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Final

RECORD OF DECISION
OPERABLE UNIT 6
HILL AIR FORCE BASE, UTAH

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August 1997

RECORD OF DECISION

FOR OPERABLE UNIT 6

HILL AIR FORCE BASE, UTAH

This is a primary document for Operable Unit 6 at Hill Air Force Base. It will be available in the Administrative Record, which will be maintained at the following locations:

Davis County Library
Central Branch
155 North Wasatch Drive
Layton, Utah 84041
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Hours:	Monday through Thursday	10:00 a.m. - 9:00 p.m.
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Environmental Management Directorate
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Building 5
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Hill AFB, Utah 84056-5137

Hours:	Monday through Friday	7:30 a.m. - 4:30 p.m.

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Submittal Date: 18 August 1997

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LIST OF ACRONYMS

AFB	Air Force Base
ARARs	Applicable or Relevant and Appropriate Requirements
BACT	Best Available Control Technology
bis	Below Land Surface
BRA	Baseline Risk Assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COCS	Chemicals of Concern
COPCs	Contaminant of Potential Concern
CPFs	Cancer Potency Factors
DCE	1,1-Dichloroethene
EE/CA	Engineering Evaluation/Cost Analysis
EPA	U.S. Environmental Protection Agency
FS	Feasibility Study
HI	Hazard Index
HQ	Hazard Quotient
IAS/SVE	In Situ Air Sparging/Soil Vapor Extraction
IWTP	Industrial Wastewater Treatment Plant
Kd	Distribution Coefficient
MAMS	Missile Assembly Maintenance and Storage (area)
MCL	Maximum Contaminant Level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NDCSD	North Davis County Sewer District
NPL	National Priorities List
PAHs	Polynucleararomatic Hydrocarbons
PA/SI	Preliminary Assessment/Site Investigation
PCBs	Polychlorinated Biphenyls
POTW	Publicly Owned Treatment Works
OU	Operable Unit
R	Retardation Factor
RAOs	Remedial Action Objectives
RFCs	Reference Concentrations
RfDs	Reference Doses
RI	Remedial Investigation
RMEs	Reasonable Maximum Exposures
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SFs	Slope Factors
TCA	1,1,1-Trichloroethane
TCE	Trichloroethene
TSCA	Toxic Substances Control Act
UDEQ	Utah Department of Environmental Quality
UPDES	Utah Pollutant Discharge Elimination System
USAF	U.S. Air Force
UST	Underground Storage Tank
UVB	Vacuum Vaporizing Well
VOCS	Volatile Organic Compounds

DECLARATION FOR THE RECORD OF DECISION

Site Name and Location

Operable Unit 6
Hill Air Force Base
Weber County, Utah

Statement of Basis and Purpose

This decision document presents the selected remedy for Operable Unit 6 (OU 6) at Hill Air Force Base (Hill AFB), Utah. It was selected in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the Administrative Record for this site.

The State of Utah concurs with the selected remedy.

Assessment of the Site

Actual or threatened releases of hazardous substances from the site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

Description of the Selected Remedy

The selected remedy for OU 6 (IRP Sites ST022, OT026, and SD40B) is part of a Basewide effort to clean up contaminated groundwater, surface water, and soil. At Hill AFB, there are nine OUs, all of which are in different stages of investigation or cleanup. IRP Sites ST022 and OT026 represent Building 1915 and the Asphalt Pad Area, respectively. Because of their proximity, they were combined to form OU 6. Operable Unit 6 includes the geographical area associated with the 1900 and 2000 series buildings on Base, as well as adjacent off-Base areas, including portions of the Craigdale and Farr Subdivisions of the City of Riverdale, Utah. Other features included in OU 6 are the Roy Gate Pond and a section of the Davis-Weber Canal.

The selected remedy addresses groundwater contamination in on- and off-Base areas to reduce concentrations of contaminants and prevent further expansion of the contaminant plume. It also addresses contaminants in the subsurface soil.

The selected remedy includes the following components:

- Continued operation of the off-Base pump-and-treat groundwater remediation system;
- Collect and treat water from contaminated seeps/springs and discharge to storm sewer;
- Collect and treat water from spring U6-303 and Cooley's Pond and discharge to shallow aquifer;
- Continued provision of alternate water supplies;
- A pump-and-treat system for the on-Base portion of the east groundwater contaminant Plume;
- Discharge options for the pump-and-treat system include injection wells, infiltration fields, and discharge to publicly owned treatment works (POTW);
- Natural attenuation for the west groundwater contaminant Plume;
- A groundwater monitoring program; and
- Institutional controls.

A remedial goal of 5 micrograms per liter (Ig/L) for trichloroethene (TCE) in groundwater, seeps and springs, and Cooley's Pond will achieve acceptable risk levels and will also meet the maximum contaminant level (MCL) for TCE under the Safe Drinking Water Act.

Polychlorinated biphenyl (PCB) contamination of surface soils at the electrical transformer substation at Building 2501, discovered during the OU 6 remedial investigation (RI), is being addressed under the Toxic Substances Control Act (TSCA).

The Building 1946 evaporation pond (IRP Site SD40B), investigated as part of OU 6, has been found to pose insignificant risks to human health and the environment. No further action is needed for this site.

Statutory Determinations

The selected remedy is protective of human health and the environment, complies with federal and State of Utah requirements that are legally applicable or relevant and appropriate requirements (ARARs) to the remedial action, and is cost effective.

This remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable for this site and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element. Because this remedy will result in hazardous substances remaining on site above health-based levels, a review will be conducted within five years after commencement of remedial actions to ensure that the remedy continues to protect human health and the environment.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

<IMG SRC 97197AB>

STATE OF UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

<IMG SRC 97197AC>

HILL AIR FORCE BASE, UTAH

DECISION SUMMARY

Section 1
SITE NAME, LOCATION, AND DESCRIPTION

Hill Air Force Base (Hill AFB) is located in northern Utah, approximately 25 miles north of Salt Lake City and about 5 miles south of Ogden. Hill AFB occupies approximately 6700 acres in Davis and Weber counties. The Base is bounded on the west by Interstate 15, on the south by State Route 193, and on the northeast by the Weber River Valley (Figure 1-1). The Base is located on a prominent terrace known as the Weber Delta.

Operable Unit 6 (OU 6), one of nine OUs at Hill AFB, is located entirely within Weber County. As is shown in Figure 1-2, OU 6 includes; buildings and adjacent land in the 1900 and 2000 areas, as well as portions of the Craigdale and Farr subdivisions of the City of Riverdale, Utah. The 2000 area, along with buildings in the 2100 and 2200 areas, comprises a security area known as the MAMS-2 (Missile Assembly Maintenance and Storage) area. The on-Base buildings within OU 6 are occupied and operated by the Silo-Based ICBM Program Office. Other prominent features within the site are the Waste Asphalt Pile, the Roy Gate Pond, and a portion of the Davis-Weber Canal.

Separating the on-Base portion of OU 6 from the off-Base portion is a steep, terraced, north-facing escarpment that forms the south wall of the Weber River Valley. There is over 200 ft of relief between Hill AFB and the valley below. The land surface in the on-Base portion of OU 6 and in the Craigdale and Farr subdivisions is generally level.

The Davis-Weber Canal is located off Base (Figure 1-1) and is situated about one-third of the way down the escarpment. It is a privately owned irrigation canal that supplies water diverted from the Weber River from mid-April to mid-October. The canal is concrete lined, but contains several visible cracks in the stretch passing through the site. Continuous monitoring of spring flow volume in the Craigdale Subdivision indicates the canal is not leaking appreciably in the OU 6 area. Testing activities adjacent to the canal have shown the shallow groundwater level to be about 80 ft below land surface (bls), or about 75 ft below the canal bottom.

Land use on Base at OU 6 is military industrial and immediately off Base is mostly residential with some agricultural use. There are no hospitals, retirement or nursing homes, schools, nurseries, or daycare centers currently located within OU 6. The nearest daycare or school is 1.3 miles from contamination associated with the site.

It is approximately 1,600 ft from the suspected groundwater plume source area at OU 6 to the Base boundary (traveling along the line of the groundwater plume) and approximately 2,000 ft from the source area to the nearest off-Base residence. Currently, the off-Base portion of the groundwater contaminant plume underlies more than 30 private residences in the community of Riverdale.

Municipal water for the City of Riverdale is supplied by the Weber Basin Conservancy District. The district provides water from wells that tap deep aquifers that are unaffected by contaminants associated with OU 6. Shallow groundwater is not currently used as a source of drinking water in the area, but is used for lawn and garden irrigation and livestock and pet watering by some of the off-Base residents.

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Land within OU 6 is not located within the 100-year floodplain. There are no jurisdictional wetlands, as regulated by the U.S. Army Corps of Engineers, within OU 6. Apart from deeper groundwater for drinking water, there are no uses or known occurrences of commercially valuable natural resources within the OU 6 area.

Section 2
SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.1 History of Site Activities

The mission of Hill AFB has generally centered on the maintenance and management of aircraft and missiles assembly. There we many on-Base industrial facilities that support aircraft, missile, vehicle, and railroad engine maintenance and repair operations. These industrial operations use numerous chemicals, including solvents and degreasers, fuels, acids, bases, and metals. Historically, these chemicals and their associated waste products were disposed of at the Base Industrial Wastewater Treatment Plant (IWTP), in chemical disposal pits, in waste disposal ponds, or in landfills.

Most of the on-Base buildings within the OU 6 site have had a varied history of maintenance and testing operations or of playing a support role (e.g., storage) for these operations. These operations used various solvents for cleaning purposes and fuels for testing purposes. Underground storage tanks (USTs) and associated piping that contained solvents may have leaked and contaminated the soil and groundwater. The specific cause of the release of solvents to the environment is not known.

2.2 Enforcement Activities

In 1987, the U.S. Environmental Protection Agency (EPA) placed Hill AFB on the National Priorities List (NPL) under CERCLA. On April 10, 1991, Hill AFB entered into a Federal Facilities Agreement with the Utah Department of Environmental Quality (UDEQ) and the EPA to establish a procedural framework and schedule for developing, implementing, and monitoring appropriate response actions at the site in accordance with existing regulations.

Prior response actions taken by Hill AFB to prevent exposure to contamination associated with the OU 6 site include the following:

- Providing an alternate source of clean irrigation water to two homes known to be affected by shallow groundwater contamination.
- Collecting and treating contaminated water from springs and field drains. The treated water is discharged to a storm sewer.
- Extracting and treating contaminated groundwater in the off-Base area as part of a removal action described in the Action Memorandum (Radian, 1996a).

