Public Health Assessment for

GEORGE AIR FORCE BASE
VICTORVILLE, SAN BERNARDINO COUNTY, CALIFORNIA
CERCLIS NO. CA2570024453
DECEMBER 1, 1998

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
Agency for Toxic Substances and Disease Registry

PUBLIC HEALTH ASSESSMENT

GEORGE AIR FORCE BASE

VICTORVILLE, SAN BERNARDINO COUNTY, CALIFORNIA

CERCLIS NO. CA2570024453

Prepared by:

Federal Facilities Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6)), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 30-day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

Additional copies of this report are available from:
National Technical Information Service, Springfield, Virginia
(703) 605-6000

You May Contact ATSDR TOLL FREE at
1-800-447-1544
or
Visit our Home Page at: http://atsdr1.atsdr.cdc.gov:8080/

FOREWORD

The Agency for Toxic Substances and Disease Registry, ATSDR, was established by Congress in 1980 under the Comprehensive Environmental Response, Compensation, and Liability Act, also known as the Superfund law. This law set up a fund to identify and clean up our country's hazardous waste sites. The Environmental Protection Agency, EPA, and the individual states regulate the investigation and clean up of the sites.

Since 1986, ATSDR has been required by law to conduct a public health assessment at each of the sites on the EPA National Priorities List. The aim of these evaluations is to find out if people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. If appropriate, ATSDR also conducts public health assessments when petitioned by concerned individuals. Public health assessments are carried out by environmental and health scientists from ATSDR and from the states with which ATSDR has cooperative agreements.

Exposure: As the first step in the evaluation, ATSDR scientists review environmental data to see how much contamination is at a site, where it is, and how people might come into contact with it. Generally, ATSDR does not collect its own environmental sampling data but reviews information provided by EPA, other government agencies, businesses, and the public. When there is not enough environmental information available, the report will indicate what further sampling data is needed.

Health Effects: If the review of the environmental data shows that people have or could come into contact with hazardous substances, ATSDR scientists evaluate whether or not these contacts may result in harmful effects. ATSDR recognizes that children, because of their play activities and their growing bodies, may be more vulnerable to these effects. As a policy, unless data are available to suggest otherwise, ATSDR considers children to be more sensitive and vulnerable to hazardous substances. Thus, the health impact to the children is considered first when evaluating the health threat to a community. The health impacts to other high risk groups within the community (such as the elderly, chronically ill, and people engaging in high risk practices) also receive special attention during the evaluation.

ATSDR uses existing scientific information, which can include the results of medical, toxicologic and epidemiologic studies and the data collected in disease registries, to determine the health effects that may result from exposures. The science of environmental health is still developing, and sometimes scientific information on the health effects of certain substances is not available. When this is so, the report will suggest what further public health actions are needed.

Conclusions: The report presents conclusions about the public health threat, if any, posed by a site. When health threats have been determined for high risk groups (such as children, elderly, chronically ill, and people engaging in high risk practices), they will be summarized in the conclusion section of the report. Ways to stop or reduce exposure will then be recommended in the public health action plan.

ATSDR is primarily an advisory agency, so usually these reports identify what actions are appropriate to be undertaken by EPA, other responsible parties, or the research or education divisions of ATSDR. However, if there is an urgent health threat, ATSDR can issue a public health advisory warning people of the danger. ATSDR can also authorize health education or pilot studies of health effects, full-scale epidemiology studies, disease registries, surveillance studies or research on specific hazardous substances.

Community: ATSDR also needs to learn what people in the area know about the site and what concerns they may have about its impact on their health. Consequently, throughout the evaluation process, ATSDR actively gathers information and comments from the people who live or work near a site, including residents of the area, civic leaders, health professionals and community groups. To ensure that the report responds to the community's health concerns, an early version is also distributed to the public for their comments. All the comments received from the public are responded to in the final version of the report.

Comments: If, after reading this report, you have questions or comments, we encourage you to send them to us.

Letters should be addressed as follows:

Attention: Chief, Program Evaluation, Records, and Information Services Branch, Agency for Toxic Substances and Disease Registry, 1600 Clifton Road (E-56), Atlanta, GA 30333.

TABLE OF CONTENTS

FOREWORD i

LIST OF TABLES iv

LIST OF FIGURES v

LIST OF ABBREVIATIONS vi

SUMMARY 1

BACKGROUND 5
- Site Description and History 5
- Remedial and Regulatory History 6
- ATSDR Involvement 8
- Demographics 9
- Land Use and Natural Resources 10
- Quality Assurance and Quality Control 12

COMMUNITY HEALTH CONCERNS 13

ENVIRONMENTAL CONTAMINATION AND POTENTIAL PATHWAYS OF EXPOSURE 14
- Evaluation of Groundwater Exposure Pathway 14
- Evaluation of Soil Exposure Pathway 21
- Evaluation of Radiological Exposure Pathway 24

ATSDR CHILD HEALTH INITIATIVE 26

CONCLUSIONS 27

PUBLIC HEALTH ACTION PLAN 29

PREPARERS OF REPORT 31

REFERENCES 32

TABLES 35

FIGURES 62

APPENDIX A: Glossary A-1

APPENDIX B: Population and Housing Data; Census Tract Map B-1

APPENDIX C: ATSDR's Comparison Values C-1

APPENDIX D: Public Comments on the Public Health Assessment D-1

LIST OF TABLES

Table 1: Evaluation of Potential Public Health Hazards at George Air Force Base 35

Table 2: Exposure Pathways at George Air Force Base 58

LIST OF FIGURES

Figure 1. Vicinity Map 62

Figure 2. Operable Unit (OU) Site Locations 63

Figure 3. Land Use in the Vicinity of George Air Force Base 64

Figure 4. Approximate Locations of Known Municipal and Domestic Water Supply Wells in the Vicinity of George Air Force Base 65

Figure 5. ATSDR's Exposure Evaluation Process 66

Figure 6. Major Hydrogeologic Features in the Mojave River Basin 67

Figure 7. Simplified Conceptual Hydrogeologic Cross Section 68

Figure 8. Operable Unit 1 TCE Plume, October 1996 69

Figure 9. Simulated Flowlines and Extraction Well Capture Zones at OU 1 Lower Aquifer . . . 70

LIST OF ABBREVIATIONS

AFB	air force base
ATSDR	Agency for Toxic Substances and Disease Registry
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
CDHS	California Department of Health Services
CREG	cancer risk evaluation guide
CV	comparison value
DCE	dichloroethylene
EMEG	environmental media evaluation guide
EPA	United States Environmental Protection Agency
IRP	Installation Restoration Program
JP-4	jet propellant #4
MCLs	maximum contaminant levels
MWA	Mojave Water Agency
NEDA	Northeast Disposal Area
NFA	no further action
NPL	National Priorities List
OU	operable unit
PA	preliminary assessment
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PCE	perchloroethylene
PHA	Public Health Assessment
PHAP	public health action plan
POLs	petroleum, oil, and lubricants
ppb	parts per billion
RMEG	reference dose media evaluation guide
RI/FS	remedial investigation/feasibility study
SCIA	Southern California International Airport
SEDA	Southeast Disposal Area
SVOC	semivolatile organic compound
TCA	1,1,1-trichloroethane
TCE	trichloroethylene
TPH	total petroleum hydrocarbons
UST	underground storage tank
VOC	volatile organic compound
VVEDA	Victor Valley Economic Development Authority
VVWRA	Victor Valley Wastewater Reclamation Authority

SUMMARY

George Air Force Base (AFB) is located in Victorville, California, in the Mojave Desert approximately 90 miles northeast of Los Angeles. Established during World War II, George AFB was a major operations and training base for the Air Force until Congress scheduled it for closure in 1988. George AFB was decommissioned in 1992, and the Air Force is overseeing the closure of the facility. Redevelopment of land and facilities at George AFB is directed by the Victor Valley Economic Development Authority. Land reuse plans at George AFB include an airport, a federal prison, and industrial and commercial uses.

Areas of concern at George AFB are divided into three operable units (OUs):

- *OU 1: Trichlorethylene (TCE) plume beneath the Northeast Disposal Area.* Groundwater in the northeast portion of the base and adjacent off-site land is contaminated with volatile organic compounds, primarily TCE. A groundwater extraction and treatment system, designed to prevent migration of the contaminant plume towards the Mojave River, was completed in 1997. The treatment system is projected to run for 30 years to reduce groundwater contamination below federal drinking water standards.

  OU 1 also includes two other sites: SD-25, an industrial/storm drain, and WP-26, the former sewage treatment plant percolation ponds. Contaminated sediments and piping were removed from the storm drain at SD-25. Investigations have determined that no further action is required at these sites.

- *OU 2: Jet fuel releases.* OU 2 consists of the facility's liquid fuel distribution system. A variety of leaks in this system resulted in an estimated of perhaps as much as a 750,000 to 800,000-gallon plume of jet propellant #4 (JP-4) encompassing an area of over 31 acres, as well as a dissolved-phase plume of benzene, toluene, ethylbenzene, and xylenes

extending over an area of 121 acres. Because the OU 2 plume is almost completely covered by asphalt, and studies conducted thus far have not demonstrated significant migration of the plume, George AFB, state and federal regulators continue to evaluate the feasibility of natural attenuation as a possible cleanup strategy. Accordingly, additional monitoring wells will be installed to further characterize and monitor this plume.

- *OU 3: Landfills and other disposal sites.* This OU consists of the remaining Installation Restoration Program sites, including old landfills, other dump and burial sites, munitions sites, fire training areas, and spill areas. In February 1997, George AFB completed a remedial investigation/feasibility study for OU 3. A record of decision for clean up of the OU 3 sites is now under review.

The Agency for Toxic Substances and Disease Registry (ATSDR) conducted site visits to George AFB in 1991 and 1997 and examined the facility for potential exposure pathways. ATSDR identified three pathways where people may be exposed to site-related contaminants: 1) exposure to contaminated groundwater, 2) exposure to contaminated soil, and 3) exposure to radiological contamination. ATSDR also identified the following community concerns: 1) base reuse, 2) groundwater and drinking water quality, and 3) radiological contamination. The evaluation of these exposure pathways and community concerns is the focus of this Public Health Assessment.

Groundwater

On-site and off-site groundwater do not represent a past, present, or future public health hazard. On-site groundwater has never been used as a source for drinking water at George AFB and no supply wells are expected to be installed there in the foreseeable future. Groundwater contamination from the OU 1 plume has migrated off site towards the Mojave River, which is a major source of drinking water for downstream communities, but has not affected any municipal or private drinking water wells. Two supply wells in the path of the plume, at the Victor Valley

Wastewater Reclamation Authority, have never been used to supply drinking water. The pump-and-treat system installed by George AFB for OU 1 is expected to prevent contaminants from migrating to the Mojave River and regular groundwater sampling will continue to monitor the movement of the plume over time. Federal regulators are monitoring the effectiveness of this pump-and-treat system and, as a result, George AFB is collecting additional data and taking other measures to optimize the effectiveness of this clean-up measure.

Soil

Soil at George AFB does not represent an apparent past public health hazard and does not represent a present or future public health hazard. Soil contamination has been detected above ATSDR health-based comparison values in very few areas of George AFB. Access to most areas of contamination is limited and the contaminant levels detected would not pose a health hazard to either children or adults from short-term exposure. Due to the low levels of contamination, exposure to contaminated soil through future industrial reuse of the base is not expected to pose a public health hazard to adults working at the base.

Radiological Contamination

Radiological contamination does not represent an apparent past public health hazard and does not represent a present or future public health hazard. A small amount of radioactive material was discovered and removed from a portion of the Southeast Disposal Area (SEDA). Radiation surveys and exploratory soil excavation indicate that this area and the two munitions storage areas were not used for disposal of significant quantities of radioactive waste. Although people using the SEDA for recreation in the past may have been exposed to small amounts of low-level radioactive material, such exposures would have been infrequent and of short duration and would not be expected to pose a health hazard. The SEDA has recently been fenced and its landfill cover has been rehabilitated. The George AFB property located south of Air Base Road, which includes

the SEDA, has been transferred to the Federal Bureau of Prisons and will be the site of a prison that is currently under construction; the SEDA will remain fenced and will be within the fenceline of the prison.

BACKGROUND

Site Description and History

George Air Force Base (George AFB) is a decommissioned military installation located in the High Desert region of San Bernardino County, California, in the Mojave Desert. This 5,347-acre facility is approximately 90 miles northeast of Los Angeles. The area immediately surrounding the base is the Victor Valley portion of the Upper Mojave River Basin (see Figure 1). Cities nearest to the base are Adelanto, directly west of the base, and Victorville, directly southeast of the base. Other communities in the Victor Valley include Apple Valley, Hesperia, Oro Grande, and Silver Lakes.

The base lies within a wedge-shaped area of the Mojave Desert, which is flanked by the Sierra Nevada Mountains to the northwest, the Radman and Cady Mountains to the northeast, the San Bernardino Mountains to the southeast, and the San Gabriel Mountains to the southwest (shown in Figure 1). The local region is comprised primarily of alluvial deposits from the surrounding mountains and recent deposits from the Mojave River (Montgomery Watson, 1997a). The facility grounds are quite flat except at the eastern edge where the surface elevation drops approximately 200 feet down to the Mojave River, which flows past the base in a northwesterly direction. The Victor Valley Wastewater Reclamation Authority (VVWRA) treatment plant is located approximately one-half mile north of the base.

George AFB, originally called the Victorville Army Airfield, was constructed between 1941 and 1943 as a flight training school. After World War II, the base was placed on standby status and used for surplus aircraft storage. The base was reopened in 1950 under the command of the newly created U.S. Air Force and renamed George Air Force Base. Flight training remained the primary mission of this base throughout its history and a number of bomber, glider, single engine, twin engine, and jet fighter aircrafts were flown there. George AFB was a major training facility for the

Air Force's F-4 Phantom and was the home of the 35th Tactical Fighter Wing (U.S. Air Force, 1997c).

In 1988, George AFB was scheduled in the first round of base closures passed by Congress under the Base Realignment and Closure program. The base was officially decommissioned in December 1992. In 1993, President Clinton announced a "Five Part Plan" to speed economic recovery in communities where military bases were to be closed. One part of this plan called for improving public participation in the base's environmental cleanup program. George AFB was among a number of installations where environmental cleanup was placed on a "fast track" so that base property could be quickly transferred to the community for reuse (U.S. Air Force, 1997c).

Remedial and Regulatory History

In the course of it primary mission of pilot training, George AFB performed numerous support activities, such as aircraft and vehicle maintenance and fire fighting training, that required the use and disposal of hazardous materials. Hazardous materials used at the base included fuels, solvents, paints and thinner, acids, and alkalis. The disposal of these materials caused contamination of soil and groundwater in some areas of the base. In addition, used aircraft parts and other refuse were buried at various sites on the base (U.S. Air Force, 1997c).

The Air Force began its environmental program—called the Installation Restoration Program (IRP)—at George AFB in 1980. A preliminary assessment (PA), involving document review, personnel interviews, and a site visit, identified a total of 67 potential hazardous waste sites at the base. These sites were attributed to aircraft and vehicle maintenance, past waste handling practices, fire fighting training, and other typical base activities. The Air Force followed the PA with a site investigation to identify areas of contamination. When trichloroethylene (TCE), a common industrial solvent, was discovered in groundwater, George AFB was placed on the U.S. Environmental Protection Agency's (EPA's) National Priority List (NPL) as a federal Superfund

site (U.S. Air Force 1997c). The 67 potential sites identified in the PA were all considered part of the George AFB NPL site, although subsequent investigations determined that no further cleanup actions were needed at many of the sites (U.S. Air Force, 1997b).

Additional Installation Restoration Program (IRP) sites have been identified since the PA, bringing the total to 68 sites (Site FT-19 is divided into three parts), which are listed in Table 1. These IRP sites were divided into three operable units (OUs) based on geographical location and the types of waste present (OUs are shown in Figure 2):

- *OU 1: TCE plume beneath the Northeast Disposal Area (NEDA).* Groundwater in the northeast portion of the base and adjacent off-site land (called the NEDA) is contaminated with volatile organic compounds (VOCs), primarily TCE. Contaminated groundwater has migrated off site to the northeast, reaching as far as the VVWRA treatment plant (Montgomery Watson, 1997a). A groundwater extraction and treatment system (called a pump-and-treat system) was completed in 1997. The system discharges treated groundwater to newly constructed percolation ponds. This treatment system was designed to prevent migration of the plume towards the Mojave River and is projected to run for 30 years to reduce groundwater contamination to below federal drinking water standards (Montgomery Watson, 1994).

  OU 1 also includes two other sites: SD-25, an industrial/storm drain, and WP-26, the former sewage treatment plant percolation ponds. Investigations have determined that no remedial action is required at these sites (James Montgomery 1992). (Table 1 summarizes the OU 1 IRP sites.)

- *OU 2: Jet fuel releases.* OU 2 consists of the base's liquid fuel distribution system (including five above-ground storage tanks, six 50,000-gallon underground storage tanks, 30,000 feet of piping, five 5,000 gallon overflow tanks, and seven concrete fuel transfer

pits). A variety of leaks in this system resulted in an estimated 750,000 to 800,000-gallon plume of jet propellant #4 (JP-4) encompassing an area of over 31 acres, as well as a dissolved-phase plume of benzene, toluene, ethylbenzene, and xylenes (BTEX) extending over an area of 121 acres (IT, 1996; U.S. Air Force, 1997b). Because the OU 2 plume is almost completely covered by asphalt and studies have shown that little or no migration of the plume is expected over time, George AFB and state and federal regulators are evaluating natural attenuation as a possible cleanup strategy (IT, 1996; U.S. Air Force, 1997b). In the meantime, George AFB operates six permanent extraction units, three mobile extraction units, and two bioventing systems to remove free product from wells within this plume. (Table 1 summarizes the OU 2 IRP sites.)

- *OU 3: Landfill and other disposal sites.* This OU consists of the remaining 62 IRP sites including old landfills, other dump and burial sites, munitions sites, and fire training areas. In February 1997, a remedial investigation/feasibility study was completed for OU 3. (Table 1 summarizes the OU 3 IRP sites.)

ATSDR Involvement

The Agency for Toxic Substances and Disease Registry (ATSDR) performed an initial site scoping visit on February 14 and 15, 1991, to meet with base environmental personnel, regulators, and community members and to identify completed and potential pathways for human exposure to contamination. At that time, community concerns focused on base reuse after closure. ATSDR again visited George AFB on August 18 and 19, 1997, to meet with base environmental personnel and state public health officials and to gather information pertinent to the preparation of a public health assessment (PHA) for George AFB.

Demographics

George Air Force Base

Population data, housing data, and a census tract map of the George AFB area are presented in Appendix B. The combined military and civilian work force at George AFB in 1992 was 3,725, although peak employment at the facility was approximately 5,500. Approximately 9,000 people (base personnel and their families) lived in residential units at the base during the peak of base operations (U.S. Air Force, 1998c). Since the base closed in 1992 there have been no permanent on-site residents.

