingly.

3. The title of Figure 9 has been modified to clarify that it shows Phase I of the extraction/treatment system. The text now states that because the exact number and location of extraction wells for Phase II is pending determination of Phase I efficiency, they are not shown on Figure 9.

4. Table 9 has been removed from the ROD. Potential ARARs are no longer presented. The USEPA and the Lahontan RWQCB have not resolved whether this is an ARAR for OU 1. (See Additional Comments [February 25, 1994] below)

5. Table 10 has been removed from the ROD. Potential ARARs are no longer presented.

6. Table 11 has been removed from the ROD. Potential ARARs are no longer presented. However, a similar footnote has been added to Table 8 (previously Table 12, see Comment 7)

7. A footnote has been added to Table 8 (previously Table 12) to state that "The USAF will seek to treat the discharge to attain a level of 0.5 µg/l TCE as measured at the percolation ponds. This level is a nonenforceable goal. The USAF may make minor modifications, as necessary, to operate the treatment system at the maximum efficiency in an effort to reach the goal." This is consistent with the language used in the text.

8. The text has been modified to state that "the USAF may make minor modifications, as necessary, in an effort to reach this goal." This is consistent with the language used in response to Comment 7.

9. This comment has been addressed by an additional inset provided by the Lahontan RWQCB on February 25, 1994 (see below).

10. Section 2.12.1 (Additional Investigations) currently states that four rounds of groundwater monitoring has occurred at the four wells installed around the STP Percolation Ponds. Additionally, Section 2.5.3 (STP Percolation Ponds) states that the STP Percolation Ponds will continue to be monitored for nitrates on a quarterly basis.

Additional Comments (Dated February 25, 1994)

The three inserts provided by the Lahontan RWQCB (two inserts for Section 2.8.2.3 and one for Table 7 [previously Table 6]) have been added as suggested with minor editorial revisions.

RESPONSE TO DTSC COMMENTS
DRAFT FINAL RECORD OF DECISION, OPERABLE UNIT 1
GEORGE AIR FORCE BASE

General Comments

DTSC had no comments for revision to the Draft Final ROD.