The provision of alternate water supplies and collecting and treating contaminated water from springs and field drains were actions taken as part of a Basewide removal to address such releases.

2.3 Investigation History

During 1998, investigative activities began in the area now designated as OU 6 when the U.S. Air Force (USAF) conducted water sampling in the Craigdale subdivision area. This sampling discovered chlorinated solvents (primarily trichloroethene, or TCE) in shallow groundwater and surface water. On the basis of the suspected direction of shallow groundwater flow through the area, Hill AFB began investigative activities in the northern portion of the Base to determine the source of the contamination.

These subsequent investigative activities were performed under a Preliminary Assessment/Site Investigation (PA/SI), and the findings suggested locations within Hill AFB were the source of the contamination found in the off-Base water. However, detected concentrations of volatile organic compounds (VOCs) in water were lower on Base than off Base, and insufficient data were available to determine the lateral or vertical extent of contamination.

Following the PA/SI, remedial investigation (RI) activities were conducted to further characterize the extent of contamination in unsaturated and saturated soil zones, the seeps, springs, and canal, and to evaluate potential downgradient receptors, aquifer properties, and transport pathways. The Work is documented in the Remedial Investigation Report (RI) (Radian, 1995b).

The Baseline Risk Assessment Report (BRA) for OU 6, which evaluated the potential human health and environmental effects caused by chemicals at the site, was released to the public in April 1995 (Radian, 1995a). The Feasibility Study Report (FS) for OU 6, which identified and evaluated remedial action alternatives, was released to the public in September 1996 (Radian, 1996b).

At the request of Hill AFB in March 1994, the Agency for Toxic Substances and Disease Registry (ATSDR) commented on the public health implications of contaminants at OU 6. Their health consultation was based on a review of site-related records and reports, interviews with Base personnel and off-Base residents, and two site visits. The conclusions of their evaluation were:

- VOCs are not present in the air in OU 6 at levels which represent a health threat;
- VOCs are not present in groundwater or spring water at levels which represent a health threat for people who occasionally contact the water or use it for irrigation; and
- VOCs will not bioaccumulate in fruits or vegetables grown in OU 6 at levels which represent a health threat.

2.4 Highlights of Community Participation

The public participation requirements of CERCLA Sections 113(k)(2)(B)(i-iv) and 117 were met for the remedy selection process. Hill AFB has a Community Relations Plan, which was finalized in February 1992. Specific to OU 6, meetings were held with the public to discuss the findings of the RI and the proposed removal action.

The Proposed Plan for OU 6 (Radian 1996c) was released to the public on November 15, 1996, for public comment and was mailed to federal, state, and local agencies, and the Administrative Record repositories. All documents of the RI/FS, as they were finalized, were placed in the Administrative Record, located at the Directorate of Environmental Management at Hill AFB and at the Central Branch of the Davis County Library in Layton, Utah.

The notice of availability of the Proposed Plan was announced in the Salt Lake Tribune, Ogden Standard Examiner, Hilltop Times, and Deseret News, in mid-November 1996. A public comment period was held from November 15 to December 16, 1996. No written comments on the Proposed Plan were received during the public comment period.

A public meeting in open-house format was held on December 11, 1996 at the Riverdale Mobile Estates Clubhouse. All interested parties on the Hill AFB mailing list which includes affected residents, were notified in writing about the session. The purpose of the open house was to answer questions and accept comments about the remedial alternatives presented in the Proposed Plan, including the preferred remedial alternative for the site, and other topics relevant to OU 6 in an informal setting. No formal comments were made during the open house.

2.5 Scope and Role of Operable Unit 6 Within Site Strategy

Response actions at Hill AFB are structured into nine OUs; most of them, including OU 6, are geographically defined and address all contaminated media within each unit. Remedial actions are addressed separately for each OU, and each of the OUs are at different stages of investigation or remediation.

The selected remedy for OU 6 incorporates or builds on prior response actions described in Section 2.2 that will continue as part of this remedy. Extraction and treatment of groundwater in the off- and on-Base areas will reduce concentrations of contaminants, and hydraulic controls will prevent further expansion of the contaminant plume. Subsurface soil contamination will be addressed by institutional controls. Collection and treatment of contaminated springs and field drains and the provision of alternate water supplies will continue.

Section 3
SUMMARY OF SITE CHARACTERISTICS

3.1 Topography and Hydrogeology

OU 6 is located in and adjacent to the northernmost portion of Hill AFB. The topography is relatively flat in the on-Base portion of OU 6, dropping steeply to the northeast in the direction of the City of Riverdale to form a steep hillside.

The OU 6 site overlies two deeper confined aquifers. The Sunset and Delta aquifers are generally first encountered about 200 and 300 ft below land surface (bls), respectively. Municipal groundwater supplies in the area are obtained from these aquifer systems. It is unclear if the Sunset and Delta are separate aquifer systems beneath OU 6. Both aquifers are Class IIA aquifers under EPA's groundwater quality classification system. Under the State of Utah, the Delta aquifer is classified as a Class IA-Pristine Ground Water aquifer, and the Sunset Aquifer as a Class II-Drinking Water Quality aquifer. Natural regional flow directions for these aquifers is westward.

Under OU 6, the uppermost shallow (unnamed) aquifer is first encountered at depths ranging from about 50 to 100 ft in the on-Base area, and at about 6 to 12 ft in the off-Base area. Groundwater flow in the shallow system is north to northeast. Because the extent of the shallow aquifer at OU 6 is probably relatively limited and them are no known users of the water for drinking water purposes, it would probably be classified as an EPA Class IIB aquifer and as a Class II under the State of Utah classification.

The major sources of groundwater recharge consist of infiltration of precipitation and seepage from streams and irrigated areas. Shallow groundwater generally flows from the recharge areas along the mountain front and on top of the plateau (on which Hill AFB is located) downslope to the north and east toward the Weber River Valley. As the shallow groundwater underlying the plateau migrates toward the Weber River, seeps and springs often emanate along the lower portion of the steep escarpment formed from the downcutting of the plateau by the Weber River. These are probably depression springs, resulting where the water table intersects the land surface.

3.2 Nature and Extent of Contamination

Environmental samples were taken from soil, sediment, groundwater, surface water, and air at the site during the RI. The chemical contaminants detected in these media are primarily chlorinated VOCs, with TCE being the most prevalent.

3.2.1 Groundwater

As shown in Figure 3-1, there are two groundwater contaminant plumes at the OU 6 site which represent TCE in groundwater. TCE is by far the most widespread and concentrated contaminant in both plumes. These plumes are confined to the shallow aquifer where there are no known users of the groundwater for domestic purposes. A comprehensive survey determined that non-municipal water is used for vegetable garden, fruit tree, lawn irrigation and livestock and pet watering. TCE and methylene chloride are the only contaminants which have been found at concentrations in excess of their respective maximum contaminant levels (MCLs) for drinking water. The highest concentration for methylene chloride has been 7 micrograms per liter (Ig/L), but all results above the MCL (5 Ig/L) have been unreproducible. Test well U6-23, adjacent to the Davis-Weber Canal (Figure 3-1), had the 7 Ig/L detection in the April 1993 sampling event, but concentrations have been below 5 Ig/L in the subsequent eight semiannual sampling events.

The larger groundwater plume to the east, which covers approximately 22 acres on Base and 16 acres off Base, is generally first encountered at about 80 to 100 ft bls in the on-Base area and 5 to 10 ft bls in the residential portion of the off-Base area. The groundwater surfaces as springs at some locations along the escarpment. The total volume of groundwater with TCE concentrations above the MCL of 5 Ig/L is estimated at 61 million gallons for the east plume.

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In this plume, TCE concentrations in the on- and off-Base groundwater we comparable; the high concentrations detected through test well sampling are 321 Ig/L on Base and 329 Ig/L off Base (near the Davis-Weber Canal). The highest concentration detected from test wells in the Craigdale subdivision is 187 Ig/L.

The western plume is smaller, contains lower concentrations of TCE, generally occurs a little over 100 ft bls, and is entirely within the Base boundary. The surface area of this plume is approximately 6 acres, the highest TCE concentration detected to date is 63 Ig/L, and it is estimated to contain 5 million gal. of groundwater exceeding the MCL.

The shape of the groundwater contaminant plumes at the site are based to a large degree on the lithologic variations in the subsurface. The plumes are traveling in a primarily sand matrix, with finer-grained silts and clays limiting lateral and vertical contaminant migration. Vertical contaminant distribution profiling has shown decreased concentrations with depth through the shallow aquifer, and no contaminants in the silt and clay confining strata underlying the aquifer. Hydrogeologic cross section A-A' (Figure 3-2), which is oriented northwest to southeast along the Base boundary (see Figure 3-1 for location), shows the vertical distribution of TCE in this area. Note that the contamination is generally found in the 105 to 135 ft bls interval, and concentrations decrease with depth.

Monitoring of basement air in 17 homes in the Craigdale subdivision detected several chlorinated VOCs, including TCE, chloroform, and 1,1,1-trichloroethane (TCA), that may be associated with the groundwater contamination.

3.2.2 Springs, Field Drains, and Surface Water

Three significant springs or field drains exist at OU 6. These consist of a spring referred to as U6-303, which discharges into an off-Base pond (Cooley's Pond), as well as field drains U6-603/604 and U6-606 (see Figure 3-1). Groundwater, springs, and field drains at OU 6 are hydraulically connected; therefore, springs and field drains that occur within or near the groundwater plume area as well as Cooley's Pond contain contaminants. However, in comparison with the surrounding groundwater, the contaminated springs and field drains and Cooley's Pond contain fewer contaminants and concentrations are generally lower. Field drains U6-606 and U6-603/604 lie outside the defined groundwater plume, while spring U6-303 and Cooley's Pond occur within the groundwater plume. The four volatile organic compounds (VOCs) which have been detected in the springs and their maximum detected concentrations (in parentheses) are TCE (180

Ig/L), chloroform (3 Ig/L), 1,1,1-TCA (2.5 Ig/L), and cis-1,2-dichloroethene (2.1 Ig/L).

Sediment samples collected from Roy Gate Pond and the off-Base pond did not contain significant contaminant levels. Groundwater is about 75 ft below the Davis-Weber Canal; therefore, there is no potential for groundwater to contaminate the water in the canal.