Surrounding Communities

The 1994 estimated populations of the surrounding communities were:

Adelanto	13,000
Apple Valley	53,450
Hesperia	58,050
Lucerne Valley	10,000
Oro Grande	430
Phelan	15,000
Silver Lakes	3,000
Victorville	57,830
TOTAL	**210,760**

Of the four regions of San Bernardino County, the High Desert region that includes George AFB is expected to see the greatest population growth in the future, with an annual growth rate of 5% until 2010. This is attributed to an influx of people looking to escape the traffic, high cost of

living, and air pollution of Los Angeles. The area is also experiencing growth from development of vacation homes and retirement communities (U.S. Air Force, 1991).

Before closure, George AFB was the largest employer in the area and provided an important economic base for the surrounding communities. As of November 1997, approximately 440 new jobs had been created through base reuse (discussed in "Land Use and Natural Resources" below) (U.S. Air Force, 1997c; CEDAR, 1997). Despite the closure of George AFB, the military remains the largest employer in the High Desert region, with nearby installations including the Fort Irwin Training Center and the Marine Corps Logistics Base. The top non-military employers in the High Desert region are the Hesperia and Victorville school districts and the Desert Valley Medical Group and Hospital (U.S. Air Force, 1997c).

Land Use and Natural Resources

Major land use in the Victor Valley involves residential development, government and commercial services, cement manufacturing, railroad and highway transportation, and limited agriculture and industrial mining. Although George AFB is located in a remote area, a residential area of Adelanto is located within 1 mile west of the base and includes two schools and parks located west of the base. A residential area of Victorville is also situated near the southeast border of the base. Land uses in the vicinity of George AFB are shown in Figure 3. The airport area (landing field and taxiways) is fenced off and patrolled regularly. Access to all other base property located north of Air Base Road is through one road and is monitored by a security guard; a second access road will be opened in the future. Base property located south of Air Base Road is not fenced or monitored, although the Southeast Disposal Area (SEDA) located on this property is fenced in. The base property south of Air Base Road has been transferred to the Federal Bureau of Prisons and will be the site of a prison that is currently under construction.

When active, George AFB was a military installation and residential community where light

industrial activities were performed. The base includes two runways, 6.3 million square feet of aircraft ramp space and associated facilities, 1,651 units of housing (vacant), 14 dormitory buildings, a hospital, and numerous office and industrial buildings. The city of Adelanto operates two schools on George AFB property (see Figure 3).

Base Reuse

The Air Force is overseeing closure of the base. Redevelopment of land and facilities at George AFB is directed by the Victor Valley Economic Development Authority (VVEDA), a joint powers authority comprised of the county of San Bernardino, the cities of Victorville and Hesperia, and the town of Apple Valley. (The city of Adelanto declined to participate in the VVEDA [CEDAR, 1997].)

The city of Victorville oversees the development of an airport, Southern California International Airport (SCIA), that uses George AFB's flight line and related facilities. SCIA is now open to commercial traffic and Victorville is currently attempting to attract major air cargo carriers to the airport. Although passenger service is not expected in the near future, SCIA does receive approximately 110,000 U.S. Army troops en route to Fort Irwin, California (U.S. Air Force, 1997b). The airport also leases space to approximately 35 military, commercial, industrial, and service entities.

The VVEDA is responsible for the redevelopment of the remaining properties outside of the airport, including housing units, office buildings, warehouses, a golf course, and the sewer and water distribution systems. VVEDA has no plans to reuse base housing units, although temporary dormitories may be used occasionally for military personnel (U.S. Air Force, 1997a; Earthtech, 1993; Montgomery Watson, 1997c). Earlier plans to allocate a portion of base housing to homeless providers have been canceled in favor of off-base locations.

The Federal Bureau of Prisons has acquired 940 acres in the southern portion of George AFB (south of Air Base Road) and is constructing a 1,152-bed medium-security men's prison and a 768-bed minimum-security women's prison. Occupancy is expected to begin in late 1999.

Drinking Water

Groundwater at George AFB has never been used as a source for drinking water (U.S. Air Force, 1997a). Drinking water wells were installed at the base in the 1980s but were never used. These wells are currently capped (U.S. Air Force, 1997b). Since 1942, George AFB drinking water has been supplied by a number of production wells—built by the Air Force on land leased from the city of Adelanto—located beyond the eastern boundary of the base, next to the Mojave River. These wells are not located in or near areas of contaminated groundwater. Locations of all known drinking water wells near George AFB are shown in Figure 4. Although the land where the wells are located will revert back to Adelanto after base closure, the Air Force contends that water rights from this property should remain with the Air Force and should be transferred along with the base for redevelopment (CEDAR, 1997). Adelanto has sued the Air Force over these water rights and has constructed an additional municipal well next to the Air Force wells. The VVEDA is connecting the base to Victorville public water to supply the base with additional capacity if needed. A number of small capacity domestic and irrigation wells are believed to exist in the vicinity, although none are believed to be located in areas of contaminated groundwater.

Quality Assurance and Quality Control

In preparing this PHA, ATSDR relied on the information provided in the referenced documents and from the referenced contacts. ATSDR assumes that adequate quality assurance and control measures were followed with chain-of-custody, laboratory procedures, and data reporting. The validity of the analyses and conclusions drawn in this document are dependent upon the availability and reliability of the referenced information.

COMMUNITY HEALTH CONCERNS

George AFB prepared community relations plans 1991 and 1996, which presented the results of interviews with members of local environmental and community groups, representatives from chambers of commerce, and officials from city and county organizations (e.g., VVEDA, the regional water quality control board, and city and town councils) (U.S. Air Force, 1991, 1997c). Through these interviews, George AFB learned that the predominant community concerns regarding the base were not about environmental contamination, but rather centered on base closure and reuse plans. Community members did, however, express concerns about water supply and quality, endangered species in the area, and noise pollution.

Some community members also were concerned about continuity in communication and environmental plan implementation once the base is closed; specifically, they wondered if the Air Force would take responsibility for contamination that might be discovered after base closure. More recently, some community members have also expressed concerns regarding the possibility that radioactive waste was stored at the base (U.S. Air Force, 1997a, 1997b).

Since these interviews, the Air Force has conducted extensive investigations and cleanup activities that address the potential health and environmental concerns related to the base. As these various activities have been completed, George AFB has made the relevant reports available to the public. ATSDR has thoroughly reviewed all available investigation, remedial, and other relevant documents to assess the public health concerns associated with George AFB. ATSDR's public health evaluations of the IRP sites are summarized in Table 1.

ENVIRONMENTAL CONTAMINATION AND POTENTIAL PATHWAYS OF EXPOSURE

In this section, ATSDR evaluates potential exposure pathways to determine whether people accessing or living near George AFB could have been, are, or will be exposed to contaminated groundwater, soil, and radiological contamination via ingestion, dermal (skin) contact, or inhalation of vapors. Exposure pathways are considered "complete" when exposure to contaminated media occurs. To determine whether completed pathways pose a potential public health hazard, ATSDR compares contaminant concentrations to health-based comparison values (CVs). If contaminant concentrations are above CVs, ATSDR further analyzes exposure variables (e.g., duration and frequency) and the toxicology of the contaminant. Figure 5 summarizes this exposure evaluation process. Table 2 presents the exposure pathways identified at George AFB.

In evaluating environmental contamination, ATSDR uses several media-specific CVs to select environmental contaminants for further evaluation within an exposure pathway. Because CVs do not represent thresholds of toxicity, exposure to chemical concentrations that are above CVs does not necessarily cause adverse health effects. CVs used in this document include EPA's maximum contaminant levels (MCLs) and ATSDR's environmental media evaluation guides (EMEGs), reference dose media evaluation guides (RMEGs), and cancer risk evaluation guides (CREGs). MCLs are enforceable drinking water regulations developed to protect public health, but they also consider economic and technological factors. CREGs, EMEGs, and RMEGs are strictly health-based CVs developed by ATSDR and are not enforceable. Appendix C further describes the CVs used in this evaluation.

Evaluation of Groundwater Exposure Pathway

Could groundwater contamination detected in both on- and off-site monitoring wells either reduce the availability or compromise the safety of area groundwater or Mojave River water?

Conclusions

On-site and off-site groundwater do not represent a past, present, or future public health hazard. On-site groundwater has never been used as a source for drinking water at George AFB and no supply wells are expected to be installed there in the foreseeable future. Groundwater contamination from the OU 1 plume has migrated off site towards the Mojave River, but has not affected any municipal or private drinking water wells. Two supply wells in the path of the plume, at the VVWRA, have never been used to supply drinking water. The installed pump-and-treat system at OU 1 is expected to prevent contaminants from migrating to the Mojave River and regular groundwater sampling will continue to monitor the movement of the plume over time.

Discussion

Hydrogeology and Groundwater Use

George AFB lies in the George Groundwater Sub-basin of the Upper Mojave River Groundwater Basin (groundwater basins are shown in Figure 6). This basin is recharged primarily by infiltration of precipitation runoff from the San Bernardino and San Gabriel mountains. The Upper Mojave River channel has perennial flow near the river's headwaters, while further downstream the river flow is subterranean. At the Mojave River Narrows southeast of the base, river flow rises back to the surface due to mounding against a bedrock barrier, before again becoming subterranean for the rest of the river's course. The river terminates at Soda Dry Lake. The Mojave River is a major source of drinking water for communities downstream of George AFB. It is estimated that 80% of the recharge for the entire Mojave Groundwater Basin is supplied by infiltration from within the Upper Mojave River Basin. There is little groundwater recharge from precipitation in the Victor Valley, as a result of low precipitation rates and high evapotranspiration rates. Local groundwater recharge occurs at the VVWRA plant (north of the base—see Figure 3), the OU 1 treatment system percolation ponds, and various small agricultural areas near the river channel

(Montgomery Watson, 1997c).

The 1923 log of an exploratory oil well in the George AFB area indicates that the site lies on alluvial sediments, including water-bearing sands and gravels with interbedded clays, to a depth of 730 feet. Beneath this is a layer of sandstone and sandy shale to a depth of 1,350 feet; this layer is followed by crystalline limestone, schists, and granite. Subsurface investigations to study environmental conditions have been limited to the upper 425 feet of sediments (Montgomery Watson, 1996). The sediment beneath George AFB has been classified into three hydrogeologic units:

- the upper alluvial unit
- the aquitard
- the lower alluvial unit

The upper and lower alluvial units are alluvial fan deposits and contain the upper and lower aquifers. These aquifers are hydraulically separated by the aquitard, a thin (approximately 25 feet thick) deposit of lacustrine (lake) silts and clays that effectively prevents vertical groundwater (and contaminant) movement from the upper to lower aquifer (see Figure 7). The aquitard appears to be a single continuous unit beneath the entire base, except for the northeast portion of the base where the aquitard is not present. The upper alluvial unit extends from ground surface to 150 to 175 feet below ground surface (bgs). The upper aquifer is encountered at depths of 90 to 150 feet bgs; the groundwater elevation of the upper aquifer drops rapidly towards the east and northeast and vanishes at the edge of the aquitard, where the upper and lower alluvial units merge. The hydraulic separation of the two aquifers by the aquitard is evidenced by a dry upper section of the lower alluvial unit—water of the lower aquifer is not encountered until 210 to 250 feet bgs. Groundwater flow in both the upper and lower aquifers is northeastward under most of

the base; flow in the lower aquifer turns eastward near the Mojave River. The existence of northwest-trending paleochannels (ancient river deposits) in the upper alluvial unit may locally affect transport of contaminants by causing preferential migration (Montgomery Watson, 1996, 1997a).

Because of the arid environment and the lack of surface water bodies in the Upper Mojave River Basin, groundwater is the principal source of water in the Victor Valley. The Mojave Water Agency (MWA) oversees the distribution of water within the Mojave River Groundwater Basin. Population increases in this area caused water use to double from 1973 to 1983, and to double again from 1983 to 1994. This increased water demand has led to overdraft of groundwater within the Mojave River Groundwater Basin (i.e., more groundwater is pumped out than is replaced through recharge). Since 1990, the MWA has received additional water from the California Water Project. More recently, the MWA proposed a Mojave River Pipeline Project that would convey imported water from the California Aqueduct to selected recharge areas in the Mojave River basins (Bechtel, 1995). One such recharge area is currently planned for a site directly downstream of George AFB and the VVWRA (U.S. Air Force, 1998d).

There are a number of drinking water supply wells in the vicinity of the base (see Figure 4). The VVWRA has two supply wells north of the base that are believed to be screened in the Mojave River Aquifer, the aquifer lying beneath and to the east of the Mojave River channel (this aquifer is shown in Figure 7). Although recent samples indicate that water from the VVWRA wells is safe to drink, the wells are used only for non-potable and industrial applications at the VVWRA treatment plant and have never been used to supply drinking water (Montgomery Watson, 1996; VVWRA, 1998). According to the California Department of Water Resources, there are four production wells located southeast of the base; screened at depths of 500 to 610 feet bgs; these wells may draw from a deeper aquifer below the lower aquifer. Eight production wells, located at the eastern boundary of the base next to the Mojave River, currently supply drinking water to George AFB and/or the city of Adelanto. A ninth well at this location was closed when its

production declined (Montgomery Watson, 1996; U.S. Air Force, 1998a). These wells are not located in or near areas of contaminated groundwater. Adelanto maintains several more municipal wells to the west of George AFB. Three wells, supplying the town of Oro Grande, are located on the eastern bank of the Mojave River east and northeast of the base. A number of smaller capacity domestic and irrigation wells are believed to exist in the vicinity of the base. These wells likely draw from the upper aquifer (Montgomery Watson, 1996); none are believed to be located in areas of contaminated groundwater.

Groundwater Quality and Sources of Contamination

This section addresses the location, extent, and potential for off-site migration, and current remedial actions at the four areas of groundwater contamination identified through IRP investigations. ATSDR has evaluated all available groundwater data and determined that contaminated groundwater from George AFB has not affected any known drinking water wells in the vicinity of George AFB.

- *OU 1: NEDA TCE plume*. This groundwater TCE plume covers approximately 600 acres in the northeastern portion of the base and extends off site to the north and east as far as the VVWRA treatment plant. TCE is present above MCLs and CVs in both the upper and lower aquifers beneath the site, and is migrating northeast towards the Mojave River (the TCE plume is shown in Figure 8). The maximum TCE concentration detected in the upper aquifer as of February 1997 was 330 ppb, while the highest concentration in the lower aquifer was 22 ppb (Montgomery Watson, 1997a). First detected through groundwater sampling in 1983, the plume is now monitored twice a year through sampling of 20 to 40 monitoring wells on and off the base. The Air Force installed and began operating nine groundwater extraction wells and an air stripper unit in 1991 to clean up the plume. The Air Force installed nine additional extraction wells in 1996. These wells were installed to remove TCE from both the upper and lower aquifers, and to prevent the plume from

migrating in to the Mojave River. Figure 9 shows the effect of the extraction wells on groundwater flow in the NEDA. The treatment system is expected to take 30 years to reduce TCE concentrations to below federal drinking water standards (Montgomery Watson, 1994). The system discharges treated water to newly constructed percolation ponds. In the past, this treated water was also discharged to the old sewage treatment plant percolation ponds (Site WP-26—see Figure 2) and an unlined arroyo (U.S. Air Force, 1997b, 1998b).

The only supply wells in the path of the plume are two wells at the VVWRA treatment plant. The VVWRA does not use these wells to supply drinking water. If the current treatment and monitoring system is maintained, ATSDR does not expect this plume to contaminate any drinking water wells in area.

TCE groundwater contamination at OU 3 Site FT-19 is being cleaned up and monitored as part of OU 1.

- *OU 2: JP-4 and BTEX plume.* This plume, consisting of free product and associated dissolved contaminants, is in the upper aquifer beneath the flight line and operational apron in the central portion of the base (see Figure 2). The plume contains perhaps as much as 750,000 to 800,000 gallons of jet fuel (U.S. Air Force, 1997b). George AFB has installed approximately 40 monitoring wells to define the plume and monitors the contaminants through twice-yearly groundwater sampling. The plume is contained within the boundaries of the base and affects no drinking water wells (IT, 1992). Recent feasibility and treatability studies have not demonstrated significant migration of the plume. However, additional studies will be undertaken to further characterize this plume. The Air Force is considering a natural-attenuation, cleanup strategy that they estimate would lower contaminants to drinking water standards in approximately 50 years (IT, 1996), but federal regulators have not yet agreed to a natural-attenuation clean-up

approach for this plume.

- *OU 3: Site OT-69 VOC plumes.* OT-69 consists of several small isolated plumes of perchloroethylene and TCE above MCLs and CVs. One plume is south of the sewage treatment plant percolation ponds (WP-26) and another is located south of the operational apron (OT-69 plumes are shown as white areas in Figure 2). TCE concentrations in these plumes are highest in the upper 6 feet of the upper aquifer and decrease to nondetectable at 30 feet and deeper below the water table (Montgomery Watson, 1996). These plumes are contained within the boundaries of the base and affect no drinking water wells. The Air Force selected natural attenuation as the cleanup strategy for these plumes and monitors the plumes through twice-yearly groundwater sampling. The Air Force has also instituted limits on future groundwater use at these sites (U.S. Air Force, 1997d).

- *OU 3: Site OT-51 JP-4 and BTEX plume.* OT-51 is a former jet engine test cell located west of the main runway (see Figure 2). The Air Force monitors the plume through groundwater sampling two times per year. The plume is contained within the boundaries of the base and affects no drinking water wells. A bioventing system has reduced most of the contaminants from the groundwater at this site; the Air Force may use oxygen enhancement if needed to complete the groundwater remediation (U.S. Air Force, 1998d).

The Air Force has instituted a long-term basewide groundwater monitoring program involving OU 1, OU 2, and OU 3 landfills and other sites. This program monitors the elevation, flow direction, and quality of groundwater and is used to assess the efficacy of groundwater remediation and the integrity of landfills at the base.

Exposure Potential

No exposure to contaminated on-site groundwater has occurred at George AFB because on-site

groundwater has never been used for drinking water at the facility. Although the OU 1 TCE plume extends off the base, it does not affect any municipal or private drinking water wells. There are two supply wells at the VVWRA treatment plant, but these wells have never been used to supply drinking water. The OU 1 plume is migrating towards the Mojave River, which is a major drinking water source for downstream communities. The installed pump-and-treat system, together with groundwater monitoring, is expected to prevent the plume from reaching the river, however. The city of Adelanto has detected no VOC contaminants in its municipal wells; the only water quality problem the city has experienced with its wells is naturally elevated fluoride levels (City of Adelanto, 1998).

The California Department of Health Services (CDHS) specifies water sampling schedules for all water purveyors, including those with supply wells located in the vicinity of George AFB. CDHS reviews the water sampling data to ensure that the drinking water distributed to consumers is safe.