3.2.3 Surface Soil

Chemicals detected in surface soil (soil depths of 0 to 2 ft bls) include pesticides, polynuclear aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs). Except for PCBs, these contaminants have been found in random locations following no discernible pattern. PCB contamination of surface soils is confined to the electrical transformer substation at Building 2501 (see Figure 1-2), where detected concentrations range from less than 1 part per million (ppm) to 34 ppm. PCBs at the active substation are being addressed under the Toxic Substances Control Act (TSCA); therefore, PCBs were removed from further consideration in the CERCLA process for OU 6.

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3.2.4 Subsurface Soil

Although soil was sampled throughout both the on- and off-Base areas, contaminated soil was found only in the on-Base area of OU 6. Contaminated subsurface soil (soil depths greater than 2 ft bls) exists in one location in the vicinity of the 2000 area. The subsurface soil near the location of two former USTs located near test well U6-6 (see Figure 3-1) contains chlorinated VOCs-primarily TCE, TCA, and 1,1-dichloroethene (1,1-DCE); other VOCs such as ethylbenzene and xylene; and "unidentified organic compounds" which may be constituents of stoddard solvent. The occurrence of organic compounds appears to be limited to depths of 10 to 22 ft bls, with the interval from 18 to 22 ft bls containing the highest concentration. The highest concentrations of TCE and 1,1-DCE detected in the subsurface soil are 0.467 milligrams per kilogram (mg/kg) and 0.439 mg/kg, respectively. The maximum concentration of what is believed to be stoddard solvent is 4660 mg/kg.

3.3 Contaminant Fate and Transport

Populations and environmental receptors that could be affected, if exposed, include Hill AFB personnel, off-Base residents, future on-Base residents, and plants and animals in the vicinity. The OU 6 conceptual model provided as Figure 3-3 illustrates some of the contaminant fate and transport principles. Some of the more important things to note from the model are the residential nature of the off-Base area and the depths to groundwater in the on- and off-Base areas.

3.3.1 Fate

Chlorinated VOCs are most likely to partition to air, followed by groundwater and soil, and are least persistent in surface water. After migrating to the air phase, they are usually quickly dispersed and degraded, except for areas with limited ventilation such as basements. The partitioning between groundwater and soil of remaining VOCs can be highly variable, depending on the soil type. In general, clays more readily sorb chlorinated VOCs and thus leave fewer contaminants to partition to the water phase. In a principally sandy matrix, such as the shallow aquifer at OU 6, the majority of contaminants are found in the water phase. In surface water chlorinated VOCs tend to readily volatilize to the air because of the large area for water-air contact, particularly in turbulent flowing streams with little vegetative cover. At OU 6, relatively low levels of TCE have been found in suspected source area soils, suggesting volatilization and/or degradation processes have removed a large portion of the original source. Modeling has indicated that the TCE and 1,1-DCE present in subsurface soil at OU 6 will not reach the groundwater at concentrations that exceed the MCLs. The consistent TCE concentrations over a large portion of the groundwater plume, coupled with the general absence of degradation products, suggest that TCE is very persistent in the OU 6 shallow aquifer environment.

3.3.2 Transport

Mechanisms for contaminant transport at OU 6 include groundwater advection, surface runoff, volatilization, and infiltration. Each of these mechanisms is shown on the conceptual model, Figure 3-3.

Groundwater advection has resulted in the transport of VOCs into off-Base areas. Testing performed in the contaminated portion of the shallow aquifer at the site has resulted in an estimate of the average travel rate for groundwater of one-third foot per day. Also, desorption tests performed with aquifer materials from the on- and off-Base portions of the contaminated aquifer resulted in estimates for the distribution coefficient (Kd) of TCE, which is an indicator of whether the contaminant will remain in soil or travel with the groundwater. The Kd was then used to determine the retardation factor (R), which provides an indication of contaminant migration retardation relative to natural groundwater flow. The R for the shallow aquifer materials at OU 6 indicates the contaminant plume front would be expected to migrate at about 60% of the rate of advective groundwater flow.

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Groundwater advection has in turn resulted in the contamination of seeps and springs and when combined with the volatilization mechanism, also has contributed to the presence of VOCs in indoor basement air. Modeling has indicated that VOCs in the subsurface soil will not leach to the groundwater in concentrations that will exceed the MCLs. Also, other chemicals detected in surface soils at the site, such as PAHs and pesticides, are not likely to volatilize appreciably or leach to the groundwater. These contaminants tend to adhere to soil particles in the surface soil; however, they may be transported via fugitive dust or surface water runoff.

3.3.3 Exposure Potential

Current on-Base land use at OU 6 is restricted to buildings involved in maintenance and testing operations. Shallow groundwater in the area is not used as a domestic water source, edible plants are not cultivated, and the area is not subject to cattle grazing. Because of the depth of contamination, there is little potential for exposure to contaminated soil. Therefore, current exposures to site-related contamination within the OU 6 on-Base area are not anticipated.

Current land use in off-Base areas is mostly residential with some agricultural use. Off-Base residents rely on municipal water for their domestic supply. Shallow groundwater is not used as a source of drinking water in the area, but has been used for lawn and garden irrigation and pet and livestock watering. There are no contaminated soils located off Base. The most likely current exposure to contaminants would be via inhalation of VOCs migrating upward from the shallow aquifer.

Effects of exposures to nearby ecosystems are expected to be minimal. Details regarding the population and environmental receptors that could be affected are discussed in Section 4, which summarizes the findings of the human health and environmental assessments.

Section 4
SUMMARY OF SITE RISKS

A BRA (Radian, 1995a) was prepared for OU 6 to evaluate potential health and environmental effects caused by actual or potential releases of and exposure to OU 6-related chemicals under current and hypothetical future conditions. The risk assessment identifies the contaminants of potential concern (COPCs), current and future exposure pathways for humans and environmental receptors, and the probability of adverse effects resulting from exposure. The four basic components of the risk assessment are summarized in this section: identification of chemicals of potential concern, exposure assessment, toxicity assessment, and risk characterization. Detailed descriptions of the risk assessment are available in the BRA.

4.1 Human Health Risks

4.1.1 Contaminants of Potential Concern

COPCs are "chemicals that are potentially site-related and whose data are of sufficient quality for use in the quantitative risk assessment" (EPA, 1989b). All data of acceptable quality from the RI were used to identify COPCs. Detailed descriptions of the screening and identification process and criteria are described in the risk assessment document. Criteria used to select COPCs followed EPA guidance. In addition, chemicals were screened against conservative risk-based-concentrations using calculated preliminary remediation goals for a residential exposure scenario.

Table 4-1 lists the media-specific COPCs and associated exposure concentration data used for risk characterization.

The COPC list was further refined into a list of chemicals of concern (COCs), which are chemicals that pose the greatest risk or exceed regulatory standards, and are shown below:

- Groundwater-TCE;
- Seeps and Springs-TCE; and
- Subsurface soil-1,1-DCE,

A detailed description of the process used to identify COCs is presented in the FS (Radian, 1996a).

4.1.2 Exposure Assessment

Exposure assessment is the determination or estimation of the magnitude, frequency, duration, and route of human and environmental exposures to COPCs present at or migrating from a site. Human exposure to COPCs from OU 6 was evaluated by performing the following tasks: 1)characterizing the potentially exposed population, 2) developing exposure scenarios, 3) identifying exposure pathways, and 4) quantifying exposures for each scenario.

4.1.2.1 Current Off-Base Residential Exposure Scenario

The current land use in the off-Base areas immediately northeast of the Hill AFB boundary consists of mostly residential homes and some small areas used for gardening and livestock grazing.

Pathways for both child and adult receptors include the following:

- Inhalation of volatile compounds from basement seepage;
- Ingestion of locally grown fruits and vegetables irrigated with contaminated ground water; and
- Ingestion of locally produced beef products from animals fed contaminated water or contaminated feed.

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The BRA (Radian, 1995a) used standard equations and assumptions in available EPA guidance to quantify chemical intake and documents all the equations and assumptions used.

4.1.2.2 Future Off-Base Residential Exposure Scenario

According to population demographics for Davis County, the population increased by 22% from 1980 to 1987 (146,540 to 179,000). Other areas near Hill AFB saw population increases; adjacent Weber County population experienced an 8.5% increase. The City of Ogden also experienced slight population growth.

The most likely future changes in land use in the area include increases in residential housing and decreasing agricultural activities. New residents will most likely be connected to the municipal water supply but could use shallow wells and drains for lawn and garden irrigation. New residents may elect to install shallow groundwater wells even though higher quality water is readily available from other sources (i.e., municipal sources and deeper aquifers).

Pathways for both child and adult receptors include the following:

- Inhalation of volatile compounds from basement seepage;
- Inhalation of volatile compounds while showering;
- Dermal contact with contaminated water while showering;
- Ingestion of contaminated drinking water,
- Ingestion of locally grown fruits and vegetables irrigated with contaminated ground water: and
- Ingestion of locally produced beef products from animals fed contaminated water or contaminated feed.

4.1.2.3 Future On-Base Residential Exposure Scenario

Residential development is not a likelihood in the on-Base areas of OU 6. However, to provide a conservative assessment of the potential risks associated with OU 6, health risks based on a future on-Base residential development were evaluated. The future potential exposure pathways associated with unrestricted, on-Base residential land use include the following:

- Inhalation of contaminated fugitive dust from the site;
- Inhalation of volatile compounds while showering;
- Dermal contact with contaminated water while showering;
- Dermal contact with and incidental ingestion of contaminated soils;
- Ingestion of contaminated drinking water;
- Ingestion of locally grown fruits and vegetables irrigated with contaminated ground water; and
- Ingestion of locally produced beef products from animals fed contaminated water or contaminated feed.

4.1.2.4 On-Base Worker Scenario

If development occurs at OU 6 in the absence of remediation, on-Base construction workers could be exposed to site-related chemicals. Exposure pathways affecting workers engaged in construction activities include the following:

- Inhalation of contaminated fugitive dust from the site;
- Inhalation of volatile compounds close to the source; and
- Dermal contact with and incidental ingestion of contaminated soils.

4.1.3 Toxicity Assessment

Contaminants may have carcinogenic (cancer-causing) effects or noncarcinogenic/systemic effects. Exposure to some of the chemicals detected at OU 6 could potentially result in both types of effects. For carcinogens, it is assumed any amount of exposure to a carcinogenic chemical poses a potential for generating a carcinogenic response in the exposed organism.

Noncarcinogenic or systemic effects include a variety of toxicological end points and may include effects on specific organs or systems, such as the kidney, liver, lungs, and others. Threshold levels generally exist for noncarcinogenic effects (i.e., a dose exceeding a certain level must be reached before health effects are observed). No adverse effects are assumed for doses below the threshold.

Cancer potency factors (CPFs), or slope factors (SFs), are used to provide conservative estimates of excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. SFs, which are expressed in units of (mg/kg-day) -1, are multiplied by the estimated intake of a potential carcinogen, in mg/kg-day, to provide an upper bound estimate of the excess lifetime cancer risk associated with exposure at the intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the SF. Use of this approach makes underestimation of the actual cancer risk unlikely. SFs are derived from the results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans).

Reference doses (RfDs) are used to indicate the potential for adverse health effects from exposure to chemicals causing noncarcinogenic effects. RfDs, which are expressed in units of mg/kg-day, are estimated threshold levels for daily exposure below which exposure is considered safe for humans, including sensitive individuals. Estimated intakes of COPCs from environmental media (e.g., the amount of a COPC ingested from contaminated drinking water) can be compared with the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied.

Toxicity values used in the health risk assessment are presented in Table 4-2. SFs and RfDs are specific to the route of exposure; for example, oral SFs are used to evaluate risk through ingestion of a carcinogenic COPC.

Most of the toxicity values in Table 4-2 were obtained from IRIS searches conducted in August, September, and October 1994 (EPA, 1994a) or from HEAST (EPA, 1994b). Carcinogenic values for some PAHs were also calculated using methods in provisional guidance for calculating the potential potency on the basis of values for benzo(a)pyrene (EPA, 1993). Table 4-2 does not list dermal toxicity values. The RfDs for most of the COPCs pertain to applied oral doses. To evaluate dermal exposures, oral toxicity values were used to derive dermal values initially using a default value of 5% for oral absorption, according to EPA guidance provided in RAGS Volume A, Appendix A (EPA, 1989b). For chemicals contributing significantly to risks using this conservative method, chemical-specific gastrointestinal absorption rates were identified and used to adjust oral toxicity values, also according to guidance in RAGS.

4.1.4 Summary of Risk Characterization

Carcinogenic and noncarcinogenic risks were calculated for each of the exposure pathways for the COPCs and compared with acceptable levels of risk. For each potentially carcinogenic COPC, the probability that an individual will develop cancer over a lifetime was estimated from projected intake levels and the cancer SF or the inhalation unit risk. Risks are probabilities that are generally expressed in exponential form. An excess lifetime cancer risk of 1 x 10 -6 indicates that an individual has a l-in-l million additional chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime under specific exposure conditions at OU 6.

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To address the range of exposures that may occur now and in the future, both average and reasonable maximum exposures (RMEs) were considered. Inclusion of both average and RME values allows risks to be estimated for the upper bound exposure situation and the more typical or average exposure. The resulting risk estimates then present a range of possible risks based on the range of possible exposure conditions.

The EPA Superfund site remediation goal set forth in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) allows a cancer risk of 10 -4 (1 in 10,000) to 10 -6 (1 in 1 million). This range is designed to be protective of human health. The cancer risk of 10 -6, based on reasonable maximum exposure, is the required point of departure for addressing risks. A cancer risk of 1 in 1 million is considered a de minimis level, or a level of negligible risk, for risk management decisions.

Table 4-3 summarizes the cancer risk estimates for each exposure scenario. The average and reasonable maximum risk estimates for the present off-Base beef consumer and the average risk estimates for the off-Base resident are below the Superfund site remediation threshold for cancer risk of 10 -6 (1 in 1 million).

Those exposure scenarios in Table 4-3 that had a risk greater than 10 -4 were the future off-Base resident (adult), and the future on-Base resident (age-adjusted and adult). These scenarios were then reviewed further and the contribution of individual contaminants to the total exposure scenario risk was determined. Table 4-4 details the contribution of all contaminants that individually contribute a risk greater than 10 -6 for these scenarios. The following contaminant/media combinations generally represent the vast majority (i.e., greater than 95%) of risk at this site: 1,1-DCE and TCE in water. Other contaminant/media combinations cumulatively contributing less than 5% of the risk include 1,1-DCE in subsurface soil, benzo(a)pyrene in surface soil, aldrin in surface soil, and chloroform in basement air 1,1-DCE, aldrin, benzo(a)pyrene, and chloroform were eliminated as COCs on the basis of the discussion below. For a more detailed discussion of these contaminants, see the FS (Radian, 1996a).

The RI results indicate that 1,1-DCE is not prevalent in the groundwater and that the low concentrations of this compound do not warrant remediation. This chemical has been detected in only one well and has not been detected in concentrations that exceed its MCL.

The aldrin detection which caused a risk greater than 10 -6 was in a sample collected from a well-maintained park area north of Building 1915. It is likely that aldrin was associated with former routine Base pesticide spraying and not with waste disposal activities at OU 6. The calculated risk from aldrin was slightly over 10 -6 and was determined using very conservative assumptions which overestimate the risk. Thus, aldrin was not considered to pose a risk significant enough to retain it as a COC.

Benzo(a)pyrene was detected in soils at levels which show a risk greater than 10 -6. Each location had a detection of benzo(a)pyrene in the surface or shallow soils, but no contaminants were found in soils deeper than 9 ft. Both locations are adjacent to roads. One is in an off-Base area along the dirt road adjacent to, and on the north side of the Davis-Weber Canal. The presence of benzo(a)pyrene at this location midway down the hillside is unlikely to be associated with operations on the Base. The other location is on Base in the 2000 area adjacent to an asphalt road. PAHs are often associated with the incomplete combustion of organic material (e.g., petroleum products), and are commonly found in vehicle exhaust and asphaltic road materials. Due to the common occurrence of this chemical near roads and the locations of the detections at OU 6, it was not retained as a COC or recommended for remediation.

Data on chloroform sampling and results indicates that occurrences of chloroform in groundwater are scattered and appear unrelated both to the VOC groundwater plume and to the detected concentrations in indoor air at off-Base locations. Additionally, the chloroform concentrations in basement air were below the nationwide background mean for chloroform in indoor air (Shah and Singh, 1988).

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To characterize the potential systemic effects of chemicals, comparisons were made between projected intakes of COPCs over a specified time and toxicity values, primarily oral and dermal RfDs and inhalation reference concentrations (RfCs). A hazard quotient (HQ), which is the ratio between exposure to a chemical and that chemical's toxicity value, was calculated for each COPC and exposure pathway. Chemical-specific HQs were then summed for each COPC and each pathway of exposure to calculate the total hazard index (HI) for each exposure scenario.

The HI is not a statistical probability of a systemic effect occurring. If the exposure level exceeds the appropriate toxicity value (i.e., the HQ is greater than 1), there may be cause for concern. The Superfund site remediation goal for noncarcinogens is a total HI of 1.

The BRA indicates that none of the hazard indices calculated for the potentially exposed populations exceeded 1.0; however, the separate analysis for "unidentified organic compounds" assumed to be stoddard solvent indicated a hazard index greater than 1.0 for a hypothetical future child exposure. This exposure would be possible only if contaminated soils 18 to 22 ft deep were brought to the surface (e.g., during excavation for a basement or home foundation), and were then part of the residential exposure scenario. Stoddard solvent was not detected in groundwater at the site. Furthermore, the hazard index for stoddard solvent was unconventionally derived using an unverified toxicity value. Complex organic mixtures like stoddard solvent are generally not amenable to evaluation by conventional toxicological methods the impact of using unverified toxicity values to unconventionally determine a hazard index is typically an overestimation of risk. Because of unlikely exposure and a probable overestimation of related risk, stoddard solvent was not included as a COC.

After reviewing risk-based, regulatory, and other considerations associated with identifying COCs, the following contaminant/media combinations warrant remediation and hence designation as COCs:

- Groundwater-TCE;
- Seeps and Springs-TCE; and
- Subsurface soil-1,1-DCE.

4.2 Environmental Evaluation

A qualitative ecological risk assessment was performed as part of the BRA (Radian, 1995a) that evaluated the adverse effects on ecological receptors at OU 6. No areas at OU 6 have been classified as critical habitats for endangered species; currently, no threatened or endangered species included on current lists of endangered and threatened wildlife and plants are full-time residents of the Base. Although no threatened or endangered species reside on Base, two endangered species, bald eagles and peregrine falcons, reside nearby. The BRA concluded that no significant accumulation of chemicals should occur in animals at the site because of the contaminants at OU 6.

4.3 Uncertainty Analysis

Uncertainty is inherent to the risk assessment process. The uncertainty analysis identifies key uncertainties so that a level of confidence in the cancer and noncancer risk estimates can be considered when risk management decisions are made. Table 4-5 summarizes uncertainties associated with the risk assessment for OU 6.

Table 4-5
Summary of Uncertainties

Condition Assumption	Source of Uncertainty	Quantitative Effect	Impact on Risk Characterization
Physical Setting/Potentially Exposed Populations			
On-Base residential land use	Use of default assumption	Overestimates risk	Removal of condition would make risks from on-Base surface soils negligible.
Residential use of shallow groundwater	Use of default assumption	Overestimates risk	Removal of condition would make shallow groundwater negligible contributor to risk for all but basement air pathway.
Chemicals of Potential Concern			
Pesticide presence	Sporadic presence	Overestimates risk	Risks of exposure to aldrin and other pesticides may not be attributable to waste management activities at OU 6. Risk characterization assumes site-wide occurrence.
PAH presence	Sporadic presence	Overestimates risk	Risks of exposure to PAHs may not be attributable to waste management activities at OU 6. Risk characterization assumes site-wide occurrence.
Chloroform	Source of contaminstant	Appears to overestimate risk	Major contributor to basement air risks, but not believed to be site related.
Exposure Assessment			
Pathways combine maximally in single individual	Use of default assumption	Overestimates risk	Unlikely that significant population will be maximally exposed by all pathways.
Exposure concentration based on detected concentrations	Possibility that breakdown products of existing chemicals might appear in the future	Possibly underestimates risk	Although vinyl chloride has not been detected at the site, and only very low concentrations of other TCE breakdown products have been detected, their appearance in the future could increase site-related risks.
Toxicity Assessment			
Toxicity values missing for some compounds	Values lacking	Underestimates risk	Because materials lacking values are generally of low toxicity, and only two COPCs lacked values, the impact is probably negligible.

Use of unverified values for trichloroethene and other chemicals	Verified values lacking	Overestimates risk	Not including trichloroethene in risk characterization would significantly reduce site-related risk.
Possible synergistic or antagonistic effects of multichemical exposure	Whether combined chemicals will have synergistic or antagonistic effects	Likely overestimates risk	Cancer risk and hazard indices are summed to account for possible synergistic effects.