Evaluation of Soil Exposure Pathway

Could exposure to surface soil contamination at George AFB result in adverse human health effects?

Conclusions

Soil at George AFB does not represent an apparent past public health hazard and does not represent a present or future public health hazard. Soil contamination has been detected above ATSDR health-based comparison values in very few areas of George AFB. Access to most areas of contamination is limited and the contaminant levels detected would not pose a health hazard to either children or adults from short-term exposure. Due to the low levels of contamination, exposure to contaminated soil through future industrial reuse of the base is not expected to pose a public health hazard to adults working at the base.

Discussion

Extent and Sources of Contamination

Soil data have not been available for most of George AFB's history because the base's environmental investigation program did not begin until 1980. ATSDR therefore evaluated past public hazards posed by past conditions at George AFB based on current environmental data.

Since 1980, soil investigations at George AFB have included soil-gas sampling, test pitting and trenching, and surface and subsurface soil sampling. Background soil samples have also been collected to determine natural soil conditions in the area. These investigations have identified areas of soil contamination at many of the IRP sites throughout the base. (Table 1 lists the investigation results for each IRP site.) Contaminants detected at various locations include VOCs, semivolatile organic compounds, polycyclic aromatic hydrocarbons, polychlorinated biphenyls, pesticides, dioxins, and metals (Montgomery Watson 1996; IT, 1992). These contaminants are attributable to the variety of base activities that involved fuels, oils, solvents, paints, and other hazardous materials.

Metals were the most common contaminants detected in surface soils. In some locations, such as industrial sites, landfills, or other waste disposal areas (see Table 1), metals and other contaminants were detected above CVs for pica children (children with an increased tendency to eat soil or other nonfood items). A few areas of the base had contaminants present at levels above CVs for non-pica children or adults. However, the contaminants that did exceed CVs were not at levels high enough to present a health hazard.

Exposure Potential

In the past, George AFB maintained residences for base personnel and their families. It is, therefore, possible that a few contaminated areas, such as landfills and waste disposal areas, may have been accessible to children living on the base. Although some soil contamination was detected at levels above CVs for pica children, ATSDR believes it is highly unlikely that any children were exposed to these areas for long enough to experience chronic adverse health effects of soil exposure. No contaminant levels detected in soil at George AFB were high enough to cause acute health effects. Based on the current soil sampling data, past exposure to soil contamination at George AFB does not represent a public health hazard.

The current reuse plan for George AFB does not call for any residential use at the base except for the federal prison to be located south of Air Base Road. All other areas of the base will be used to support SCIA, leased to industrial and commercial tenants, remain in possession of the Air Force, or be left as is until additional reuse plans are developed. (Two schools located at George AFB will remain open and are discussed below under "ATSDR Child Health Initiative.") ATSDR evaluated the available soil data with the assumption that the base will continue to be used for industrial activities only and that children generally will not be present at George AFB (except on school grounds). Based on these assumptions, the low contaminant levels detected, and the ongoing remediation activities, present or future exposure to soil contamination at George AFB does not represent a public health hazard.

Surface soil samples were not collected adjacent to Site OT-62, a suspected pesticide rinse water disposal pit located near the Civil Engineering Facility. However, this pit was examined during the Environmental Baseline Survey phase of the installation in 1992 and no cracks or seams were observed in the pit. Because the original procedure was to discharge rinsate waters into the pit and allow them to evaporate and then, sometime before 1992, that procedure was changed and all rinsate wastes were drummed and shipped to the Defense Reutilization and Marketing Office for

proper disposal, the decision was made to remove, backfill, and pave over the pit facility.

Evaluation of Radiological Exposure Pathway

Is radioactive waste present at George AFB, and, if so, could it cause adverse health effects?

Conclusions

Radiological contamination does not represent an apparent past public health hazard and does not represent a present or future public health hazard. A small amount of radioactive material was discovered and removed from a portion of the Southeast Disposal Area (SEDA). Radiation surveys and exploratory soil excavation indicate that this area and the two munitions storage areas were not used for disposal of significant quantities of waste containing small quantities of radioactive material. Although people using the SEDA for recreation in the past may have been exposed to small amounts of low-level radioactive material, such exposures would have been infrequent and of short duration and would not be expected to pose a health hazard. The SEDA has recently been fenced and its landfill cover has been rehabilitated. The George AFB property located south of Air Base Road, which includes the SEDA, has been transferred to the Federal Bureau of Prisons and will be site of a prison that is currently under construction; the SEDA will remain fenced and will be within the fenceline of the prison.

Discussion

Extent and Sources of Contamination

Base records and community members suggest that a portion of the SEDA (located south of Air Base Road), as well as two munitions areas, may have been used for the disposal of low-level

radioactive waste between 1965 and 1970 (U.S. Air Force 1997a, 1997b; Montgomery Watson, 1996). Disposed aircraft dials, circuit breakers, toggle switches, compasses, and aircraft engine gear boxes can be potential sources for low-level radioactivity because, in the 1960s, radium was used for aircraft dials, circuit breakers, and toggle switches, and tritium was used in the gear boxes of aircraft engines.

In 1993, base personnel identified and removed one radioactive object—a cesium-137 source—from RW-09, the suspected radiation disposal site in the SEDA. More recently, walk-over and drive-over radiation surveys, as well as extensive soil excavation, were performed at RW-09 and the two munitions storage areas. Investigations of OU 3 in 1994 included a walk-over radiation survey of the suspected waste sites, followed by excavation and inspection of 4,000 cubic yards of soil at the site. These activities led to the recovery of another cesium-137 source and one vacuum tube that contained low levels of uranium and thorium, which are not considered dangerous at the detected levels (Montgomery Watson, 1996). A drive-over survey (using a specially equipped four-wheel drive vehicle) in 1995 covered a total of over 230,000 data points in the three suspected disposal areas (IT, 1995). Radiation counts (500 to 1,200 counts/second) in all three areas were considered normal for the native soils. Small, isolated areas of high (1,200 to 1,400 counts/second) to very high (1,400 to 3,000 counts/second) readings were observed. These readings appeared to be artifacts, however. In the first instance, the areas of higher radiation appeared to be caused by depressions in the ground surface between a bunker and a wall, which effectively magnified the amount of background radiation, and in the second instance, asphalt pavement, which tends to emit higher background levels of radiation than the native soil at George AFB, caused the higher radiation counts (IT, 1995).

Exposure Potential

Three radioactive objects, containing limited amounts of radioactive materials, were identified and removed from the suspected disposal areas. The data gathered indicate that these areas were not

used for the disposal of significant quantities of radioactive materials. Although in the past this area may have been used by hunters, dirt bikers, and other recreational users, any exposures to these radioactive materials during recreational activity are assumed to have been infrequent and of short duration and would not be expected to pose a health hazard. Access to the area is now restricted by a fence, a rehabilitated landfill cover, and the federal prison which is under construction at the site.

ATSDR CHILD HEALTH INITIATIVE

ATSDR recognizes that infants and children may be more sensitive to exposures than adults in communities with contamination of their water, soil, air, or food. This sensitivity is a result of several factors: 1) Children are more likely to be exposed to soil or surface water contamination because they play outdoors and often bring food into contaminated areas (e.g., children may come into contact with and ingest soil particles at higher rates than do adults; also, some children with a behavior trait known as "pica" are more likely than others to ingest soil and other nonfood items); 2) Children are shorter than adults, which means they can breathe dust, soil, and any vapors close to the ground; 3) They are smaller, resulting in higher doses of chemical exposure per body weight; and 4) The developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages. Because children depend completely on adults for risk identification and management decisions, ATSDR is committed to evaluating their special interests at sites such as George AFB, as part of the ATSDR Child Health Initiative.

ATSDR has attempted to identify populations of children in the vicinity of George AFB and any completed exposure pathways to these children. The Adelanto School District operates two schools on base: a magnet school for the visual and performing arts and a middle school. Two other schools are located within a mile southwest of the base. In the past, George AFB maintained residences for base personnel and their families. Residential areas are also located directly to the

west of George AFB in Adelanto and to the southeast in Victorville.

ATSDR did not identify any completed exposure pathways from George AFB to children at nearby schools or residential areas. The school grounds at George AFB are located more than 1,000 feet from the nearest IRP sites. There are no health hazards associated with soil on the school grounds or along the normal school route on Corey Boulevard (U.S. Air Force, 1994). In fact, most contamination present at George AFB is in groundwater or subsurface soil. Although some surface soil contamination was detected at levels above CVs for pica children, ATSDR believes it is highly unlikely that any children living or attending school at the base were exposed to these areas for long enough to experience chronic adverse health effects of soil exposure. Assuming that the base will continue to be used for industrial activities only and that children generally will be present only on school grounds, present and future exposure to soil should not present a public health hazard for children.

CONCLUSIONS

- *On the basis of available data, ATSDR concludes that exposure to contaminants in groundwater and soil at George AFB does not pose an apparent public health hazard.*

- *On-site and off-site groundwater do not represent a past, present, or future public health hazard.* On-site groundwater has never been used as a source for drinking water at George AFB and no supply wells are expected to be installed there in the foreseeable future. Groundwater contamination from the OU 1 plume has migrated off site towards the Mojave River, but has not affected any municipal or private drinking water wells. Two supply wells in the path of the plume, at the VVWRA, have never been used to supply drinking water. The installed pump-and-treat system at OU 1 is expected to prevent contaminants from migrating to the Mojave River and regular groundwater sampling will

continue to monitor the movement of the plume over time.

- *Soil at George AFB does not represent an apparent past public health hazard and does not represent a present or future public health hazard.* Soil contamination has been detected above ATSDR health-based comparison values in very few areas of George AFB. Access to most areas of contamination is limited and the contaminant levels detected would not pose a health hazard to either children or adults from short-term exposure. Due to the low levels of contamination, exposure to contaminated soil through future industrial reuse of the base is not expected to pose a public health hazard to adults working at the base.

- *Radiological contamination does not represent an apparent past public health hazard and does not represent a present or future public health hazard.* A small amount of radioactive material was discovered and removed from a portion of the SEDA. Radiation surveys and exploratory soil excavation indicate that this area and the two munitions storage areas were not used for disposal of significant quantities of radioactive waste. Although people using the SEDA for recreation in the past may have been exposed to small amounts of low-level radioactive material, such exposures would have been infrequent and of short duration and would not be expected to pose a health hazard. The SEDA has recently been fenced and its landfill cover has been rehabilitated. The George AFB property located south of Air Base Road, which includes the SEDA, has been transferred to the Federal Bureau of Prisons and will be the site of a prison that is currently under construction; the SEDA will remain fenced and will be within the fenceline of the prison.

- On the basis of information available on groundwater and surface soil contamination at George AFB, the previous and ongoing remediation efforts, and the past, present, and planned future uses of this land and these facilities, ATSDR concludes that the George

AFB site should be assigned to the No Apparent Public Health Hazard category

PUBLIC HEALTH ACTION PLAN

This public health action plan (PHAP) for George AFB contains a description of actions taken and those to be taken by ATSDR, the Air Force, and other entities at and in the vicinity of George AFB after the completion of this PHA. The purpose of the PHAP is to ensure that this PHA not only identifies ongoing and potential public health hazards, but provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. The public health actions that are completed, being implemented, planned, or recommended are as follows:

Completed Actions

- George AFB installed a groundwater pump-and-treat system to contain and clean up the TCE plume beneath the NEDA.

Ongoing and Planned Actions

- The Air Force is operating and maintaining the OU 1 groundwater pump and treat system. This system will operate for an estimated 30 years to reduce groundwater contamination to below federal drinking water standards. While the Air Force and regulatory agencies are considering a natural attenuation cleanup strategy for the OU 2 jet fuel plume located beneath the flight line, the Air Force is removing free product from the groundwater at OU 2.

- The Air Force has instituted a long-term basewide groundwater monitoring program

involving OU 1, OU 2, and OU 3 landfills and other sites. This program monitors the elevation, flow direction, and quality of groundwater and is used to assess the efficacy of groundwater remediation and the integrity of landfills at the base.

- CDHS specifies water sampling schedules for all water purveyors, including those with supply wells located in the vicinity of George AFB. CDHS reviews the sampling data to ensure that the drinking water distributed to consumers is safe.

- The Air Force will continue to maintain fences around restricted IRP sites and repair landfill covers as needed. The Air Force will also continue to operate the various soil remediation systems at the base (e.g., soil-vapor extraction and bioventing systems).

- The VVEDA's current reuse plans for George AFB call only for industrial use of the base. If reuse plans change to include residential use, ATSDR may reevaluate the potential public health effects on future populations at the base.

- The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA; also known as Superfund), as amended, requires ATSDR to conduct needed follow-up health actions in communities living near hazardous waste sites. To identify appropriate actions, ATSDR created the Health Activities Review Panel (HARP). HARP has evaluated the data and information contained in the George Air Force Base Public Health Assessment for appropriate public health actions. No follow-up health activities are recommended at George Air Force Base because there is no known exposure at this site at levels that pose a public health hazard.

PREPARERS OF REPORT

W. Mark Weber, Ph.D.
Geologist/Environmental Health Scientist
Federal Facilities Assessment Branch
Division of Health Assessment and Consultation

Gary Campbell, Ph.D.
Environmental Health Scientist
Federal Facilities Assessment Branch
Division of Health Assessment and Consultation

REFERENCES

Bechtel. 1995. Potential Benefits of the Proposed Mojave River Pipeline Project on the Ground-water Resources of the Mojave River Region. Prepared by Bechtel Corporation for Mojave Water Agency, Apple Valley, California. May 1995.

CEDAR. 1997. Military Base Closures Announced in December 1988 - BRAC 1: George Air Force Base. Listed on the California Economic Diversification and Revitalization (CEDAR) Website. August 1997.

City of Adelanto. 1998. Personal communication with Jack Stonesifer, Water Superintendent. City of Adelanto. January 15, 1998.

Earthtech. 1993. Basewide Environmental Baseline Survey, George Air Force Base, California. Prepared by Earth Technologies for George Air Force Base, California. December 1993.

IT. 1992. Remedial Investigation Operable Unit 2 JP-4 Spill, George Air Force Base, California. Prepared by International Technology Corporation for George Air Force Base, California. October 1992.

IT. 1995. Report of Southeast Disposal Area Background Radiation Survey, George Air Force Base, California. Prepared by International Technology Corporation for U.S. Air Force, George Air Force Base, California. August 1995.

IT. 1996. Draft Natural Attenuation Monitoring Treatability Study Report, George Air Force Base, California. Prepared by International Technology Corporation for Air Force Center for Environmental Excellence, Brooks Air Force Base, Texas. March 1996.

James Montgomery. 1992. Final Remedial Investigation Operable Unit 1, George Air Force Base, California. Prepared by James Montgomery, Consulting Engineers for U.S. Army Corps of Engineers Sacramento District, California. August 1992.

Montgomery Watson. 1994. Final Record of Decision Operable Unit 1, George Air Force Base, California. Prepared by Montgomery Watson for U.S. Army Corps of Engineers Sacramento District, California. March 1994.

Montgomery Watson. 1996. Final Operable Unit 3 Remedial Investigation, George Air Force Base, California. Prepared by Montgomery Watson for Air Force Center for Environmental Excellence, Brooks Air Force Base, Texas. April 1996.

Montgomery Watson. 1997a. Final Basewide Ground-water Monitoring Report, February 1997 Event, George Air Force Base, California. Prepared by Montgomery Watson for Air Force Center

for Environmental Excellence, Brooks Air Force Base, Texas. June 1997.

Montgomery Watson. 1997b. Draft Remedial Action Report (Post Construction) OU 1 Groundwater Extraction Treatment System, George Air Force Base, California. Prepared by Montgomery Watson for Air Force Center for Environmental Excellence, Brooks Air Force Base, Texas. June 1997.

Montgomery Watson. 1997c. Draft Operable Unit 3 Record of Decision, George Air Force Base, California. Prepared by Montgomery Watson for Air Force Center for Environmental Excellence, Brooks Air force Base, Texas. April 1997.

U.S. Air Force. 1991. Final Draft Community Relations Plan for the Installation Restoration Program at George Air Force Base, California. July 1991.

U.S. Air Force. 1994. Draft George Air Force Base Installation Restoration Program Newsletter. October 1994.

U.S. Air Force. 1997a. Personal communication with Bob Sommer, Base Environmental Coordinator. George Air Force Base, California. June 26, 1997.

U.S. Air Force. 1997b. Personal communication with Bob Sommer, Base Environmental Coordinator. George Air Force Base, California. August 5, 1997.

U.S. Air Force. 1997c. Final Draft Community Relations Plan for the Installation Restoration Program at George Air Force Base, California. October 1997.

U.S. Air Force. 1997d. Draft George Air Force Base Installation Restoration Program Newsletter. April 1997.

U.S. Air Force. 1998a. Personal communication with Bob Sommer, Base Environmental Coordinator. George Air Force Base, California. January 14, 1998.

U.S. Air Force. 1998b. Personal communication with Bob Sommer, Base Environmental Coordinator, George Air Force Base, California. April 2, 1998.

U.S. Air Force. 1998c. Personal communication with Bob Sommer, Base Environmental Coordinator, George Air Force Base, California. April 9, 1998.

U.S. Air Force. 1998d. Comments on the George AFB Draft Public Health assessment by Charles Weir, U.S. Air Force ATSDR Liaison Officer. June 24, 1998.

VVWRA. 1998. Personal communication with Bruce Corria, Health and Safety Officer. Victor Valley Wastewater Reclamation Authority. April 9, 1998.

TABLES

TABLE 1: EVALUATION OF POTENTIAL PUBLIC HEALTH HAZARDS AT GEORGE AIR FORCE BASE

Site	Reuse Parcel	Site Description/ Waste Disposal History	Known or Suspected Hazardous Material	Investigation Results/ Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard[1]
OU 1: Northeast Disposal Area TCE Plume						
Northeast Disposal Area Trichloro-ethylene (TCE) Plume	A	A groundwater TCE plume is present in the upper and lower aquifers beneath the northeastern portion of the base and extends off site to the north. The plume covers approximately 600 acres. Perchloroethylene (PCE) has also been detected in the plume at lower concentrations.	TCE, PCE	**Groundwater:** TCE has been detected above comparison values (CVs) since 1983, when the first sampling was performed. George AFB samples 20 to 40 monitoring wells in and around the plume twice per year to monitor the effects of the groundwater extraction/treatment system.	George AFB installed and began operating nine groundwater extraction wells and an air stripper system in 1991 and added nine additional extraction wells in 1996. The wells are positioned to remove TCE from the upper aquifer and to contain the plume in the lower aquifer. The system is expected to operate for up to 30 years to reduce the TCE concentration to below the U.S. Environmental Protection Agency Maximum Contaminant Level (MCL) of 5 parts per billion (ppb).	This site poses no public health hazard. No drinking water wells have been affected by the contaminants and there are no downgradient wells at risk. The groundwater pump-and-treat system is expected to prevent contamination from migrating into the Mojave River.