4.4 Overview of Site Risks

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

Remedial action at OU 6 is warranted on the basis of potential future risks to human health and the environment (i.e., to prevent a significant risk to residents). Also, remedial action is generally warranted when MCLs are exceeded. TCE associated with domestic groundwater use accounts for the majority of the risk by ingestion, inhalation, and dermal pathways.

Section 5
DESCRIPTION OF ALTERNATIVES

This section describes the alternatives that were developed to meet the remedial action objectives (RAOs) for OU 6. More detailed information on the alternatives is presented in the Feasibility Study Report (Radian, 1996b). The RAOs are as follows:

- Restore the groundwater aquifer and seeps and springs, and the Cooley's Pond water to TCE concentrations of 5 Ig/L or less (i.e., the drinking water standard), which results in a risk that is protective of human health.

- Prevent human exposures to 1,1-DCE in subsurface soil that lead to a total excess cancer risk for 1,1-DCE greater than 10 -6. This corresponds to a concentration of 26 Ig/kg or lower.

The area of groundwater with contaminant concentrations that exceed the MCL for TCE is 6 acres in the west plume and 39 acres (22 acres on Base; 16 acres off Base) in the cast plume. The volume of contaminated groundwater in the west plume is estimated to be 5 million gal.; that of the east plume is estimated to be 61 million gal. (see Figure 3-1).

The area of subsurface soil that exceeds the RAO for soil is limited to an area of approximately 3300 ft 2 and a thickness of 4 ft (18 to 22 ft bls). The volume of soil contamination is estimated to be 490 yd 3.

5.1 Elements Common to All Alternatives

There are two elements common to all of the alternatives which are discussed here for conciseness.

1. Because these alternatives will result in hazardous substances on-site above health-based levels, a review will be conducted within five years after commencement of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

2. The Utah Department of Natural Resources, Division of Water Rights has developed a groundwater management plan for the Weber Delta sub-area of the East Shore area, which includes Hill AFB. Areas of groundwater contamination surrounding Hill AFB are identified as restricted. No new wells will be permitted in the restricted areas nor will change applications which propose to transfer water into these areas be granted. When the contamination is successfully cleaned up and no longer poses a threat to groundwater aquifers, the State Engineer will consider allowing the construction of wells in these areas. Before that time, alternate water supplies will be provided if necessary.

Alternatives 2 through 5 all include additional institutional controls to prevent completion of potential exposure pathways or to protect facilities installed as part of the remedy.

Institutional controls for properties not fee-owned by the Air Force will include: (1) water rights and well drilling restrictions and advisories to prevent exposure to contaminated groundwater; and (2) fencing with warning signs to restrict access to exposure areas, construction areas, and treatment facilities. Leases or easements may be needed to enact some of the institutional controls.

Institutional controls for Air Force fee owned property will include: (1) issuing a continuing order which remains in effect as long as the property is owned by the Air Force which restricts access to or disturbance of contaminated soil, restricts construction activities, and restricts installing water supply wells in zones of contaminated groundwater. (2) filing a notice to the deed detailing the restrictions of the continuing order, and (3) a covenant to the deed in the event of property transfer.

In the case of the sale or transfer of property within OU 6 by the United States to any other person or entity, the Air Force will place covenants in the deed which will restrict access and prohibit disturbance of contaminated soils or the remedial action without approval of the United States. These covenants will be in effect until removed upon agreement of the State of Utah, the U.S. Environmental Protection Agency, and the U.S. Air Force or their successors in interest. The Air Force will also include in the deed the covenants required by Section 120(h)(3) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), which include: (1) a warranty that the United States will conduct any remedial action found to be necessary after the date of the transfer; and (2) a right of access in behalf of the U.S. Environmental Protection Agency and the Air Force or their successors in interest to the property to participate in any response or corrective action that might be required after the date of transfer. The right of access referenced in the preceding sentence shall include the State of Utah for purposes of conducting or participating in any response or corrective action that might be required after the date of transfer.

In the event that the land use is changed or structures are removed, the Air Force will re-evaluate the protectiveness of the remedy selected for OU 6, and will take any appropriate remedial action.

5.2 Alternative 1-No Further Action

In Alternative 1, no actions beyond those proposed in the Hill AFB OU 6 Action Memorandum (Radian, 1996a) are implemented. The Action Memorandum, which addresses mainly off-Base actions, proposes a phased approach. The objective and recommended actions for each phase are as follows:

- Phase I: Stop Plume Migration in Off-Base Area. The recommended pump-and-treat system began operating in the summer of 1996.

- Phase II: Remove Concentrated Portion of Off-Base Plume. The recommended pump-and-treat system began operating in the summer of 1996.

- Phase III: Removal of Canal Contribution to Plume. Relining the Davis-Weber Canal is recommended; however, further data need to be collected to 1) identify exact sections of the canal requiring relining, and 2) evaluate the effects of the anticipated relining. Monitoring the water levels in wells located above and below the canal is also included in Phase III.

- Phase IV: Stop Off-Base Migration. A pump-and-treat system is recommended; however, pending the results of an ongoing treatability study of in situ treatment technologies at OU 6, this recommended action may be replaced with either the in situ air sparging/SVE or UVB technology.

- Phase V: Remove Northern Arm of Off-Base Plume. A pump-and-treat system is recommended; however, this action will not be implemented until after the effects of the other phases can be evaluated.

In Alternative 1, all groundwater in the east plume is treated until remediation is complete by the components of the OU 6 Phase I, II, and V systems, which consist of groundwater extraction, air stripping, and discharge into a storm drain. Seep and spring water is also treated until remediation is completed. No action is taken for soils. The west groundwater contaminant plume is remediated by natural attenuation. Figure 5-1 shows the site plan for Alternatives 1 and 2.

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Phases I and II of the OU 6 removal action consist of two rows of extraction wells (seven total wells) in the off-Base area. Extracted groundwater is treated in a low-profile air stripper, which uses trays in place of packing for air-water contact. Treated water is discharged to an existing storm drain. During initial operation of the treatment system, the rates of natural attenuation of the TCE concentrations in the northern arm of the off-Base portion of the plume (see Figure 3-1) will be monitored. Groundwater modeling has shown that TCE concentrations in the northern arm will decrease to 5 Ig/L (the MCL) within five years through natural attenuation. It is also anticipated that the concentrations will decrease because of the Phase I and II treatment system actions.

If the concentrations in the northern arm are reduced to or below the MCL by natural attenuation and operation of the Phase I and II systems, no additional treatment will be implemented in the off-Base area. However, if after five years concentrations remain above the MCL, additional treatment will be conducted. This treatment, which corresponds with Phase V, will consist of a row of two extraction wells in the northern arm of the off-Base plume. If it becomes necessary to install the Phase V system, additional soil gas and groundwater sampling will be conducted to determine the most appropriate locations for the extraction wells.

Water from three springs and field drains in the OU 6 area will be collected, treated, and discharged. At spring U6-303, the spring water and water from the nearby off-Base pond (Cooley's Pond) will be pumped to a treatment system. Treatment options include an air stripping system and an activated carbon adsorption system. A best available control technology (BACT) analysis (R307-1-3, UAC) will be performed if air stripping is chosen to determine if off-gas collection and treatment is required. The treated water will be discharged to the far southeast end of the pond. The overflow from the pond discharges into the shallow aquifer.

At field drain U6-603/604 (shown in Figure 3-1), TCE is remediated by volatilization as the water cascades into a piped channel and is discharged to an existing storm sewer. This collection and treatment system is already in place. At seep U6-606, if contaminated flow remains five years after startup of the off-Base treatment system, water will be collected in the existing cistern and treated in the air stripper for the off-Base system. Treated water from the springs and field drains will meet UPDES requirements (UAC R317-8).

Adoption of this alternative should prevent groundwater contamination from migrating laterally in the direction of the hydraulic gradient (i.e., north to northeast away from the Base). Existing water fights restrictions would prevent access to the contaminated groundwater. For the west contaminant plume, this alternative relies on natural attenuation through natural physical, chemical, and biological processes to reduce groundwater contaminant concentrations.

The results of groundwater modeling indicate that the portion of the off-Base plume between the Phase I and Phase II treatment systems will be remediated quickly (2 to 3 years); however, the remaining portion of the east plume may take significantly longer to remediate. The rates of natural attenuation for all areas will be monitored, and remedial actions will be installed if concentrations do not decrease as predicted.

This alternative incorporates an ongoing program of semiannual monitoring for groundwater and seeps and springs at OU 6. Monitoring for the Davis-Weber Canal, which corresponds with Phase III, is also included.

Remediation times required to reduce TCE concentrations in groundwater to the MCL of 5 Ig/L are estimated to be the following:

- West groundwater plume: 28 to 35 years (by natural attenuation);
- East groundwater plume, off Base: 50 to 75 years; and
- East groundwater plume, on Base: 50 to 75 years.

The net present value of Alternative 1 is approximately $2,550,000. This includes a capital cost of $850,000 and a present worth O&M cost of approximately $1,700,000. A 30-year period of operation is assumed for costing purposes.

5.3. Alternative 2-Alternative 1 Plus Institutional Actions

In Alternative 2, all aspects of Alternative 1 are included. Additional monitoring of the groundwater is included to ensure the effectiveness of natural attenuation. The site plan is shown in Figure 5-1.

An expanded monitoring system will be installed to monitor natural attenuation of both the east and west plumes. The expanded system will include the installation and monitoring of four additional wells and monitoring of four existing wells that are not monitored under the current semiannual monitoring programs at the Base. If concentrations do not decrease as predicted within five years, remedial actions will be implemented to remediate the plumes more quickly. The remediation time frames are the same as for Alternative 1.

The net present value of Alternative 2 is approximately $2,900,000. This includes a capital cost of $1,000,000 and a present worth O&M cost of approximately $1,900,000. A 30-year period of operation for all components is assumed for costing purposes.

5.4. Alternative 3-Pump-and-Treat with Discharge of the Treated Water

This alternative includes all aspects of Alternative 2. In addition, it includes an on-Base pump-and-treat system for the west plume and the on-Base portion of the east plume. The entire west plume is located on Base, while the east plume is located partly on Base and partly off Base. For both areas, the groundwater is treated by air stripping. The groundwater pump-and-treat systems are intended to shorten the remediation times and act as hydraulic barriers to prevent the further migration of the plumes. Figure 5-2 shows the site plan for Alternative 3.

For the on-Base portion of the east plume, groundwater will be extracted using two rows of extraction wells. A row of wells along the Base boundary will hydraulically contain the groundwater to prevent it from flowing off Base. These wells will be monitored for their effectiveness in hydraulically containing the plume. If the plume is not contained, additional extraction wells will be installed until the plume is contained. Another row of wells will be installed hydraulically upgradient of the Base boundary to capture the plume more quickly. Pumping tests will be performed to assist the determination of the final number and spacing of the extraction wells in the system. The placement of the wells and associated piping may require rerouting of Perimeter Road. The extracted groundwater from all of the wells will be combined and piped to a low-profile air stripper. An analysis of the best available control technology (BACT) requirements (R307-1-3, UAC) was conducted. The analysis indicated that off-gas collection and treatment will not be necessary for the air stripper.

The air stripper will reduce the TCE concentrations in the extracted groundwater to 1.25 Ig/L (one-fourth the MCL) or lower. Discharge options considered for the treated groundwater include: 1) discharge to the shallow aquifer through underground injection wells or a subsurface drain field, and 2) discharge to the sanitary sewer, which flows to the North Davis County Sewer District (NDCSD)publicly owned treatment works (POTW). Because the discharge to the shallow aquifer will be essentially the same whether the drain field or injection wells are selected, the drain field option will be included for the purpose of describing this alternative. The discharge to the POTW will also be included.

The drain field will be installed in a location hydraulically upgradient of the plume, as shown in Figure 5-2. The existing geologic information for the area proposed for the drain field indicates the presence of permeable zones capable of receiving the treated water. Percolation tests have confirmed this capability. The drain field will be approximately 500 ft long and 200 ft wide. Piping will be installed to carry treated water from the air stripper system to the drain field.

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Piping will also be installed to carry treated water from the air stripper to a sanitary sewer line connection. The POTW is not on or immediately adjacent to OU 6; however, Hill AFB currently has a permit to discharge to the NDCSD POTW. Because the costs for the discharge to the POTW are higher than for the discharge to the drain field, the discharge to the POTW will be used only in the event that the drain field requires any maintenance activity.

At the west plume, groundwater will be extracted using a system of extraction wells located along the downstream edge of the plume. The extracted groundwater from all of the wells will be combined and piped to a low-profile air stripper. A BACT analysis indicated that off-gas collection and treatment will not be necessary for the air stripper. Following treatment, the water will be discharged to a drain field located upgradient of the plume. Piping will also be installed so that the treated water can be discharged to the POTW in case the drain field requires any maintenance.

Remediation times required to reduce TCE concentrations in groundwater to the MCL of 5 Ig/L are estimated to be the following:

- West groundwater plume: 6 to 9 years;
- East groundwater plume, off Base: 2 to 3 years; and
- East groundwater plume, on Base: 20 to 30 years.

The net present value for Alternative 3 is approximately $5,740,000. This includes a capital cost of $2,490,000 and a present worth O&M cost of approximately $3,250,000.

A 30-year period of operation is assumed for costing purposes for components other than the groundwater remediation system for the west plume. For the west plume treatment system, a conservative remediation time of nine years is assumed for costing purposes.

5.5 Alternative 4-Alternative 2 Plus In Situ Remediation of On-Base Plumes

Alternative 4 includes all the elements of Alternative 2. In addition, it includes in situ treatment for the west plume and the on-Base portion of the cast plume. The in situ technologies of air sparging and soil vapor extraction (IAS/SVE) and UVB (vacuum vaporizing well) have been evaluated in a treatability study at OU 6 for their effectiveness for the site conditions. Details of the treatability study are presented in the Treatability Study Work Plan (Radian, 1994b). The UVB technology was selected as the representative in situ technology for the purposes of comparing the alternatives.

At the east plume, it is assumed for cost estimating purposes that one row of UVB wells is installed at the Base boundary (this row incorporates the existing UVB well used for the treatability study), while additional UVB wells are installed upgradient along the axis of the plume (see Figure 5-3). The row of UVB wells at the Base boundary is intended to prevent further off-Base migration of TCE. Therefore, these wells are placed such that some overlap of the radius of influence occurs to ensure effective capture and treatment of the groundwater plume. The UVB wells along the axis are placed to treat the hot spot. The placement of the wells at the Base boundary may require the rerouting of Perimeter Road. One row of UVB wells is installed at the west plume. The UVB wells at the west plume are spaced according to their estimated radius of influence (with some overlap). The wells extend past the edges of the existing plume to allow for expansion of the plume. The upgradient portion of the plume is wider than the downgradient portion. If this expansion continues as the water moves downgradient, the UVB wells placed outside the existing boundaries of the plume will capture and treat this water.

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A BACT analysis indicated that off-gas collection and treatment will not be necessary for the UVB system.

Remediation times required to reduce TCE concentrations in groundwater to the MCL of 5 Ig/L are estimated to be the following:

- West groundwater plume: 7 to 14 years;
- East groundwater plume, off Base: 2 to 3 years; and
- East groundwater plume, on Base: 25 to 50 years.

The net present value of this alternative is approximately $7,170,000. This includes a capital cost of $3,450,000 and a present worth O&M cost of approximately $3,720,000.

A 30-year period of operation for components other than the west plume treatment system is assumed for cost estimating purposes. For the west plume remediation system, a conservative remediation time of 14 years is used for costing purposes.

5.6 Alternative 5-Alternative 3 Plus Accelerated Treatment of On-Base Plumes and Soil Remediation

This alternative includes all the elements of Alternative 3. In addition, it includes an extensive series of extraction wells to shorten the remediation timeframe. The presumptive remedy for soils (i.e., SVE) is implemented for the area of subsurface 1,1-DCE contamination. Figure 5-4 shows the site for Alternative 5

For the on-Base portion of the east plume, groundwater will be extracted using a system of extraction wells located along the Base boundary and an estimated seven rows of wells along the length of the plume. The wells along the Base boundary will hydraulically contain the groundwater flow off Base. These wells will be monitored for their effectiveness in hydraulically containing the plume; if the plume is not contained, additional extraction wells will be installed until the plume is contained. The wells along the length of the plume are placed according to the estimated radius of influence to achieve complete capture of all water in the plume as quickly as possible. Pumping tests will be performed to determine the final number and optimum spacing of the extraction wells in the system. The placement of the wells and associated piping may require rerouting of Perimeter Road and North Carolina Road. The extracted groundwater from all of the wells will be combined and piped to a low-profile air stripper. An analysis of BACT requirements (R307-1-3, UAC) was conducted, and indicated that off-gas collection and treatment will not be necessary for the air stripper. The discharge options for the treated groundwater are the same as for Alternative 3.

At the west plume, groundwater will be extracted using a system of extraction wells. The extracted groundwater from all of the wells will be combined and piped to a low-profile air stripper. A BACT analysis indicated that off-gas collection and treatment will not be necessary for the air stripper The discharge options considered for the west plume are the same as those for Alternative 3.

An SVE system is installed to reduce the concentrations of 1,1-DCE in the subsurface soil to the remedial goal of 26 Ig/kg. This level corresponds with a total excess cancer risk of 10 -6, assuming direct exposure. The SVE system will also reduce the concentrations of other VOCs such as TCE. A cluster of three SVE wells is installed in the vicinity of the subsurface soil contamination near test well U6-6. The three wells are screened at different intervals as follows: 1) 15 to 30 ft, 2) 30 to 45 ft, and 3) 45 to 60 ft. Although contamination was detected in only the 18- to 22-ft interval, the SVE wells completed at the lower intervals will ensure that any other VOCs in the soil below is removed.

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Remediation times required to reduce TCE concentrations in groundwater to the MCL of 5 Ig/L are estimated to be the following:

- West groundwater plume: 4 to 6 years;
- East groundwater plume, off Base: 2 to 3 years; and
- East groundwater plume, on Base: 12 to 18 years.

Although modeling has indicated that most areas of the on-Base portion of the east plume could potentially be remediated in six to nine years, the presence of the Waste Asphalt Pile will slow the remediation of the, portion of the plume below it.

The net present value for Alternative 5 is approximately $6,960,000. This includes a capital cost of $4,320,000 and a present worth O&M cost of approximately $2,640,000.

A five-year period of operation is assumed for costing purposes for the SVE system. A 9-year period of operation is assumed for costing purposes for the east plume groundwater remediation system, except for monitoring and reporting activities, which are assumed to be 12 years. For the west plume treatment system, a conservative remediation time of six years is assumed for costing purposes.

Section 6
SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

This section presents a comparative analysis of the five alternatives according to the nine evaluation criteria specified in the NCP. These evaluation criteria are divided into three categories: threshold, primary balancing, and modifying criteria. The two threshold criteria must be met by the selected remedy. The five primary balancing criteria form the basis for comparing alternatives. The two modifying criteria consider state and community acceptance. The three categories and the criteria they include are described further in Table 6-1.

In the Proposed Plan for Operable Unit 6, Hill AFB identified its preferred alternative as a modification to Alternative 3. The preferred alternative includes all elements of Alternative 3 except it uses natural attenuation, rather than a pump-and-treat system, to address the west plume on Base. For this reason, the discussions of Alternative 3 in the balancing criteria sections will specifically address both treatment and natural attenuation for the west plume. The preferred alternative and Alternative 3 include the same discharge options for the treated water that is extracted from the on-Base portion of the east plume.

6.1 Threshold Criteria

6.1.1 Overall Protection of Human Health and the Environment

Alternative 1, the No Further Action alternative, is not protective of human health. The other four alternatives protect human health and the environment, because they address the risks posed at the site. All of the alternatives eventually meet the remedial action objectives of restoring the groundwater aquifer and seeps and springs to TCE concentrations of 5 Ig/L or less, but only Alternatives 3, 4, and 5 do so in a reasonable time frame. Alternatives 2, 3, 4, and 5 are additionally protective because they include institutional actions to ensure that land use in the on-Base area remains industrial, the groundwater is not extracted from the shallow aquifer, and the contaminated subsurface soil is not excavated. Alternative 5 further reduces risk by remediation of the subsurface soil.

6.1.2 Compliance with ARARs

The ARARs identified for OU 6 are presented in Tables A-1 through A-6 of Appendix A. Tables A-7 and A-8 present the alternative-specific identification of, and compliance with, ARARs. Alternatives 1 and 2 will not meet ARARs because they will not restore the groundwater in the east plume to beneficial use in a reasonable timeframe. Because Alternatives 1 and 2 do not meet the threshold criteria, they were considered no further in the comparison of the alternatives. Alternatives 3, 4, and 5 will comply with all their applicable chemical-, location-, and action-specific ARARs. They will meet the MCLs for groundwater and comply with emissions standards. Because Alternatives 3, 4, and 5 include discharge of treated water from the off-Base treatment systems, they will be required to meet the substantive requirements for a Utah Pollutant Discharge Elimination System (UPDES) permit.