TABLE 1 (continued): EVALUATION OF POTENTIAL PUBLIC HEALTH HAZARDS AT GEORGE AIR FORCE BASE

Site	Reuse Parcel	Site Description/ Waste Disposal History	Known or Suspected Hazardous Material	Investigation Results/ Environmental Monitoring Results[1]	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard[2]
SD-25	A	An industrial outfall and pipeline used since the 1940s to carry industrial wastes and stormwater into the storm drain. The waste sources were disconnected from the storm drain in 1983 and connected to a sanitary sewer.	Petroleum, oil, and lubricants (POLs), fuels, solvents, paint strippers	**Sediments:** In 1992, after remediation activities were complete, confirmatory samples of soil/sediment from the storm drains contained metals at levels consistent with background levels for typical desert soils.	Contaminated and potentially contaminated sediments were excavated from storm drains and perforated portions of the pipeline were removed and replaced with non-perforated pipe.	This site poses no public health hazard. There are no exposures to contamination from this site.
WP-26	C/D	Sewage treatment plant percolation ponds were used from the 1950s to 1980 for the discharge of treated wastewater.	Treated domestic and industrial waste effluent	**Subsurface soil:** Nitrates were detected above background levels. Metals were detected within the background range for typical desert soils.	The percolation ponds were used to discharge treated water from the Operable Unit (OU) 1 groundwater treatment system; groundwater downgradient of the ponds was monitored to ensure that nitrates in soil beneath the ponds did not affect the groundwater.	This site poses no public health hazard. There is no exposure to contamination from this site. Nitrates have not been detected in wells downgradient to the percolation ponds and the contaminated percolation ponds are no longer used.

TABLE 1 (continued): EVALUATION OF POTENTIAL PUBLIC HEALTH HAZARDS AT GEORGE AIR FORCE BASE

Site	Reuse Parcel	Site Description/ Waste Disposal History	Known or Suspected Hazardous Material	Investigation Results/ Environmental Monitoring Results[1]	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard[2]
OU 2: JP-4 Releases						
SS-30	C	Groundwater plume of JP-4 free product dissolved-phase benzene, toluene, ethylbenzene, and xylenes (BTEX) released from leaks in the liquid fuel distribution system.	JP-4, BTEX	**Surface soil:** Almost the entire area above OU 2 is covered by asphalt pavement. **Subsurface soil:** Estimated volumes of soil contaminated at concentrations above CVs: ▪ benzene: 250,000 cubic yards ▪ toluene: 315,000 cubic yards ▪ ethylbenzene: 90,000 cubic yards ▪ xylene: 120,000 cubic yards These volumes overlap to a large extent. **Groundwater:** The free product plume is estimated to contain approximately 350,000-400,000 gallons of jet fuel. Estimated volumes of groundwater contaminated at concentrations above CVs: ▪ benzene: 1,975 acre-feet ▪ toluene: 350 acre-feet ▪ ethylbenzene: 100 acre-feet ▪ xylene: 170 acre-feet These volumes overlap to a large extent. Limited areas of PCE and TCE contamination were also detected and are addressed as part of OU 3 (Site OT-69).	George AFB operates six permanent extraction units, three mobile extraction units, and two bioventing systems to remove free product from wells within this plume. The mobile extraction units are rotated among various wells to maximize free-product recovery. Recent studies have determined that the groundwater plume is stable and that natural attenuation (with monitoring) would achieve cleanup within 50 years. The Air Force and regulators are reviewing natural attenuation as a cleanup strategy. Groundwater is sampled twice per year.	This site poses no public health hazard. There are no drinking water wells affected by this site. Studies indicate that the plume is not migrating. Regardless of whether natural attenuation or an active remediation strategy is chosen for this site, no human exposure to this contamination is expected.

TABLE 1 (continued): EVALUATION OF POTENTIAL PUBLIC HEALTH HAZARDS AT GEORGE AIR FORCE BASE

Site	Reuse Parcel	Site Description/ Waste Disposal History	Known or Suspected Hazardous Material	Investigation Results/ Environmental Monitoring Results[1]	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard[2]
ST-57	C	Fuel pit leaks, from 1979 to 1981, caused by faulty construction.	JP-4	Site is addressed as part of Site SS-30.	Site is addressed as part of Site SS-30.	This site poses no public health hazard. See Site SS-30.
SS-58	C	Building 690 gasoline spill.	Leaded fuels	Site is addressed as part of Site SS-30.	Site is addressed as part of Site SS-30.	This site poses no public health hazard. See Site SS-30.
ST-54	D	A pipeline leak of an unknown quantity of jet fuel in 1980 from Building 708.	Fuels	Site is addressed as part of Site SS-30.	Site is addressed as part of Site SS-30.	This site poses no public health hazard. See Site SS-30.
ST-67	C	Liquid fuel distribution system, consisting of 25,000 feet steel pipe running from the bulk storage tank farm to the aircraft parking ramp and operational apron.	Fuels	Site is addressed as part of Site SS-30.	Site is addressed as part of Site SS-30.	This site poses no public health hazard. See Site SS-30.

TABLE 1 (continued): EVALUATION OF POTENTIAL PUBLIC HEALTH HAZARDS AT GEORGE AIR FORCE BASE

Site	Reuse Parcel	Site Description/ Waste Disposal History	Known or Suspected Hazardous Material	Investigation Results/ Environmental Monitoring Results[1]	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard[2]
OU 3: All Other Sites						
DP-02	A	Paints and pesticides were disposed of at this site.	Pesticides, leaded paint	Site inspection and photograph review indicate that this site is contained within LF-14.	No further action (NFA) recommended. Site is addressed under LF-14.	This site poses no public hazard. See LF-14.
DP-03	A	Photographs indicate that the site was an acid and oil burial area active from the early 1950s to the mid-1960s. This site is one of the suspected source areas for the OU 1 TCE plume.	Acids (hydrochloric, sulfuric), oil, fuel, unidentified drums	**Soil gas:** BTEX were detected. **Surface soil:** Polycyclic aromatic hydrocarbons (PAHs) were detected above CVs. No metals or volatile organic compounds (VOCs) were detected. **Subsurface soil:** PAHs were detected above CVs. No VOCs were detected. Metals were detected within the background range.	A 2-foot soil cover was installed and access is restricted by fencing and posting. One monitoring well downgradient from the site is sampled yearly.	This site poses no public health hazard. Access to the site has been limited and contaminants were detected at levels that do not pose a public health hazard. Access to contaminated soil is now restricted by the installed cover.

TABLE 1 (continued): EVALUATION OF POTENTIAL PUBLIC HEALTH HAZARDS AT GEORGE AIR FORCE BASE

Site	Reuse Parcel	Site Description/ Waste Disposal History	Known or Suspected Hazardous Material	Investigation Results/ Environmental Monitoring Results[1]	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard[2]
DP-04	A	Pesticide and oil reportedly were buried at the site.	Pesticides, waste oil	**Soil gas:** BTEX were detected. **Surface soil:** Metals were detected within the background range. Pesticides and polychlorinated biphenyls (PCBs) were detected below CVs. No VOCs or semivolatile organic compounds (SVOCs) were detected. **Subsurface soil:** Two metals exceeded background levels. No VOCs, SVOCs, pesticides, or PCBs were detected. **Groundwater:** VOCs detected in groundwater at this site are addressed as part of OU 1.	A 2-foot soil cover was installed and access is restricted by fencing and posting. One monitoring well downgradient from the site is sampled yearly.	This site poses no public health hazard. Access to the site has been limited and contaminants were detected at levels that do not pose a public health hazard. Access to soil is now restricted by the installed cover.
DP-60	A	Sewage sludge was dumped in this area. Aerial photographs showed discolored soils at this location.	Sewage sludge	**Soil gas:** TCE was detected. **Surface soil:** No metals were detected above background levels. **Groundwater:** TCE detected in groundwater is addressed in OU 1.	NFA	This site poses no public health hazard. Access to the site is limited and contaminants were detected at levels that do not pose a public health hazard. Contaminated groundwater is addressed as part of OU 1.

TABLE 1 (continued): EVALUATION OF POTENTIAL PUBLIC HEALTH HAZARDS AT GEORGE AIR FORCE BASE

Site	Reuse Parcel	Site Description/ Waste Disposal History	Known or Suspected Hazardous Material	Investigation Results/ Environmental Monitoring Results[1]	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard[2]
FT-19a	A	Fire training area where fuels and waste oils were pumped into a bermed area and burned.	Waste oils, fuel	**Soil gas:** TCE, PCE, and 1,1,1-trichloroethane (TCA) were detected. **Surface soil:** VOCs, SVOCs, and dioxins were detected below CVs. **Subsurface soil:** Metals were detected above background levels and CVs. VOCs were detected below CVs. High levels of total petroleum hydrocarbons (TPH) were detected.	A bioventing system was installed and is operating. Groundwater is monitored as part of the OU 1 TCE plume.	This site poses no public health hazard. Access to the site is limited and contaminants were detected at levels that do not pose a public health hazard. The site is scheduled to remain part of airfield operations.
FT-19b	A	Area was used for disposal and burning of hospital wastes such as syringes and vials.	Waste oils, fuel, hospital wastes	**Soil gas:** TCE, PCE, chloroform, TCA, dichloroethene (DCE), carbon tetrachloride, methylene chloride, and BTEX were detected. **Surface soil:** Beryllium was detected above CVs. Other metals were detected above background levels. Dioxins were detected below CVs. **Subsurface soil:** VOCs and SVOCs were detected below CVs. TPH was detected.	Surface soil with medical waste was excavated. The feasibility study determined that no further action except monitoring was required. Groundwater is monitored as part of the OU 1 TCE plume.	This site poses no public health hazard. Access to the site is limited and contaminants were detected at levels that do not pose a public health hazard. The site is scheduled to remain part of airfield operations.

TABLE 1 (continued): EVALUATION OF POTENTIAL PUBLIC HEALTH HAZARDS AT GEORGE AIR FORCE BASE

Site	Reuse Parcel	Site Description/ Waste Disposal History	Known or Suspected Hazardous Material	Investigation Results/ Environmental Monitoring Results[1]	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard[2]
FT-19c	A	Fire training area where fuels and waste oils were pumped into a bermed area and burned.	Waste oils, fuel	**Soil gas:** PCE, TCA, and chloroform were detected. **Surface soil:** VOCs, SVOCS, and dioxins were detected below CVs. Metals were detected above background levels. **Subsurface soil:** Metals were detected above background levels. High levels of TPH were detected.	A soil vapor extraction system was installed and is operating. Groundwater is monitored as part of the OU 1 TCE plume.	This site poses no public health hazard. Access to the site is limited and contaminants were detected at levels that do not pose a public health hazard. The site is scheduled to remain part of airfield operations.
LF-14	A/D	Base landfill	All base wastes (lube oil, paint, lacquer, naphthalene, PD-680, TCE, cleaning fluids, batteries, fire-fighting foam, hydraulic fluid, etc.)	**Soil gas:** BTEX, PCE, TCE, and TCA were detected. **Surface soil:** PAHs exceeded CVs. Metals were detected above background levels. Pesticides were detected below CVs. **Subsurface soil:** Metals were detected above background levels. SVOCs were detected below CVs. No VOCs, pesticides, or PCBs were detected. **Groundwater:** Metals were detected slightly above background levels. No VOCs, SVOCs, pesticides, or PCBs were detected.	The existing soil cover was rehabilitated and access is restricted by fencing and posting. Two monitoring wells downgradient from the site are sampled yearly.	This site poses no public health hazard. Access to the site is limited and contaminants were detected at levels that do not pose a public health hazard. Access to contaminated soil is restricted by the rehabilitated cover.

TABLE 1 (continued): EVALUATION OF POTENTIAL PUBLIC HEALTH HAZARDS AT GEORGE AIR FORCE BASE

Site	Reuse Parcel	Site Description/ Waste Disposal History	Known or Suspected Hazardous Material	Investigation Results/ Environmental Monitoring Results[1]	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard[2]
LF-35	A/D	Landfill	Wood, debris containing asbestos, fiberglass	Investigation determined that the waste at this site is nonhazardous if undisturbed.	Access and land use restrictions were instituted and warning signs were posted.	This site poses no public health hazard. Access to the site is restricted, and the site is scheduled to remain part of airfield operations.
LF-36	A	Construction debris/borrow pit	Pavement, rock	Investigation determined that the waste at this site was nonhazardous.	NFA	This site poses no health hazard. Waste at this site is nonhazardous.
LF-43	A	Rubble disposal	Rubble	This site is located within Site DP-04.	NFA. This site is addressed as part of Site DP-04.	This site poses no public health hazard. See Site DP-04.
LF-45	A	Construction demolition	Construction and demolition materials	This site is located within Site DP-03.	NFA. This site is addressed as part of Site DP-03.	This site poses no public health hazard. See Site DP-03.
SD-18	A/B	Site was reportedly used for surface disposal of jet fuel and oil from 1965 to 1966.	Jet fuels, oil	**Surface soil:** No VOCs or SVOCs were detected. Metals were within the background range. **Subsurface soil:** No VOCs were detected.	NFA	This site poses no public health hazard. Contaminants were detected at levels that do not pose a public health hazard.
SD-41	A	Rip-rap for industrial drain discharge	Small empty cans, construction debris, asphalt, concrete, and rubble	Investigation determined that the waste at this site was nonhazardous.	NFA	This site poses no public health hazard. Waste at this site is nonhazardous.

TABLE 1 (continued): EVALUATION OF POTENTIAL PUBLIC HEALTH HAZARDS AT GEORGE AIR FORCE BASE

Site	Reuse Parcel	Site Description/ Waste Disposal History	Known or Suspected Hazardous Material	Investigation Results/ Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard[2]
LF-37	B	This site was suspected to have been a landfill in the mid-1960s. There were unverified reports that trash and aircraft parts were dumped there in the 1940s.	Concrete, asphalt, rubble	**Soil gas:** BTEX, TCE/PCE, and DCE/TCA were detected. **Surface soil:** No VOCs were detected. **Subsurface soil:** VOCs were detected below CVs. **Groundwater:** No VOCs, SVOCs, pesticides, or PCBs were detected. Metals were detected at or below background levels.	NFA	This site poses no public health hazard. Contaminants were detected at levels that do not pose a public health hazard.
LF-38	B	Trash disposal	Trash	**Surface soil:** Metals were detected above background levels. No VOCs, SVOCs, pesticides, or PCBs were detected. **Subsurface soil:** Metals were detected slightly above background levels. No VOCs, SVOCs, pesticides, or PCBs were detected. Test pits showed no debris, drums, or soil staining.	NFA	This site poses no public health hazard. Access to the site is limited and contaminants were detected at levels that do not pose a public health hazard.

TABLE 1 (continued): EVALUATION OF POTENTIAL PUBLIC HEALTH HAZARDS AT GEORGE AIR FORCE BASE

Site	Reuse Parcel	Site Description/ Waste Disposal History	Known or Suspected Hazardous Material	Investigation Results/ Environmental Monitoring Results[1]	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard[2]
OT-50	B	Garage-like building containing an earth embankment and sand pile used for aircraft gun alignment.	Bullet fragments	**Surface soil:** Elevated copper and lead levels were detected in the sand pile.	NFA	This site poses no public health hazard. Access to the site is limited. Though the structure will remain for the time being (in case a future military contractor decides to reuse it), it will probably be removed eventually to make room for warehouses.
OT-51	B	Jet engine test cells facilities. Periodic fuel spills reportedly occurred, including an 8,000-gallon spill in the 1950s. Heavy soil staining was observed beneath a section of a surface-drainage trench.	Fuels	**Surface soil:** BTEX were detected below CVs. TPH was detected. A "hot spot" of TPH was detected near Building 819. **Subsurface soil:** BTEX were detected below CVs. TPH was detected. **Groundwater:** Benzene was detected above CVs near the hot spot. Toluene and xylenes were detected below CVs.	Two underground storage tanks (USTs) used to collect waste fuel were removed. A bioventing system has reduced most of the contaminants in the groundwater; the Air Force may use oxygen enhancement if needed to complete the groundwater clean up. Groundwater is sampled from four monitoring wells three times per year.	This site poses no health hazard. Access to the site is limited and remediation is expected to reduce soil and groundwater contamination to concentrations that do not pose a public health hazard.
SS-59	B	Building 819, near the engine test cells.	Fuels	This site is addressed as part of Site OT-51.	NFA. This site is addressed as part of Site OT-51.	This site poses no public health hazard. See Site OT-51.

TABLE 1 (continued): EVALUATION OF POTENTIAL PUBLIC HEALTH HAZARDS AT GEORGE AIR FORCE BASE

Site	Reuse Parcel	Site Description/ Waste Disposal History	Known or Suspected Hazardous Material	Investigation Results/ Environmental Monitoring Results[1]	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard[2]
FT-20	C	Abandoned fire training area used from 1940 to 1970.	Waste oils, fuels	**Soil gas:** TCE was detected. **Surface soil:** Metals were detected slightly above background levels. **Subsurface soil:** Metals were detected slightly above background levels.	NFA	This site poses no public health hazard. Access to the site is limited and contaminants were detected at levels that do not pose a public health hazard. This site is scheduled to remain part of airfield operations.
LF-13	C	Original base landfill, closed in 1946, was used for trash disposal until 1950. Miscellaneous dumping occurred there until the mid-1950s.	POLs, incinerator ash, unknown materials	**Soil gas:** BTEX, PCE/TCE, and DCA/TCA/Freon were detected. **Surface soil:** Metals were detected slightly above background levels. No SVOCs, pesticides, or PCBs were detected. **Subsurface soil:** Metals were detected slightly above background levels. No VOCs were detected. Test pits showed concrete rubble but no drums or soil staining. **Groundwater:** TCE was detected and is addressed as part of OU 1. Metals were detected slightly above background levels.	NFA	This site poses no public health hazard. Access to the site is limited and contaminants were detected at levels that do not pose a public health hazard.

TABLE 1 (continued): EVALUATION OF POTENTIAL PUBLIC HEALTH HAZARDS AT GEORGE AIR FORCE BASE

Site	Reuse Parcel	Site Description/ Waste Disposal History	Known or Suspected Hazardous Material	Investigation Results/ Environmental Monitoring Results[1]	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard[2]
OT-69	C	PCE/TCE groundwater plumes	PCE, TCE	**Groundwater:** OT-69 consists of several small, localized TCE and PCE plumes. TCE was detected above CVs. Concentrations were highest in the upper 6 feet of the aquifer and decreased to non-detectable at 30 feet and deeper below the water table. TCE concentrations in the vadose zone were lower than the concentrations in groundwater; therefore, it was determined that soil contamination does not pose a source for further groundwater contamination. Fate and transport modeling determined that percolation from the OU 1 treatment system will reduce TCE concentrations at OT-69 to below the MCL (5 ppb) within 2 years.	Natural attenuation, monitoring, and restrictions on groundwater use were instituted. Groundwater is sampled at the plumes one or more times per year.	This site poses no public health hazard. No drinking water wells are affected, and no new wells will be installed in the area.
SS-21	C	Tip tank drainage area	Fuels	**Subsurface soil:** Low concentrations of TPH were detected. VOCs were not detected. Trenches showed a buried layer of asphalt and one area of stained soil.	NFA	This site poses no public health hazard. Access to the site is limited and contaminants were detected at levels that do not pose a public health hazard. This site is scheduled to remain part of airfield operations.
SS-24	C	Building 580 transformer storage	Transformer oils	**Surface soil:** No PCBs were detected.	NFA	This site poses public health hazard. No contamination was detected.

TABLE 1 (continued): EVALUATION OF POTENTIAL PUBLIC HEALTH HAZARDS AT GEORGE AIR FORCE BASE

Site	Reuse Parcel	Site Description/ Waste Disposal History	Known or Suspected Hazardous Material	Investigation Results/ Environmental Monitoring Results	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard[2]
SD-28	C	Abandoned drain pit/dry well	Fuels	A geophysical survey of the area failed to detect a drain pit or dry well.	NFA	This site poses no public health hazard. Existence of the site could not be verified.
SS-55	C/D	Collection point for fuel that was spilled from a 5,000 gallon fuel truck.	Fuels	**Surface soil:** TPH was not detected. **Subsurface soil:** TPH was not detected.	NFA	This site poses no public health hazard. No contamination was detected.
ST-56	C	Building 690 jet fuel pipeline leak. Quantity of fuel lost was suspected to be at least 1,000 gallons.	Jet fuel JP-4	**Surface soil:** TPH was not detected. **Subsurface soil:** TPH was not detected. **Groundwater:** Groundwater samples were not collected. The water table (upper aquifer) is an estimated 145 feet below ground surface.	NFA	This site poses no public health hazard. No contamination was detected in soil. Due to the depth of the water table, it is unlikely that groundwater was affected by any spilled jet fuel.
WP-29	C	Eight sludge drying beds adjacent to the former sewage treatment plant. The beds were used for drying sanitary and industrial sludges. (The majority of this sludge was from residential waste.)	Sanitary and industrial sludge	**Surface soil:** Metals were detected above background levels. SVOCs were detected below CVs.	NFA	This site poses no public health hazard. Access to the site is limited and contaminants were detected at levels that do not pose a public health hazard. This site is scheduled to remain part of airfield operations.

TABLE 1 (continued): EVALUATION OF POTENTIAL PUBLIC HEALTH HAZARDS AT GEORGE AIR FORCE BASE

Site	Reuse Parcel	Site Description/ Waste Disposal History	Known or Suspected Hazardous Material	Investigation Results/ Environmental Monitoring Results[1]	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard[2]
WP-32	C	Leach field for disposal of sanitary wastes and minor aircraft maintenance waste. Types, quantities, and time periods are unknown.	Sanitary wastes, minor aircraft maintenance wastes	**Soil gas:** No VOCs were detected. **Surface soil:** Metals were detected above background levels. PAHs were detected above CVs.	NFA	This site poses no public health hazard. Access to the site is limited and contaminants were detected at levels that do not pose a public health hazard. This site is scheduled to remain part of airfield operations.
WP-68	D	Concrete-walled paint disposal pit with an unlined bottom.	Paints	**Surface soil:** Metals were detected above background levels. SVOCs were detected below CVs.	NFA	This site poses no public health hazard. Access to the site is limited and contaminants were detected at levels that do not pose a public health hazard. This site is scheduled to remain part of airfield operations.
DP-01	D	Paint drum burial	Leaded paint	**Subsurface soil:** Soil borings and trenches showed no indication of paint dumping. Existence of the site is suspect.	NFA	This site poses no public health hazard. Existence of the site is suspect.
DP-46	D	Buried F-111 aircraft wreckage.	Aircraft wreckage. It is unknown if the wreckage contains hazardous material. The aircraft wings, however, may contain asbestos.	Geophysical survey detected what is thought to be the aircraft wreckage. Shallow soil borings indicate the wreckage is covered by at least 3 feet of fill material.	NFA. The Air Force will institute a deed restriction when it transfers the property to prohibit disturbance of the wreckage through construction, digging, etc.	This site poses no public health hazard. Access to the site was limited in the past and is now restricted by 3 feet of cover. A deed restriction is also planned.

TABLE 1 (continued): EVALUATION OF POTENTIAL PUBLIC HEALTH HAZARDS AT GEORGE AIR FORCE BASE

Site	Reuse Parcel	Site Description/ Waste Disposal History	Known or Suspected Hazardous Material	Investigation Results/ Environmental Monitoring Results[1]	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard[2]
DP-47	D	Aircraft parts burial	Miscellaneous aircraft parts	Geophysical survey and test pits failed to locate buried aircraft parts. Existence of the site is suspect.	NFA	This site poses no public health hazard. Existence of the site is suspect.
LF-12	D	Landfill used from 1953 to 1957. Site may have been used to burn waste with waste oils in the 1950s. Site was used for disposal of trash and rubble from the 1960s-1970s, and street sweepings in the 1980s.	All base wastes (lube oil, paint, lacquer, naphthalene, PD-680, TCE, cleaning fluids, batteries, fire-fighting foam, hydraulic fluid, etc.)	**Soil gas:** BTEX and TCE were detected. **Surface soil:** Metals were detected slightly above background levels. Dioxins were detected below CVs. No VOCs, SVOCs, pesticides, or PCBs were detected. **Subsurface soil:** No VOCs, SVOCs, pesticides, or PCBs were detected. **Groundwater:** Petroleum hydrocarbons were detected in downgradient monitoring wells. Metals were detected above CVs in unfiltered samples from downgradient monitoring wells. The Air Force attributed this to the high turbidity of these samples—metal concentrations in the one filtered duplicate sample did not exceed any CVs.	Surface controls were installed, the existing soil cover was rehabilitated, and access is restricted by fencing and posting. One monitoring well downgradient from the site is sampled yearly.	This site poses no public health hazard. Access to the site is limited and contaminants were detected at levels that do not pose a public health hazard. There is no exposure to groundwater from this site. If the Air Force relinquishes this property it will apply deed restrictions to prevent disturbance of the landfill.

TABLE 1 (continued): EVALUATION OF POTENTIAL PUBLIC HEALTH HAZARDS AT GEORGE AIR FORCE BASE

Site	Reuse Parcel	Site Description/ Waste Disposal History	Known or Suspected Hazardous Material	Investigation Results/ Environmental Monitoring Results[1]	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard[2]
LF-39	D/J	From 1944 to 1965, this site was reportedly used for disposal of construction debris and rubble. Trash may have been dumped and burned there in the early 1950s.	Construction debris, rubble	**Soil gas:** BTEX were detected. **Subsurface soil:** Metals were detected slightly above background levels in soil cores collected during installation of monitoring wells. No VOCs were detected. Test pits did not show debris, drums, or any other buried materials.	NFA. Two monitoring wells downgradient from the site are sampled yearly.	This site poses no public health hazard. Contaminants were detected at levels that do not pose a public health hazard.
LF-44	D	Miscellaneous trash and rubble disposal	Trash, rubble	**Surface soil:** Lead was detected slightly above background levels. No SVOCs, pesticides, or PCBs were detected. **Subsurface soil:** Metals were detected slightly above background. No VOCs, SVOCs, pesticides, or PCBs were detected.	The Air Force has placed a deed restriction on the site to restrict access and prohibit future digging, drilling, and other activities.	This site poses no public health hazard. Access to the site is restricted and contaminants were detected at levels that do not pose a public health hazard.
OT-48	D	Reported munitions disposal area	Munitions	This site was determined to be part of Site SS-23. No munitions or unexploded ordnance were encountered during investigation of the site.	NFA. This site as addressed as part of Site SS-23.	This site poses no public health hazard. No munitions were encountered at the site. See Site SS-23.
SD-27	D	Abandoned drain pit/dry well (4 foot diameter, 30 feet deep) used for disposal of waste oil from equipment maintenance. The well was pumped out, backfilled, compacted, and paved when abandoned.	Waste POLs	**Subsurface soil:** VOCs were detected below CVs. Metals were detected above background levels. No significant contamination was detected, however, in soil samples from beneath the dry well, and it was determined that there had been no vertical migration of contamination beneath the well. The water table is approximately 110 feet below the bottom of the dry well.	NFA	This site poses no public health hazard. Contaminants disposed of in the dry well did not migrate to groundwater. Contaminated subsurface soil is inaccessible.

TABLE 1 (continued): EVALUATION OF POTENTIAL PUBLIC HEALTH HAZARDS AT GEORGE AIR FORCE BASE

Site	Reuse Parcel	Site Description/ Waste Disposal History	Known or Suspected Hazardous Material	Investigation Results/ Environmental Monitoring Results[1]	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard[2]
SS-23	D	Salvage yard/hazardous waste storage area used for recovery and temporary storage of waste oils and solvents. Small spills may have occurred here. Drummed waste was stored on concrete pads and waste oil was stored in an aboveground storage tank.	Waste oils, solvents	**Surface soil:** Chromium and lead were detected above background levels. **Subsurface soil:** Chromium and lead were detected above background levels.	Aboveground storage tanks and the drum storage pads were removed.	This site poses no public health hazard. Access to the site is limited and contaminants were detected at levels that do not pose a public health hazard. This site is now used to store construction equipment and material storage for the airport.
SS-53	D	Jet fuel spill	Fuels	Stressed vegetation or other evidence of a spill could not be identified through site inspection and photograph review.	NFA	This site poses no public health hazard. Existence of the site could not be verified.
WP-16	D	POL leach field for truck maintenance area	POLs	Review of facility records failed to identify a potential contamination source area.	NFA	This site poses no public health hazard. Existence of the site could not be verified.
WP-17	D	POL leach field	POLs	**Surface soil:** No VOCs or metals were detected. **Subsurface soil:**. Metals were detected above background levels. VOCs were detected below CVs.	Bioventing system was installed and is operating.	This site poses no public health hazard. Access to the site is limited and contaminants were detected at levels that do not pose a public health hazard. This site is scheduled to remain part of airfield operations.

TABLE 1 (continued): EVALUATION OF POTENTIAL PUBLIC HEALTH HAZARDS AT GEORGE AIR FORCE BASE

Site	Reuse Parcel	Site Description/ Waste Disposal History	Known or Suspected Hazardous Material	Investigation Results/ Environmental Monitoring Results[1]	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard[2]
OT-22	F/J	Golf course that was irrigated with water from the sewage treatment plant percolation ponds (Site WP-26).	Sanitary sewer effluent	Soil samples collected from Site WP-26 did not indicate the presence of contamination; therefore, there appears to be no possible source of contamination for Site OT-22.	NFA	This site poses no health hazard. No source of potential contamination could be identified for this site.
DP-10	K	Landfill used from 1978 to 1981 (at least).	Jet engine starter cartridges which contained residues from standard explosive mixtures.	Site is addressed as part of Site LF-07.	Site is addressed as part of Site LF-07.	The site poses no apparent past public health hazard and no present or future public health hazard. See Site LF-07.
DP-15	K	Munitions/oil possibly buried in a trench.	Small arms munitions residue, waste oil	Site is addressed as part of Site LF-07.	Site is addressed as part of Site LF-07.	The site poses no apparent past public health hazard and no present or future public health hazard. See Site LF-07.
DP-33	K	Grenade practice range, closed in 1966 or 1967.	Grenade debris, paint cans	Site is addressed as part of Site LF-07.	Munitions debris was removed. Site is addressed as part of Site LF-07.	The site poses no apparent past public health hazard and no present or future public health hazard. See Site LF-07.
DP-34	K	Munitions may have been used at this site until the early 1970s.	Practice bombs, small arms cartridges	Site is addressed as part of Site LF-07.	Munitions debris was removed. Site is addressed as part of Site LF-07.	The site poses no apparent past public health hazard and no present or future public health hazard. See Site LF-07.

TABLE 1 (continued): EVALUATION OF POTENTIAL PUBLIC HEALTH HAZARDS AT GEORGE AIR FORCE BASE

Site	Reuse Parcel	Site Description/ Waste Disposal History	Known or Suspected Hazardous Material	Investigation Results/ Environmental Monitoring Results[1]	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard[2]
LF-07	K	Base landfill. This site encompasses most of the other sites in the Southeast Disposal Area (SEDA). All the SEDA sites, therefore, were addressed together in the investigation activities for Site LF-07.	Domestic wastes, waste oil, fuels, other hazardous wastes	**Soil gas:** BTEX, PCE/TCE, and DCE/TCA/carbon tetrachloride were detected. **Surface soil:** Metals were detected above background levels. One pesticide was detected above CVs. Dioxins were detected below CVs. **Subsurface soil:** Metals were detected above background levels. Toluene was detected below CVs. No SVOCs, pesticides, or PCBs were detected. **Groundwater:** Metals were detected above background in unfiltered samples, but were not detected above background in filtered samples.	A fence was installed and the existing soil cover was rehabilitated. Two monitoring wells downgradient from the site are sampled yearly for indicator parameters.	The site poses no apparent past public health hazard and no present or future public health hazard. Although this site was used in the past as a recreational area for hunters and dirt bikers, exposure to soil during recreational activity is assumed to have been infrequent and of short duration. Access to contaminated soil is now restricted by the rehabilitated cover and the federal prison now under construction at the site.
LF-08	K	Disposal area for JP-4 and leaded gasoline sludge.	JP-4 and leaded gasoline sludge	Site is addressed as part of Site LF-07.	Site is addressed as part of Site LF-07.	The site poses no apparent past public health hazard and no present or future public health hazard. See Site LF-07.
LF-11	K	Landfill	Paper	Because wastes reportedly buried at this site were limited to paper, further investigation was not performed.	Site is addressed as part of Site LF-07.	The site poses no apparent past public health hazard and no present or future public health hazard. See Site LF-07.

TABLE 1 (continued): EVALUATION OF POTENTIAL PUBLIC HEALTH HAZARDS AT GEORGE AIR FORCE BASE

Site	Reuse Parcel	Site Description/ Waste Disposal History	Known or Suspected Hazardous Material	Investigation Results/ Environmental Monitoring Results[1]	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard[2]
RW-09	K	Radioactive disposal area used from 1965 to 1970. Precise volume of waste, if any, is unknown.	Low-level radioactive wastes, unidentified chemicals	Investigation activities included walk-over and drive-over radiological surveys, trenching, and excavation of over 4,000 cubic yards of soil. Three small radioactive objects were recovered, leading to the conclusion that RW-09 was not a disposal site for significant amounts of radioactive materials.	Site is addressed as part of Site LF-07.	The site poses no apparent past public health hazard and no present or future public health hazard. See Site LF-07.
SS-52	K	Creosote spill area from creosote operations prior to 1960.	Creosote	Site is addressed as part of Site LF-07.	Site is addressed as part of Site LF-07.	The site poses no apparent past public health hazard and no present or future public health hazard. See Site LF-07.
WP-40	K	Chemical toilet sludge	Chemical toilet waste sludge	Site is addressed as part of Site LF-07.	Site is addressed as part of Site LF-07.	The site poses no apparent past public health hazard and no present or future public health hazard. See Site LF-07.
OT-49	none	Residue from numerous aircraft crashes.	Aircraft residue	The existence of this site is not documented and its location could not be verified.	NFA	The site poses no public health hazard. Existence of the site could not be verified.
OT-61	none	Shop waste disposal area	Cleansers, solvents	A record search failed to locate or verify the existence of a centralized shop waste disposal area.	NFA	The site poses no public health hazard. Existence of the site could not be verified.

TABLE 1 (continued): EVALUATION OF POTENTIAL PUBLIC HEALTH HAZARDS AT GEORGE AIR FORCE BASE

Site	Reuse Parcel	Site Description/ Waste Disposal History	Known or Suspected Hazardous Material	Investigation Results/ Environmental Monitoring Results[1]	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard[2]
OT-62	none	Rinse water disposal pit	Pesticides	One possible pesticide rinse water disposal pit was identified during a site inspection. This pit was found to be structurally sound; it is therefore unlikely that this pit leaked pesticides into the surrounding soil. No samples were collected.	NFA	This site poses no public health hazard. No evidence of surface soil contaminants were found and all wastes removed and the site was paved over.
OT-64	none	Transformer sites	PCB oils	Oil leaks from any malfunctioning transformers could not be located or verified.	NFA	The site poses no public health hazard. Existence of the site could not be verified.
OT-65	none	Nine fortified hangars were used for storage of miscellaneous materials (barbed wire, PVC pipe, sewer pipe, fire hydrants, fertilizer). One hangar was used as an explosive ordnance detonation range.	Explosive ordnance, fertilizer, miscellaneous materials	**Surface soil:** Arsenic was detected slightly above background levels.	NFA	This site poses no public health hazard. Contaminants were detected at levels that do not pose a public health hazard. No reuse has been planned for this site.
OT-66	none	Stormwater discharge from residential areas to drainage areas.	Fuel, non-point source discharges	**Surface soil:** Metals were detected slightly above background levels. SVOCs were detected below CVs.	NFA	This site poses no public health hazard. Contaminants were detected at levels that do not pose a public health hazard. No reuse has been planned for this site.

TABLE 1 (continued): EVALUATION OF POTENTIAL PUBLIC HEALTH HAZARDS AT GEORGE AIR FORCE BASE

Site	Reuse Parcel	Site Description/ Waste Disposal History	Known or Suspected Hazardous Material	Investigation Results/ Environmental Monitoring Results[1]	Corrective Activities and/or Current Status	Evaluation of Public Health Hazard[2]
SD-42	Off-site	Rip-rap around off-base water supply wells	Empty cans, construction debris	It was determined that the waste at this site (concrete, clay pipe, debris) was nonhazardous.	NFA. Material was removed.	The site poses no public health hazard. Waste material at the site was nonhazardous.
ST-31	N/A	Removed, abandoned USTs	Removed, abandoned USTs	USTs have been removed.	NFA. USTs were taken off site.	The site poses no public health hazard. No contamination has been identified and the USTs have been taken off site.
WP-63	none	Sewage sludge disposal areas	Sewage sludge	A record search failed to locate or verify the existence of any sewage sludge burial sites along any perimeter roads.	NFA	The site poses no public health hazard. Existence of the site could not be confirmed.

[1] See Appendix B for explanation of comparison values.
[2] No residential reuse has been planned for the base. In its public health evaluations of these sites, therefore, ATSDR assumes industrial rather than residential reuse. In its public health evaluations, ATSDR considers access to most areas of the base to be limited because George AFB remains fenced in and access to the base is controlled by security guards.
N/A = not applicable

Sources: Earthtech, 1993; IT, 1995, 1996; Montgomery Watson, 1994, 1996, 1997a, 1997c; U.S. Air Force, 1997a, 1997b, 1998a, 199b, 1998c.