For Alternatives 3, 4, and 5, the water in Cooley's Pond will comply with the MCLs because it will be treated by a carbon adsorption or air stripping treatment system. For Alternatives 3 and 5, both the injection well and drain field options for discharge of treated water from the on-Base treatment systems, as well as the discharge from Cooley's Pond, will comply with the applicable chemical-specific ARARs, which include the Utah Groundwater Quality Protection Standards (R317-6 UAC). They will also comply with the action-specific ARARs, which include the Federal and State Underground Injection Control Standards (40 CFR Parts 144-147 and R317-7 UAC). Also for Alternatives 3 and 5, the discharge to the POTW will comply with the action-specific ARARs, which include the National Pretreatment Standards (40 CFR Part 403).

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<IMG SRC 97197AR>
<IMG SRC 97197AS>

6.2 Primary Balancing Criteria

6.2.1 Long-Term Effectiveness and Permanence

At the conclusion of remedial activities for Alternatives 3, 4, and 5 and the preferred alternative, the TCE concentrations in groundwater will be at or below the MCL of 5 Ig/L. For groundwater, Alternatives 3 and 5 and the preferred alternative are rated higher than Alternative 4 because they provide a low level of residual risk while using an extensive system of groundwater extraction and air stripping, which are technologies that have proved to be reliable.

Alternative 5 is ranked slightly higher than Alternative 3 and the preferred alternative, which may require longer operation and monitoring. However, Alternative 5 will require a higher level of operation and maintenance because of the additional treatment systems that will be operated. Alternatives 3 and 5 and the preferred alternative are equal in their adequacy and reliability of controls to manage treatment residuals. The long-term effectiveness of the preferred alternative, which includes natural attenuation for the west plume, is the same as for Alternative 3, which includes a pump-and-treat system for the west plume.

For soils, Alternatives 3 and 4 and the preferred alternative would rank equally. Alternative 5 receives the highest ranking, because it results in a slightly lower magnitude of residual risk because it reduces the contaminant concentrations in the subsurface soil.

6.2.2 Reduction of Toxicity, Mobility, or Volume Through Treatment

For Alternatives 3, 4, and 5 and the preferred alternative, the off-Base groundwater extraction system reduces the volume (and mass) of TCE in the groundwater and reduces the mobility of the contaminants through hydraulic containment. Alternatives 3 and 5 and the preferred alternative are rated higher than Alternative 4 because they reduce the mobility of the contaminants in the on-Base portions of the east and west plumes through hydraulic containment, and they also significantly reduce the mass of contaminants in the groundwater within the west plume and the on- and off-Base portions of the east plume. Alternative 5 receives a slightly higher rating than Alternative 3 and the preferred alternative because it also reduces the volume (and mass and toxicity) of 1,1-DCE in the subsurface soil. The preferred alternative, which includes natural attenuation for the west plume is ranked slightly lower than Alternative 3, which includes a pump-and-treat system. The pump-and-treat option would use treatment to a greater degree to reduce contaminant volume.

6.2.3 Short-Term Effectiveness

There are no additional short-term risks (from truck traffic, construction dust, noise, etc.) to the community or the environment that could not be avoided or minimized. A summary of the remediation time for Alternatives 3, 4, and 5 and the preferred alternative is presented in Table 6-2. Alternatives 3 and 5 and the preferred alternative are rated higher than Alternative 4 because they require shorter time periods to meet the cleanup objectives and protect against human exposure to TCE in groundwater. Alternative 5 receives a slightly higher rating for short-term effectiveness than Alternative 3 and the preferred alternative because it meets the cleanup goals in a shorter time period. Note that Alternative

3, which includes a pump-and-treat system for the west plume, is ranked equally with the preferred alternative, which includes natural attenuation.

6.2.4 Implementability

The administrative implementability for Alternatives 3, 4, and 5 and the preferred alternative is about equal. Alternative 4 is rated lower than Alternatives 3 and 5 and the preferred alternative because the reliability of UVB systems has yet to be demonstrated. Also, the equipment, personnel, materials, and services required to implement the UVB technology are not as readily available as they are for the components of the other alternatives. Alternative 3 and the preferred alternative are rated higher than Alternative 5 because they require significantly less equipment and fewer services to be implemented. The preferred alternative is rated higher than Alternative 3 because of its use of natural attenuation, rather than a pump-and-treat system, for the west plume. Natural attenuation would require less equipment and fewer services. The rerouting of roads, if necessary, for Alternatives 3, 4, or 5 or the preferred alternative would not significantly affect the implementability of the alternatives.

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6.2.5 Cost

Table 6-3 presents a summary of the capital, operation, and maintenance costs for Alternatives 3, 4, and 5 and the preferred alternative. Note that for alternatives with remediation times of 30 years or longer, a 30-year period was used for costing purposes. For alternatives with estimated remediation times shorter than 30 years, the upper ranges of remediation times were used in the cost estimates. The preferred alternative has the lowest cost, followed by Alternative 3, Alternative 5, and Alternative 4, respectively.

6.3 Modifying Criteria

6.3.1 State Acceptance

The State of Utah agrees with the selected remedy. No change to the selected remedy is necessary.

6.3.2 Community Acceptance

A public meeting was held on 11 December 1996 to discuss the Proposed Plan. The comments received from the public regarding the selected remedy are discussed in the Responsiveness Summary, which is part of this ROD. No comments were offered that agreed with or opposed the preferred alternative.

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Section 7
THE SELECTED REMEDY

This section describes the selected remedy and explains how the selected remedy meets the statutory requirements.

7.1 Description of the Selected Remedy

The selected remedy is Alternative 3 with the following modification: the west plume will be addressed through natural attenuation, rather than by a pump-and-treat system. Natural attenuation, rather than pump and treat, was selected to address the west plume because it provides the same level of protection of human health and the environment, and its cost is lower. The selected remedy includes the following components (see Figure 7-1):

- Continued operation of the off-Base pump-and-treat system.
- A pump-and-treat system for the on-Base portion of the east plume. The treated water is discharged into the shallow aquifer via a subsurface drain field. Discharge piping to a sanitary sewer connection of the NDCSD POTW will be installed as a back-up discharge provision.
- Natural attenuation of the west plume, rather than pump and treat.

- Treatment of the springs and field drains. Spring U6-303 and the water in Cooley's Pond will be treated by an activated carbon or air stripping treatment system; field drain outfall U6-603/604 will be treated by volatilization in a piped channel; and U6-606 will be treated in an air stripper if contaminated flow remains five years after startup of the off-Base treatment system.

- A groundwater monitoring program.

- Institutional controls.

- Provisions of alternate water supplies, if needed, to any residents who are using spring or field drain water for irrigation.

7.1.1 Remediation Goals and Performance Standards

The remediation goals for OU 6 are to:

- Restore the groundwater aquifer, seeps and springs, and Cooley's Pond water to TCE concentrations of 5 Ig/L or less (i.e., the drinking water standard), which results in a risk that is protective of human health.

- Prevent human exposures to 1,1-DCE in on-Base subsurface soil that lead to a total excess cancer risk for 1,1-DCE greater than 10 -6. This corresponds to a concentration of 26 Ig/kg or lower.

The area of attainment for groundwater is the area in which TCE exceeds the MCL, and the area of attainment for subsurface soil is the area in which 1,1-DCE concentrations exceed 26 Ig/kg.

7.1.2 Restoration Timeframe

The restoration timeframe for the selected remedy is as follows:

- East Plume, off Base: 2 to 3 years;

- East Plume, on Base: 20 to 30 years; and

- West Plume: 28 to 35 years.

7.1.3 Costs

The capital, operation, and maintenance costs for the selected remedy are as follows:

- Capital Costs: $1,950,000;

- Operation and Maintenance Costs: $2,760,000; and

- Total Present Worth Costs: $4,710,000.

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7.2 Statutory Determinations

The selected remedy for OU 6 meets the statutory requirements of Section 121 of CERCLA as amended by SARA. These statutory requirements include the following:

- Protection of human health and the environment;

- Compliance with ARARs;

- Cost effectiveness;

- Utilization of permanent solutions and alternative treatment technologies to the maximum extent practicable; and

- Preference for treatment as a principal element.

The discussion below explains how the selected remedy meets the statutory requirements.

7.2.1 Protection of Human Health and the Environment

The selected remedy for OU 6 protects human health and the environment through treatment and institutional controls as follows:

- The on- and off-Base pump-and-treat systems will collect and treat the groundwater in the east plume until the TCE concentrations are reduced to 5 Ig/L or less (i.e., the MCL), which results in a risk that is protective of human health.

- Collection and treatment systems will treat the water from field drain U6-603/604, seep U6-606, spring U6-303, and Cooley's Pond until the TCE concentrations are reduced to 5 Ig/L or less, which results in a risk level that is protective of human health.

- Institutional controls, including long-term management of the contaminated subsurface soil, deed restrictions for Hill AFB property, and water rights restrictions, will be implemented to prevent access to contaminated groundwater and soil.

- Monitoring of the groundwater, springs, and field drains will be conducted to assess progress toward achieving remediation goals.

- Natural attenuation of the west plume is protective of human health and the environment.

The concentrations of contaminants are relatively low, and are expected to attenuate to concentrations below drinking water standards before the groundwater travels off Base. The groundwater in the shallow aquifer is not currently used, and the institutional controls described will prevent future use until remediation is complete. Groundwater is available from the deeper aquifer systems and is expected to provide adequate supplies for a timeframe longer than the attenuation timeframe of the west plume. The timeframe for natural attenuation is also reasonable in that it is similar to that of the pump and treat portion of the remedy which remediates the east plume.

The selected remedy will not cause any unacceptable short-term risks or cross-media impacts. Appropriate health and safety procedures will be followed during implementation of the selected remedy to minimize short-term risks to the community, workers, and the environment. A review will be conducted within five years after the selected remedy is implemented to ensure that it provides adequate protection of human health and the environment.

7.2.2 Compliance with Applicable or Relevant and Appropriate Requirements

Federal and state ARARs are presented in Tables A-1 through A-6 in Appendix A. The alternative-specific identification of, and compliance with, ARARs is summarized in Tables A-7 and A-8. The ARARs for the preferred alternative are the same as for Alternative 3 in Table A-8. The selected remedy will comply with the chemical-, location-, and action-specific ARARs as discussed below.