TABLE 2: EXPOSURE PATHWAYS AT GEORGE AIR FORCE BASE

Pathway Name	Exposure Pathway Elements						Comments
	Source of Contamination	Environmental Medium	Point of Exposure	Route of Exposure	Time of Exposure	Exposed Population	
Completed Exposure Pathways							
None	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Potential Exposure Pathways							
Off-site groundwater: VOCs contamination	Contaminated soil and groundwater at George AFB	Groundwater	Drinking water pumped from aquifers near George AFB.	Ingestion Dermal contact Inhalation	**Past, present, and future:** VOCs have not been detected in off-site drinking water supply wells.	Consumers of drinking water pumped from aquifers near George AFB	Two supply wells at the Victor Valley Wastewater Reclamation Authority (VVWRA) treatment plant, north of George AFB, are in the path of the OU 1 TCE plume. These wells are not used to supply drinking water, however. No other known drinking water wells are in the path of groundwater contaminant plumes from George AFB. A pump-and-treat system was installed to clean up the OU 1 TCE plume and should prevent contaminants from migrating to the Mojave River, which is an important water supply for downstream communities.

TABLE 2 (continued): EXPOSURE PATHWAYS AT GEORGE AIR FORCE BASE

Pathway Name	Exposure Pathway Elements						Comments
	Source of Contamination	Environmental Medium	Point of Exposure	Route of Exposure	Time of Exposure	Exposed Population	
Potential Exposure Pathways (continued)							
On-site soil	Historical spills and disposal of hazardous materials (fuels, oil, solvents, paints, munitions, debris, etc.) in landfills, waste pits, and other disposal areas throughout the base.	Surface and subsurface soil	Landfills and other disposal areas that may have been used for recreation.	Ingestion Dermal contact	**Past:** No historical soil data are available for the base, so past exposures cannot be confirmed or quantified. **Present and future:** Exposure to workers at the base through industrial use does not pose a public health hazard. Children attending the schools on base are not exposed to contamination either on school grounds or on the route to the school.	**Past:** George AFB personnel and residents, including children. **Present and future:** Workers for Southern California International Airport and other tenants of the base; children attending the two schools located at the base.	Soil contamination has been detected above comparison values (CVs) in very few areas of George AFB. Access to most areas of contamination is limited and the contaminant levels detected do not pose a health hazard, to either children or adults, through short-term exposure. Exposure to contaminated soil through future industrial reuse of the base is not expected to pose a public health hazard.

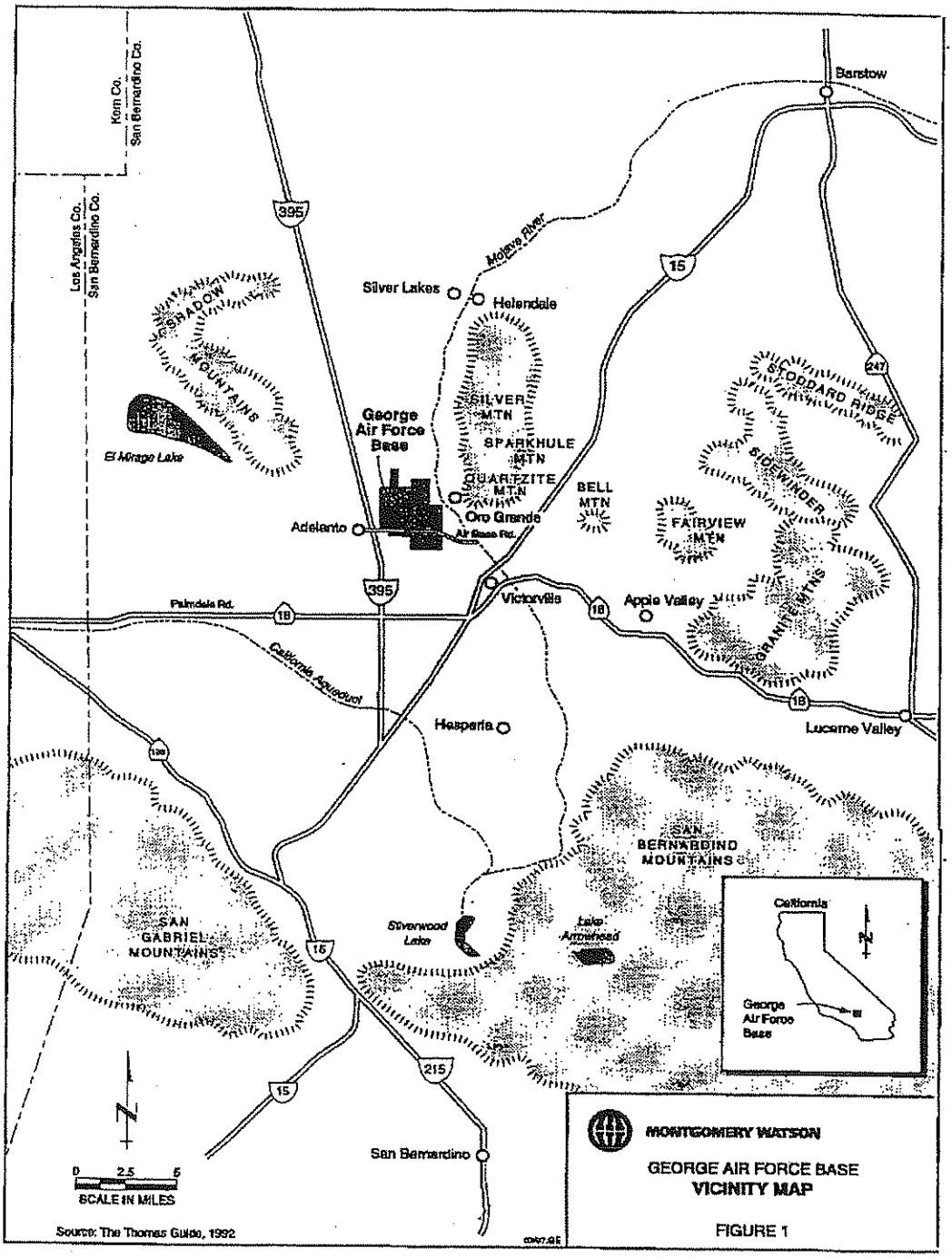
TABLE 2 (continued): EXPOSURE PATHWAYS AT GEORGE AIR FORCE BASE

Pathway Name	Exposure Pathway Elements						Comments
	Source of Contamination	Environmental Medium	Point of Exposure	Route of Exposure	Time of Exposure	Exposed Population	
Potential Exposure Pathways (continued)							
Radiological exposure	Historical disposal of small amounts low-level radioactive waste (e.g., aircraft dials, circuit breakers, and engine gear boxes) in the Southeast Disposal Area (SEDA) and munitions disposal areas.	Low-level radioactive waste and surrounding soil	Waste disposal areas	Dermal contact Ingestion Inhalation	**Past:** Radioactive waste sites may have been accessible in the past to hunters, dirt bikers, and other recreational users. **Present and future:** All potential radioactive waste disposal areas have been surveyed and cleared of radioactive material (only a small amount was found). The SEDA is fenced and its landfill cover has been rehabilitated. Air Force property south of Air Base Road (including the SEDA) has been transferred to the Federal Bureau of Prisons and will be the site of a prison that is currently under construction.	Hunters, dirt bikers, and other recreational users who may have accessed these disposal areas.	A small amount of radioactive material was discovered and removed from a portion of the SEDA. Radiation surveys and exploratory soil excavation have indicated that this area was not used for the disposal of significant quantities of radioactive waste. Although people using the area for recreation in the past may have been exposed to small amounts of radioactive material, any such exposures would have been infrequent and of short duration and would not be expected to pose a health hazard.

N/A = not applicable

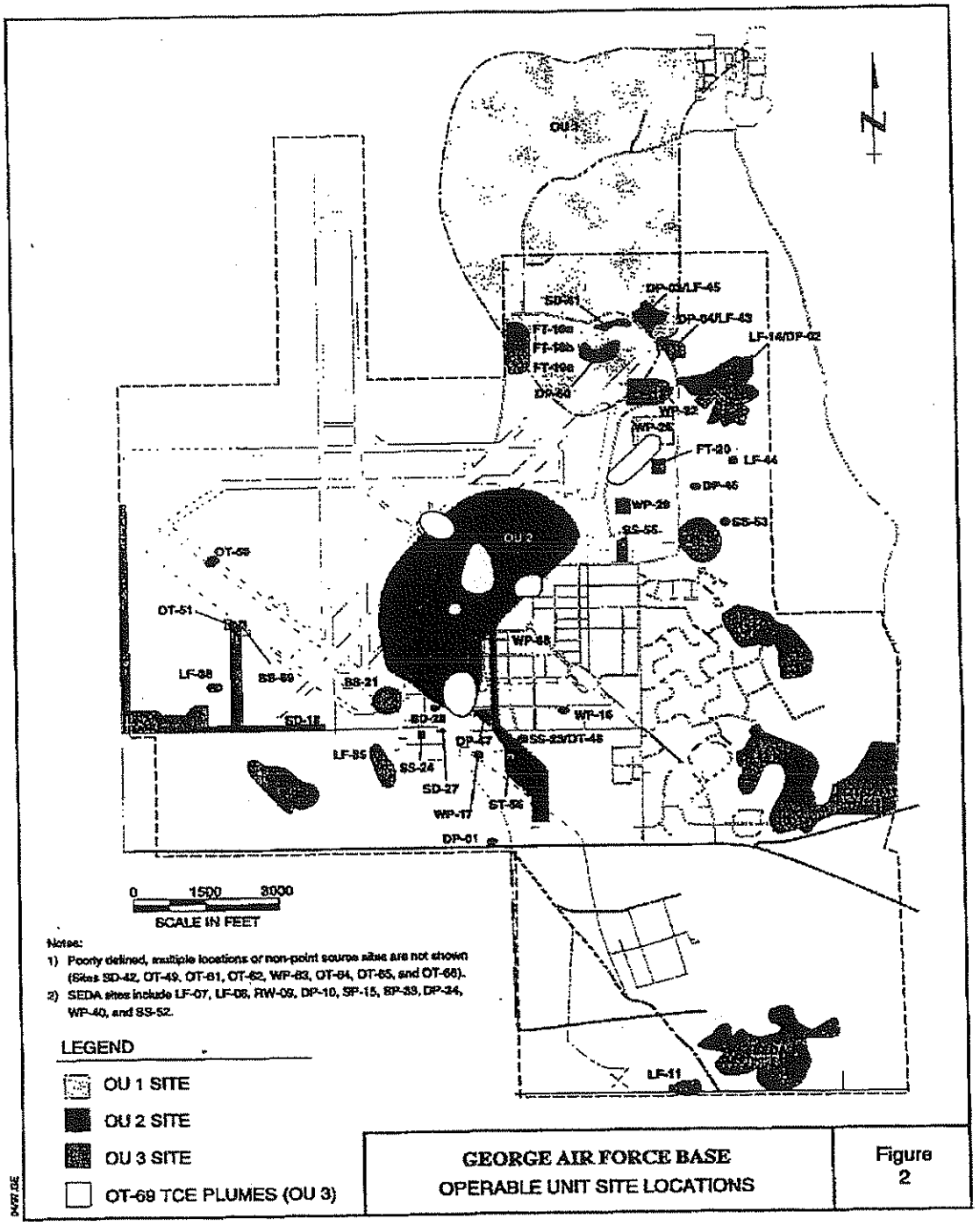
FIGURES

Figure 1



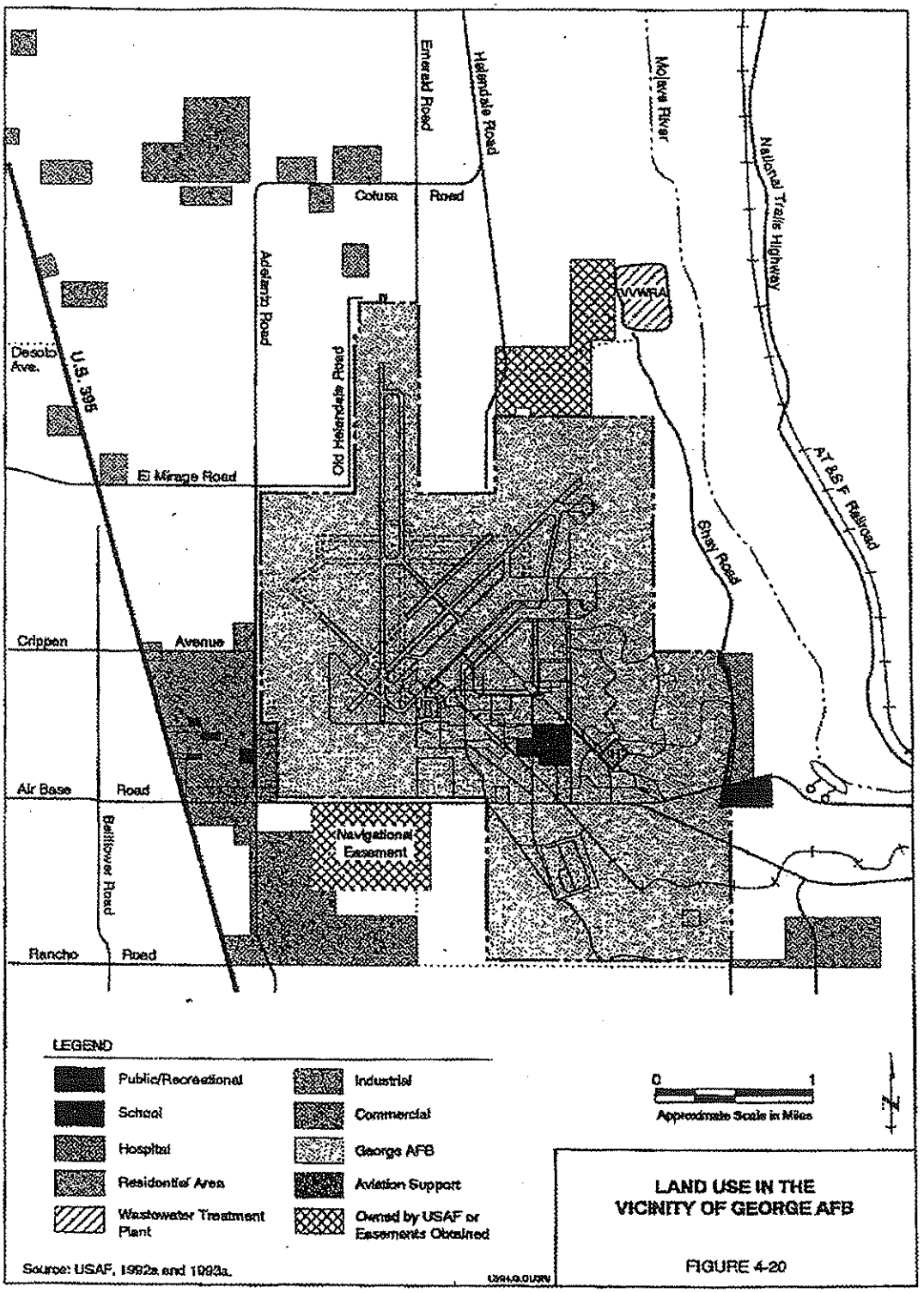
Source: Montgomery Watson, 1997b

Figure 2



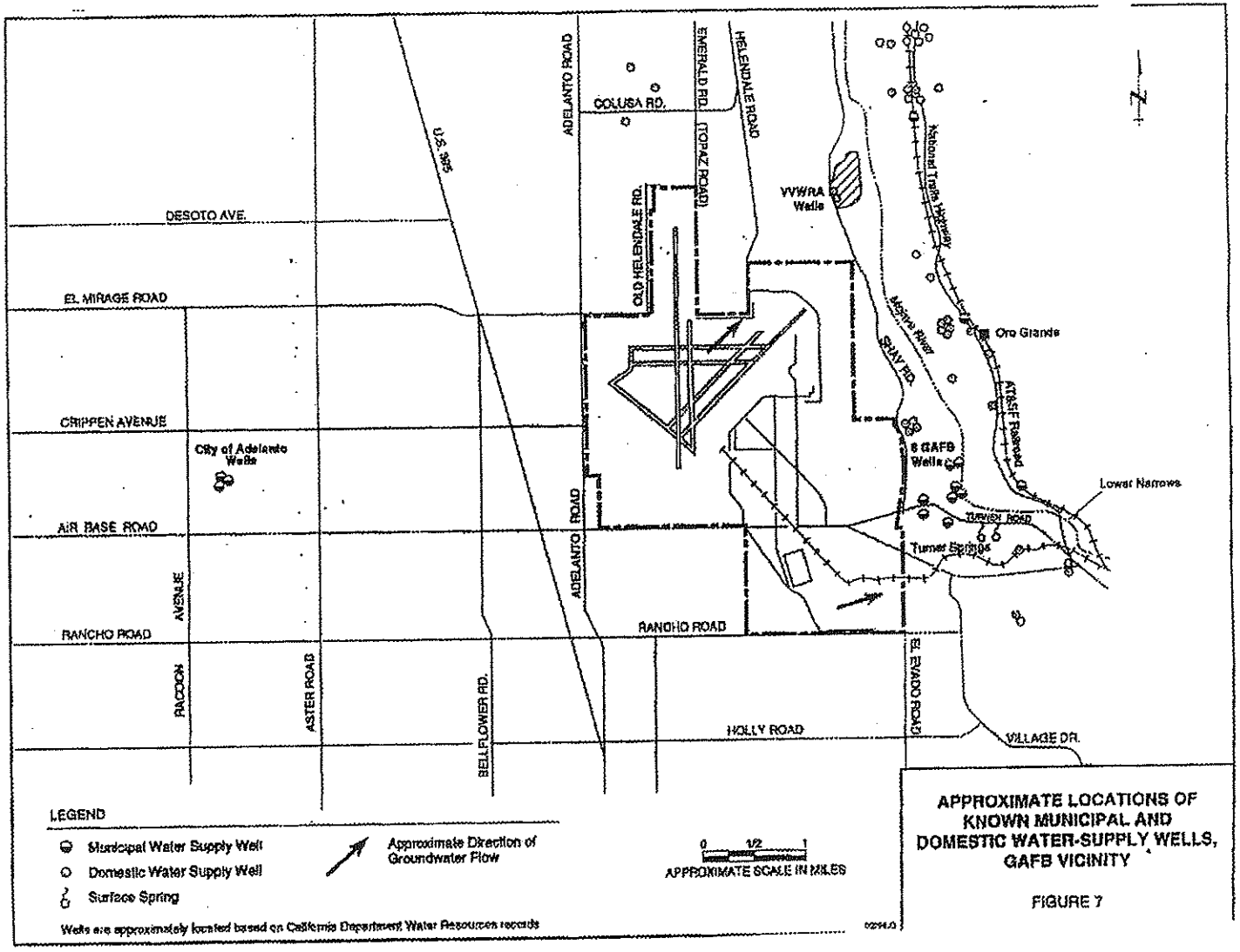
Source: Montgomery Watson, 1997b

Figure 3



Source: Montgomery Watson, 1997b

Figure 4



Source: Montgomery Watson, 1997b

Figure 5

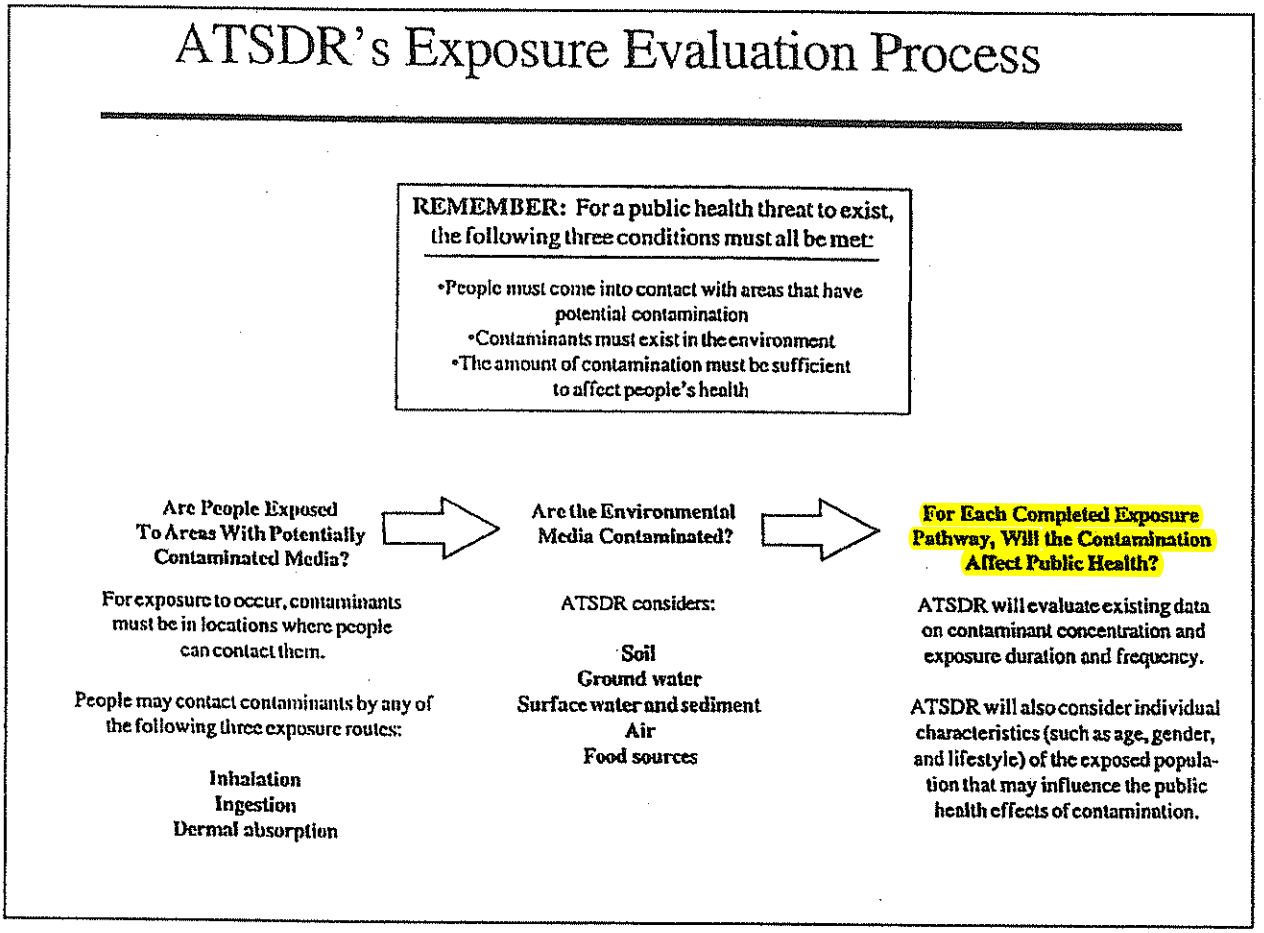
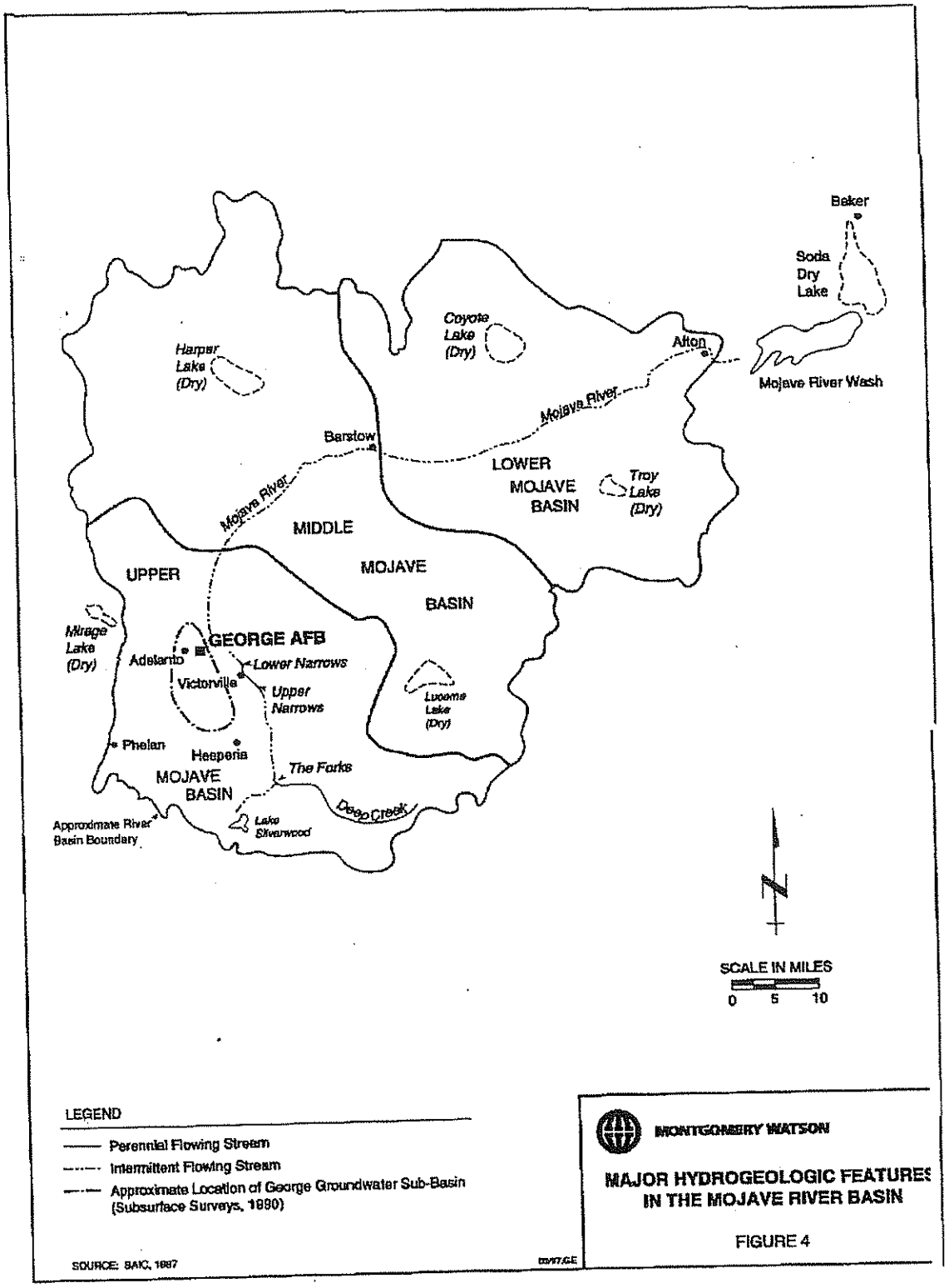
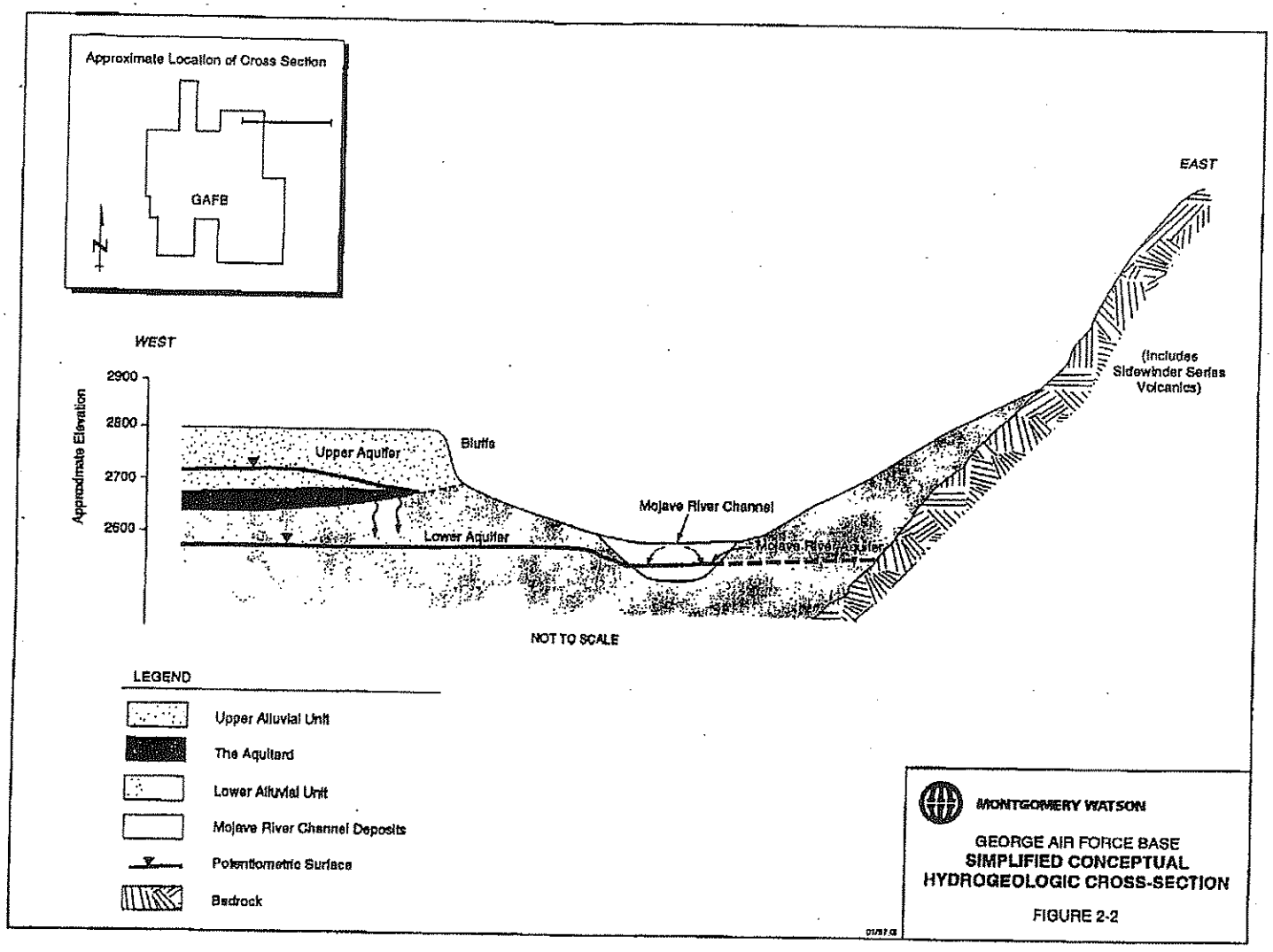

ATSDR's Exposure Evaluation Process
REMEMBER: For a public health threat to exist, the following three conditions must all be met:
•People must come into contact with areas that have potential contamination
•Contaminants must exist in the environment
•The amount of contamination must be sufficient to affect people's health
Are People Exposed To Areas With Potentially Contaminated Media?
For exposure to occur, contaminants must be in locations where people can contact them.
People may contact contaminants by any of the following three exposure routes:
Inhalation
Ingestion
Dermal absorption
Are the Environmental Media Contaminated?
ATSDR considers:
Soil
Ground water
Surface water and sediment
Air
Food sources
For Each Completed Exposure Pathway, Will the Contamination Affect Public Health?
ATSDR will evaluate existing data on contaminant concentration and exposure duration and frequency.
ATSDR will also consider individual characteristics (such as age, gender, and lifestyle) of the exposed population that may influence the public health effects of contamination.

Figure 6



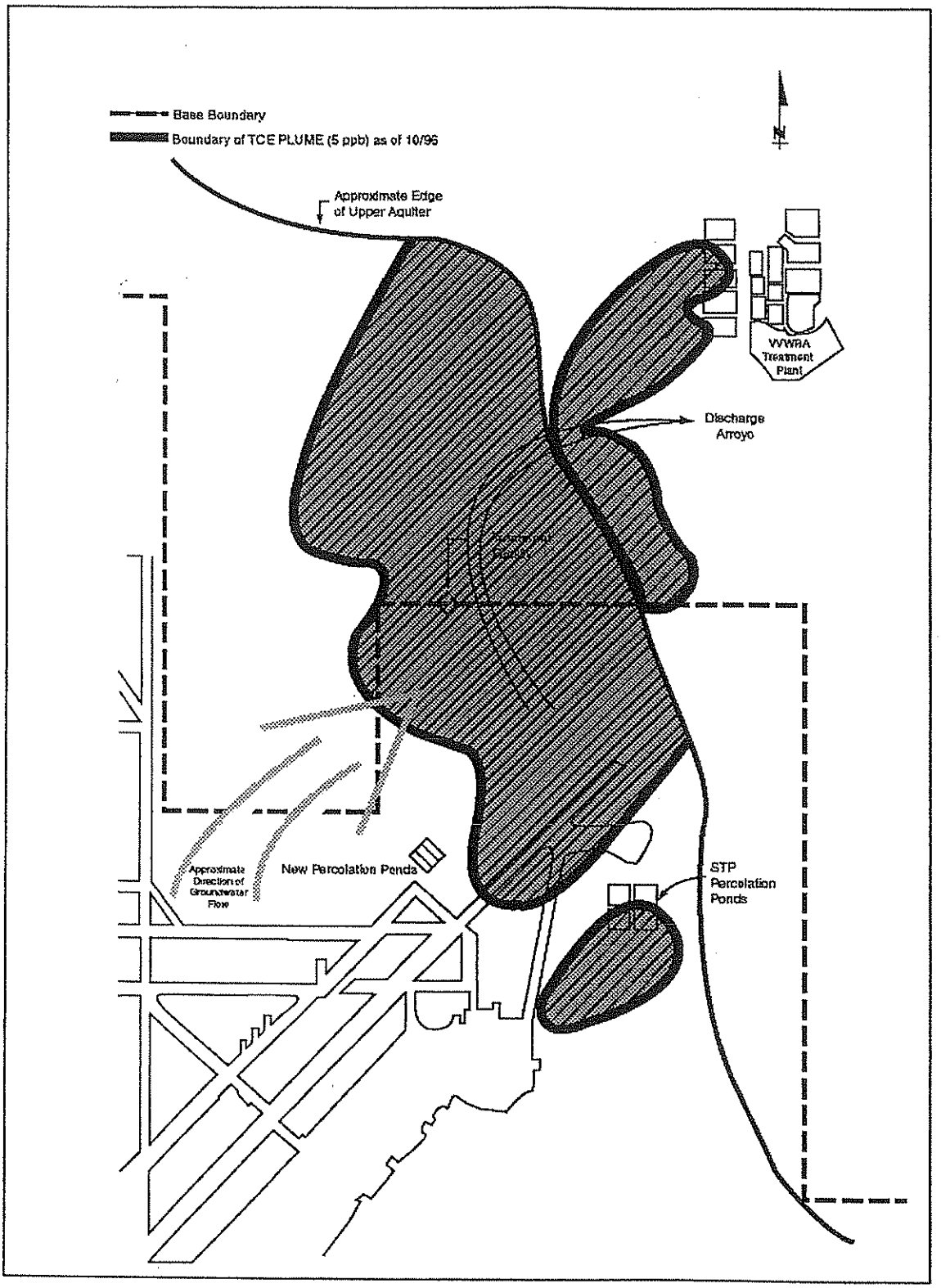
Source: Montgomery Watson, 1997b

Figure 7



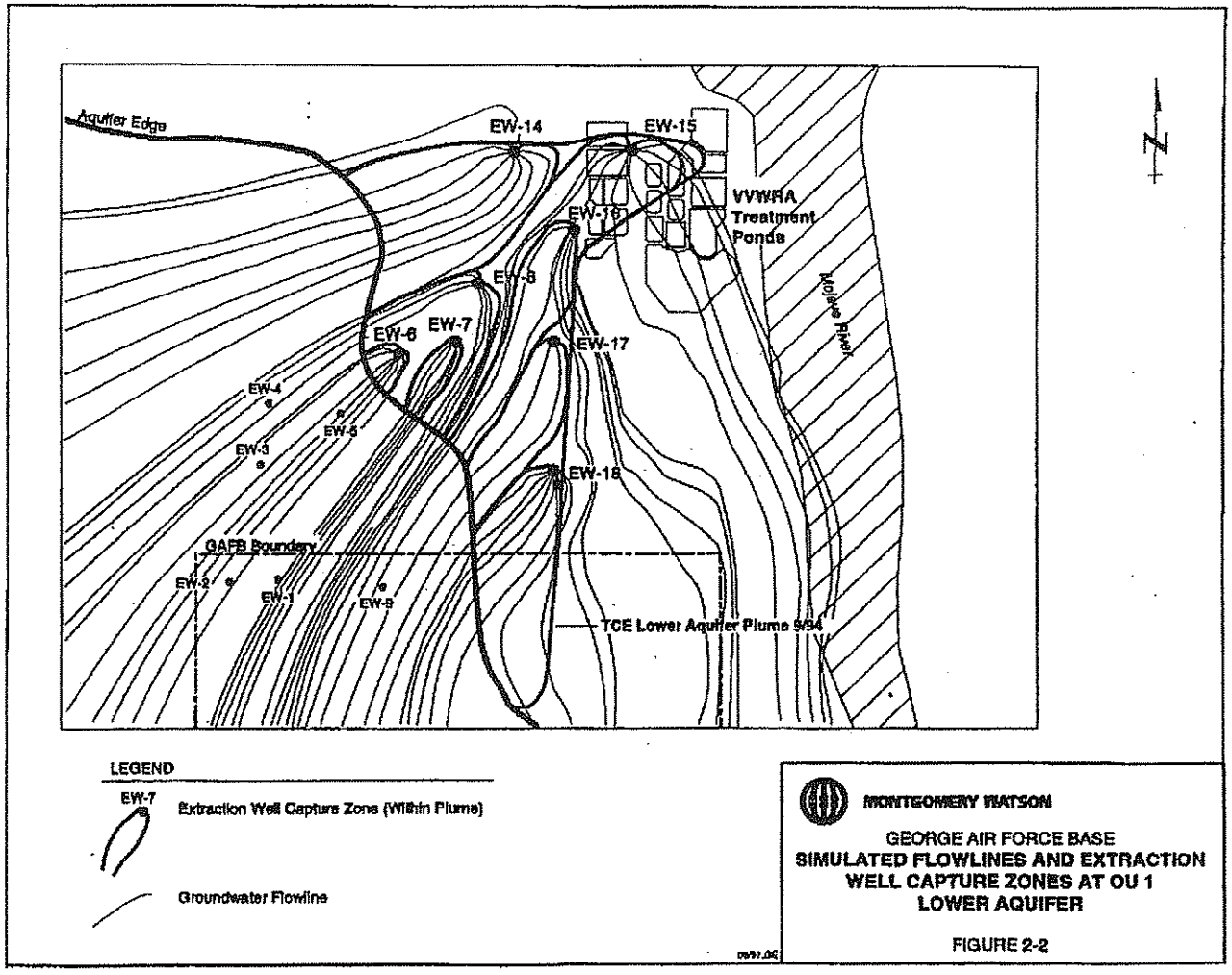
Source: Montgomery Watson, 1997b

Figure 8



Source: adapted from Montgomery Watson, 1997b

Figure 9



Source: Montgomery Watson, 1997b

APPENDICES

APPENDIX A: Glossary

Acute

Occurring over a short time, usually a few minutes or hours. An *acute* exposure can result in short-term or long-term health effects. An *acute* effect happens a short time (up to 1 year) after exposure.

Background Level

A typical or average level of a chemical in the environment. *Background* often refers to naturally occurring or uncontaminated levels.

Carcinogen

Any substance that may produce cancer.

CERCLA

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980, also known as Superfund. This is the legislation that created ATSDR.

Chronic

Occurring over a long period of time (more than 1 year).

Comparison Values

Estimated contaminant concentrations in specific media that are not likely to cause adverse health effects, given a standard daily ingestion rate and standard body weight. The *comparison values* are calculated from the scientific literature available on exposure and health effects.

Concentration

The amount of one substance dissolved or contained in a given amount of another. For example, sea water contains a higher concentration of salt than fresh water.

Contaminant

Any substance or material that enters a system (the environment, human body, food, etc.) where it is not normally found.

Dermal

Referring to the skin. *Dermal* absorption means absorption through the skin.

Dose

The amount of substance to which a person is exposed. *Dose* often takes body weight

into account.

Environmental contamination

The presence of hazardous substances in the environment. From the public health perspective, *environmental contamination* is addressed when it potentially affects the health and quality of life of people living and working near the contamination.

Exposure

Contact with a chemical by swallowing, by breathing, or by direct contact (such as through the skin or eyes). *Exposure* may be short term (acute) or long term (chronic).

Hazard

A source of risk that does not necessarily imply potential for occurrence. A hazard produces risk only if an exposure pathway exists, and if exposures create the possibility of adverse consequences.

Ingestion

Swallowing (such as eating or drinking). Chemicals can get in or on food, drink, utensils, cigarettes, or hands where they can be ingested. After *ingestion*, chemicals can be absorbed into the blood and distributed throughout the body.

Inhalation

Breathing. Exposure may occur from inhaling contaminants because they can be deposited in the lungs, taken into the blood, or both.

Media

Soil, water, air, plants, animals, or any other parts of the environment that can contain contaminants.

Minimal Risk Level (MRL)

An *MRL* is defined as an estimate of daily human exposure to a substance that is likely to be without an appreciable risk of adverse effects (noncancer) over a specified duration of exposure. *MRLs* are derived when reliable and sufficient data exist to identify the target organ(s) of effect or the most sensitive health effect(s) for a specific duration via a given route of exposure. *MRLs* are based on noncancer health effects only. *MRLs* can be derived for acute, intermediate, and chronic duration exposures by the inhalation and oral routes.

National Priorities List (NPL)

The Environmental Protection Agency's (EPA) listing of sites that have undergone

preliminary assessment and site inspection to determine which locations pose immediate threat to persons living or working near the release. These sites are most in need of cleanup.

No Apparent Public Health Hazard

Sites where human exposure to contaminated media is occurring or has occurred in the past, but the exposure is below a level of health hazard.

No Public Health Hazard

Sites for which data indicate no current or past exposure or no potential for exposure and therefore no health hazard.

Plume

An area of chemicals in a particular medium, such as air or groundwater, moving away from its source in a long band or column. A *plume* can be a column of smoke from a chimney or chemicals moving with groundwater.

Potential/Indeterminate Public Health Hazard

Sites for which no conclusions about public health hazard can be made because data are lacking.

Potentially Exposed

The condition where valid information, usually analytical environmental data, indicates the presence of contaminant(s) of a public health concern in one or more environmental media contacting humans (i.e., air, drinking water, soil, food chain, surface water), and there is evidence that some of those persons have an identified route(s) of exposure (i.e., drinking contaminated water, breathing contaminated air, having contact with contaminated soil, or eating contaminated food).

Public Availability Session

An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.

Public Health Action

Designed to prevent exposures and/or to mitigate or prevent adverse health effects in populations living near hazardous waste sites or releases. Public health actions can be identified from information developed in public health advisories, public health assessments, and health consultations. These actions include recommending the dissociation (separation) of individuals from exposures (for example, by providing an alternative water supply),

conducting biologic indicators of exposure studies to assess exposure, and providing health education for health care providers and community members.

Public Health Assessment

The evaluation of data and information on the release of hazardous substances into the environment in order to assess any current or future impact on public health, develop health advisories or other recommendations, and identify studies or actions needed to evaluate and mitigate or prevent human health effects; also, the document resulting from that evaluation.

Public Health Hazard

Sites that pose a public health hazard as the result of long-term exposures to hazardous substances.

Route of Exposure

The way in which a person may contact a chemical substance. For example, drinking (ingestion) and bathing (skin contact) are two different *routes of exposure* to contaminants that may be found in water.

Superfund

Another name for the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), which created ATSDR.

Volatile organic compounds (VOCs)

Substances containing carbon and different proportions of other elements such as hydrogen, oxygen, fluorine, chlorine, bromine, sulfur, or nitrogen; these substances easily become vapors or gases. A significant number of the *VOCs* are commonly used as solvents (paint thinners, lacquer thinner, degreasers, and dry cleaning fluids).

APPENDIX B: Population and Housing Data; Census Tract Map

POPULATION DATA TABLE
George Air Force Base, San Bernardino County

	George AFB	Adelanto	Victorville
Total persons	5,085	8,517	40,674
Total area, square miles	2.78	36.88	41.83
Persons per square mile	1,832	231	972
% Male	57.8	50.3	50.0
% Female	42.2	49.7	50.0
% White	70.5	70.8	73.1
% Black	16.1	14.0	9.6
% American Indian, Eskimo, or Aleut	0.8	1.5	1.1
% Asian or Pacific Islander	8.7	4.2	3.7
% Other races	3.9	9.5	12.6
% Hispanic origin	8.8	17.3	23.0
% Under age 10	25.0	25.5	19.7
% Age 65 and older	0.1	5.3	11.6

Source: Census of Population and Housing, 1990: Summary Tape File 1A (California) [machine-readable data files]. Prepared by the Bureau of the Census. Washington, DC: The Bureau [producer and distributor], 1991.

HOUSING DATA TABLE
George Air Force Base, San Bernardino County

	George AFB	Adelanto	Victorville
Households*	1,132	2,881	14,241
Persons per household	3.67	2.96	2.83
% Households owner-occupied	0.2	30.3	60.8
% Households renter-occupied	99.8	69.7	39.2
% Households mobile homes	0.0	14.0	11.9
% Persons in group quarters	18.3	0.0	1.0
Median value, owner-occupied households, $	55,000	70,400	102,800
Median rent paid, renter-occupied households, $	432	370	443

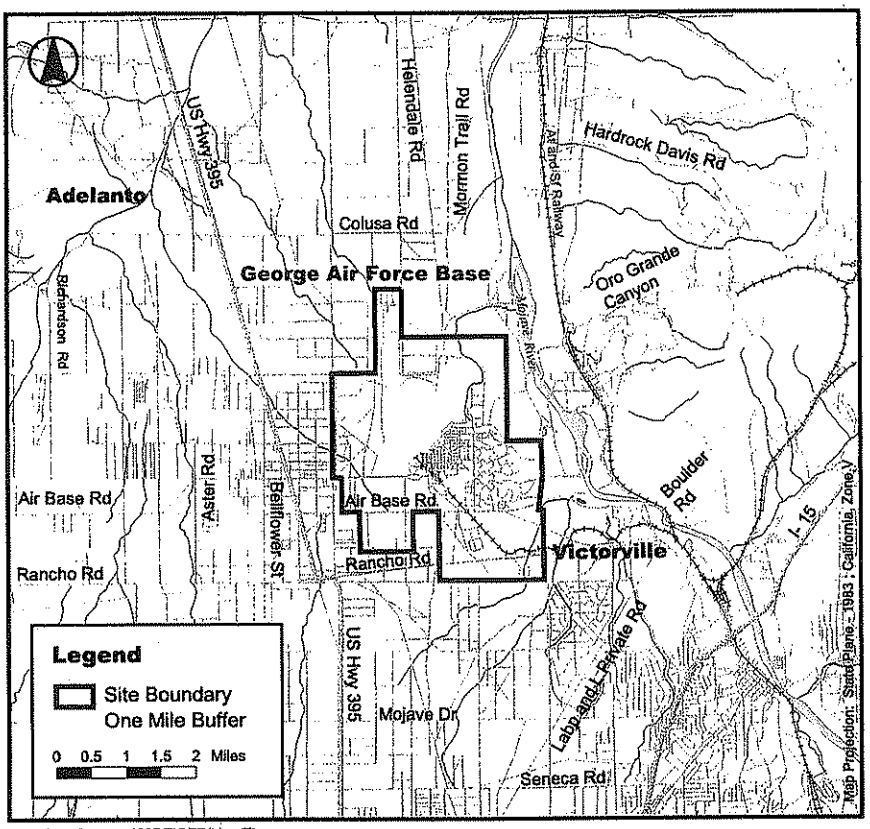
* A household is an occupied housing unit, but does not include group quarters such as military barracks, prisons, and college dormitories.

Source: Census of Population and Housing, 1990: Summary Tape File 1A (California) [machine-readable data files]. Prepared by the Bureau of the Census. Washington, DC: The Bureau [producer and distributor], 1991.

George Air Force Base

Victorville, California

CERCLIS No. CA2570024453

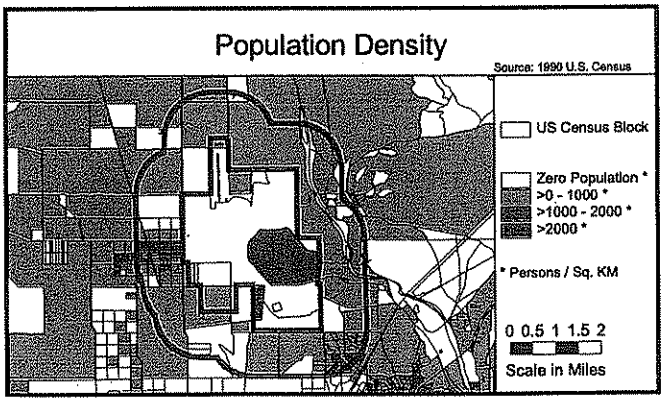


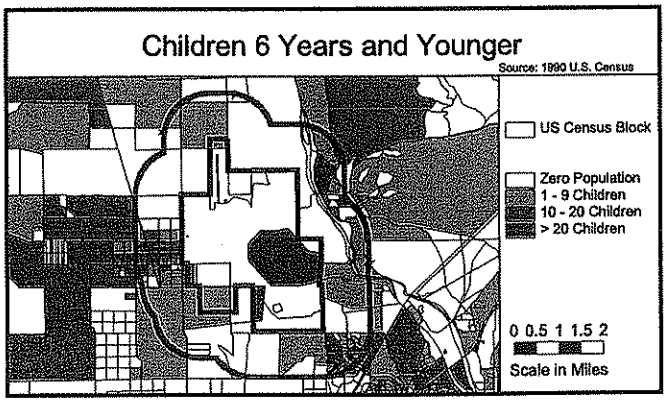
Base Map Source: 1995 TIGER/Line Files

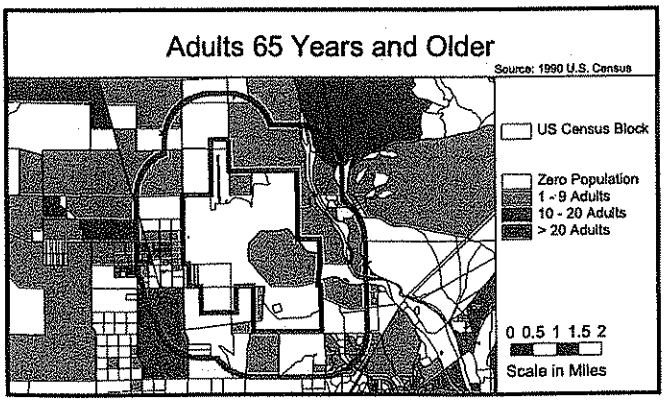
San Bernardino County, California

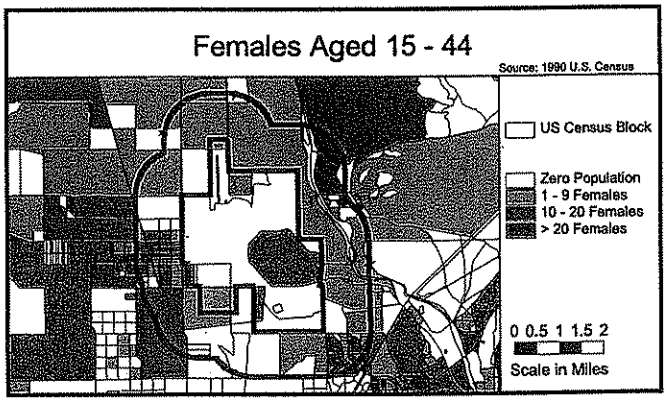
Demographic Statistics Within One Mile of Site*	
Total Population	11719
White	8195
Black	1784
American Indian, Eskimo, Aleut	118
Asian or Pacific Islander	794
Other Race	822
Hispanic Origin	1573
Children Aged 6 and Younger	2286
Adults Aged 65 and Older	282
Females Aged 15 - 44	3066
Total Housing Units	3632

Demographics Statistics Source: 1990 U.S. Census
*Calculated using an area-proportion spatial analysis technique









JVA063098

APPENDIX C: ATSDR's Comparison Values

The conclusion that a contaminant exceeds the comparison value does not mean that it will cause adverse health effects. Comparison values represent media-specific contaminant concentrations that are used to select contaminants for further evaluation to determine the possibility of adverse public health effects.

Cancer Risk Evaluation Guides (CREGs)

CREGs are estimated contaminant concentrations that would be expected to cause no more than once excess cancer in a million (10^{-6}) persons exposed over a lifetime. ATSDR's CREGs are calculated from EPA's cancer potency factors.

Environmental Media Evaluation Guides (EMEGs)

EMEGs are based on ATSDR minimal risk levels (MRLs) and factors in body weight and ingestion rates. An EMEG is an estimate of daily human exposure to a chemical (in mg/kg/day) that is likely to be without noncarcinogenic health effects over a specified duration of exposure.

Maximum Contaminant Level (MCL)

The MCL is the drinking water standard established by EPA. It is the maximum permissible level of a contaminant in water that is delivered to the free-flowing outlet. MCLs are considered protective of public health over a lifetime (70 years) for people consuming 2 liters of water per day.

Reference Media Evaluation Guides (RMEGs)

ATSDR derives RMEGs from EPA's oral reference doses. The RMEG represents the concentration in water or soil at which daily human exposure is unlikely to result in adverse noncarcinogenic effects.

APPENDIX D: Public Comments on the Public Health Assessment

The George AFB public health assessment was available for public review and comment from September 11, 1998 through October 11, 1998. The public comment period was announced in a press release dated September 4, 1998. Copies of the public health assessment were made available for review at the Adelanto and Victorville branches of the San Bernardino County Public Library and at the George AFB Library. The public health assessment was also sent to state and federal agencies and interested members of the general public.

A total of two agencies supplied written comments. The specific comments that were received either identified new information or suggested additions or corrections to the text to improve the clarity, completeness, or accuracy of a sentence or a paragraph. A summary of the comments and ATSDR's response is given below:

1. **Comment:** The JP-4 free product estimate has recently been revised from 350,000 - 400,000 to 750,000 - 800,000 gallons.

Response: The text was updated on pages 1, 7, and 18.

2. **Comment:** EPA does not agree that the OU-2 plume shows little or no migration. George AFB has agreed to put in additional monitoring wells to better define the plume.

Response: The text was updated to reflect these new developments. Unless data are developed that indicates the OU-2 plume is potentially endangering nearby drinking water wells, the public health evaluation of the OU-2 plume is not changed by this information.

3. **Comment:** The EPA is not satisfied that the OU-1 pump and treat system is not fully meeting the objective for that system for TCE removal in the upper aquifer and hydraulic control in the lower aquifer. George AFB is taking steps to optimize the operation of the pump and treat system and additional data may be needed.

Response: The text was revised to reflect these activities. Given that the character and migration of the OU-1 plume is monitored and there are no potential points of human exposure to the contaminants of this plume in close proximity, continued monitoring and regulatory oversight and controls will preclude a future potential pathway of human exposure to site contaminants at levels that may result in harmful health effects.

4. **Comment:** The EPA disagrees, on several grounds, that the JP-4 plume can be successfully cleaned-up natural attenuation within 50 years. EPA has requested that George AFB perform a soil vapor extraction pilot project to evaluate active source removal.

Response: The text has been modified to reflect these changes. As stated in response to Comment 2 above, the present information does not warrant a change in the public health evaluation of this plume and its public health implications.

5. **Comment:** Both the EPA and George Air Force Base supplied additional information and/or clarification regarding the pesticide rinsate pit (Site OT-62). Both agencies confirmed that when the site was investigated, the pit was found to be free of cracks or seams and that records indicated that rinsate water had been placed directly in the lined pit for evaporation. In 1992, all residual pit wastes were drummed and shipped to the Defense Reutilization and Marketing Office for proper disposal. Since no contamination or residue existed, the pit was determined to be a No Further Action site. The pit was then filled in and paved over with asphalt paving.

Response: Given the additional information and clarification, ATSDR has withdrawn its recommendation for sampling and further evaluation of Site OT-62. The text has been modified and corrected to reflect this additional information.