Chemical-Specific ARARs - The selected remedy will comply with the chemical-specific ARARs for groundwater, seeps and springs, air quality, and discharge limits from groundwater treatment systems.

The selected remedy will comply with the MCLs, which are specified in the National and Utah Primary Drinking Water Standards, as restoration goals for the groundwater, seeps, springs, and Cooley's Pond. By extracting and treating the contaminated groundwater in the east plume, the selected remedy will also comply with the Utah Groundwater Quality Protection Standards. Natural attenuation of the west plume will meet the MCL for TCE within a reasonable timeframe given the circumstances of the site.

The emissions from the air stripping systems will meet the National Ambient Air Quality Standards, National Emissions Standards for Hazardous Air Pollutants, Utah Emissions Standards for Hazardous Air Pollutants, and Utah Standards for the Control of Installations.

Location-Specific ARARs - Emissions from the air stripping systems will meet the Requirements for Ozone Non-attainment Areas, Davis and Salt Lake Counties, specified in the Utah Emission Standards.

Action-Specific ARARs - The selected remedy will comply with the action-specific ARARs listed in Appendix A.

By extracting and treating the contaminated groundwater, the selected remedy will meet the requirements of the Utah Corrective Action Cleanup Standards Policy for UST and CERCLA Sites and the Utah Groundwater Quality Protection Standards. The selected remedy will comply with the Utah Cleanup Action and Risk-Based

Closure Standards because it will also implement long-term management, consisting of water rights restrictions, deed restrictions, and a continuing order restricting access to contaminated groundwater and contaminated soil.

The discharge of the treated groundwater from the off-Base treatment system and the treated water from the springs and field drains will comply with the substantive requirements of the Utah Pollutant Discharge Elimination System (UPDES). All activities associated with discharging the treated groundwater from the on-Base treatment system into the subsurface drain field and the discharge from Cooley's Pond will comply with the Federal and State Underground Injection Control Standards, as well as the Utah Ground Water Quality Protection Rule (UAC R317-6). The discharge of treated water from the on-Base system to the NDCSD POTW will comply with the National Pretreatment Standards. The groundwater monitoring provisions will comply with the Federal and State of Utah Requirements for Releases From Solid Waste Management Units.

The emissions from the air stripping systems will comply with the requirements of the Federal and State Air Emissions Standards, the Utah Definitions and General Requirements for Air Conservation, and the Utah Standards for the Control of Installations.

7.2.3 Cost Effectiveness

The selected remedy, Alternative 3 (with natural attenuation, rather than pump and treat, for the west plume) provides a more cost-effective solution than any of the other alternatives that meet the threshold criteria. The selected remedy is more cost effective than Alternative 3 with pump and treat, because it is equally protective of human health and the environment, and its cost is lower. The selected remedy is superior to Alternative 4 for all the balancing criteria. It is also more implementable and more protective of workers than either Alternative 3 with pump and treat or Alternative 5. Alternatives 3 and 5 and the selected remedy include the same controls to prevent exposure to contaminants in groundwater. All three alternatives would reach the remedial goals, but Alternative 3 and the selected remedy could take up to 12 years longer. In Alternative 3, the west plume will naturally attenuate in approximately the same timeframe as the cast plume is remediated by the pump-and-treat system. Therefore, the use of natural attenuation instead of pump and treat does not substantially change the remediation timeframe for groundwater restoration at OU 6. The water rights restrictions imposed through the State Engineer's Office will prevent the use of the shallow groundwater until it is restored. Therefore, the timeframe for the selected remedy is acceptable, and the additional costs of Alternative 3 with pump and treat and Alternative 5 are not warranted for the reduced timeframe.

Alternative 3 and the selected remedy are rated slightly lower than Alternative 5 for long-term effectiveness and permanence and reduction of toxicity, mobility, and volume through treatment only because they do not include treatment for the contaminants in the on-Base subsurface soils. The potential risks for soils are within the low end of the 10 -4 to 10 -6 risk range, which is acceptable but which still may be potentially significant. However, the potential risks are based on an unlikely exposure scenario in which the soils are excavated and brought to the surface. This scenario is particularly unlikely because the small volume of contaminated soils is deeper than most excavations for basements for housing construction. Excavation could be controlled or prevented through the use of the institutional controls provided in Alternative 3 and the selected remedy. Also, modeling indicates that the contaminants in the soil will not cause further contamination of the groundwater. Therefore, the institutional controls in Alternative 3 and the selected remedy are more cost effective to implement than the SVE in Alternative 5.

7.2.4 Utilization of Permanent Solutions and Alternative Treatment Technologies

The selected remedy meets the statutory requirement to utilize permanent solutions and treatment technologies, to the maximum extent practicable. The selected remedy provides the best balance of tradeoffs among the alternatives with respect to the five balancing criteria.

The evaluation criteria that were most critical in the selection decision were long-term effectiveness and permanence, implementability, and cost. The selected remedy is superior to Alternative 4 for all the balancing criteria. The selected remedy provides the same level of long-term effectiveness and permanence for groundwater restoration as Alternative 3 with pump and treat and Alternative 5. The selected remedy is also more implementable and cost effective than either Alternative 3 with pump and treat or Alternative 5.

7.2.5 Preference for Treatment as a Principal Element

The selected remedy satisfies the preference for treatment as a principal element for the east groundwater plume. The on- and off-Base pump-and-treat systems will permanently and significantly reduce the concentrations of TCE in the groundwater aquifer, seeps, and field drains. This preference is not satisfied for the west groundwater plume, where TCE concentrations are expected to naturally attenuate.

7.3 Documentation of Significant Changes

The Proposed Plan for Hill AFB OU 6 was distributed for public comment on 15 November 1996. A public meeting on the Proposed Plan was held on 11 December 1996. The Proposed Plan identified Alternative 3 with natural attenuation (instead of groundwater extraction/treatment) for the west plume as the preferred alternative.

Since that time, a new treatment option has been proposed for spring U6-303 and Cooley's Pond as part of the preferred alternative. The existing air stripper treatment system may be upgraded or replaced by a carbon adsorption treatment system with a prefilter. Both treatment options will meet the remedial goal (i.e., the MCL) for spring U6-303 and the pond water.

Because the configuration of the extraction wells for the on-Base portion of the cast plume has been modified, the estimated restoration timeframe for that area has become 20 to 30 years instead of 30 to 45 years.

Also, the discharge option for the on-Base treatment system for the cast plume has changed slightly. The preferred alternative now includes discharge of the treated water through a subsurface drain field instead of an underground injection wells. Discharge piping is also included so that treated water can be discharged to the NDCSD POTW in case of any maintenance problems or activities associated with the drain field.

Section 8
REFERENCES

Agency for Toxic Substances and Disease Registry (ATSDR), 1994, Health Consultation for Hill Air Force Base 0U 6. Ogden, Utah, July 1994.

Radian, 1994a. Final Engineering Evaluation/Cost Analysis for Operable Unit 6, Hill AFB, Utah, October 1994.

Radian, 1994b. Final Treatability Study Work Plan for Operable Unit 6, Sites ST22, OT26, Hill AFB, Utah, October 1994.

Radian, 1995a. Final Baseline Risk Assessment for Operable Unit 6, Sites ST22, 0T26, Hill AFB, Utah, April 1995.

Radian, 1995b. Final Remedial Investigation for Operable Unit 6. Sites ST22, OT26, Hill AFB, Utah, July 1995.

Radian, 1996a. Action Memorandum for Operable Unit 6, Sites ST22, OT26, SD40B, Hill AFB, Utah, December 1996.

Radian, 1996b. Final Feasibility Study for Operable Unit 6, Sites ST22, OT26, Hill AFB, Utah, September 1996.

Radian, 1996b. Final Proposed Plan for Operable Unit 6, Hill AFB, Utah, November 1996.

Shah, J.J., and H.B. Singh, 1988. "Distribution of Volatile Organic Chemicals of Volatile Organic Chemicals in Outdoor and Indoor Air, A National VOCs Data Base." Environmental Science and Technology, Volume 22 (1988), Number 12.

U.S. Environmental Protection Agency (EPA), 1989a. Guidance on Preparing Superfund Decision Documents, Interim Final. EPA/540/G-89/007, July 1989.

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U.S. Environmental Protection Agency (EPA), 1992. Health Effects Assessment Summary Tables (HEAST). Annual FY-1992. OHEO ECAO-CIN-821, March 1992.

U.S. Environmental Protection Agency (EPA), 1993. Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons. EPA/600/9-93/089, July 1993.

U.S. Environmental Protection Agency (EPA) 1994a. Integrated Risk Information System (IRIS). Database search. August-October, 1994.

U.S. Environmental Protection Agency (EPA), 1994b. Health Effects Assessment Summary Tables (HEAST). Annual FY-1994. EPA 540-R-94-020, March 1994.

U.S. Environmental Protection Agency (EPA). 1994c. Superfund Health Risk Technical Support Center. Request for interim guidance on pending toxicity values. August 1994.

Section 9
RESPONSIVENESS SUMMARY

9.1 Overview

This responsiveness summary provides information about the views of the community with regard to the proposed remedial action (RA) for Hill Air Force Base (Hill AFB) Operable Unit 6 (OU 6), documents how public comments have been considered during the decision-making process, and provides responses to concerns.

The public was informed of the selected RA in the following ways:

- All items contained within the Administrative Record have been on file in the Davis County Library and at the Environmental Management Directorate at Hill AFB since the final version of each document was issued. The documents include the Remedial Investigation Report (Radian, 1995b), Baseline Risk Assessment Report (Radian, 1995a), Feasibility Study Report (Radian, 1996b), and the Proposed Plan for OU 6 (Radian, 1996c).

- The notices of availability for the documents in the Administrative Record were published in the Salt Lake Tribune, Ogden Standard Examiner, Hilltop Times, and Deseret News.

- A newsletter describing the Proposed Plan was sent to all affected and interested parties prior to the public comment period. The newsletter listed the locations where copies of the Proposed Plan were available.

- A public comment period for the Proposed Plan was held from November 15, 1996 through December 16, 1996.

- A notice about the public meeting was published in the Salt Lake Tribune, Ogden Standard Examiner, Hilltop Times, and Deseret News.

- A public meeting in open-house format was held on December 11, 1996, at Riverdale Mobile Estates Clubhouse in Riverdale Utah.

- Written comments by the public were encouraged.

9.2 Background on Community Involvement

The public participation requirements of CERCLA Sections 113(k)(2)(B)(i-v) and 117 were met. Hill AFB has a Community Relations Plan, based on community interviews that was finalized in February 1992. The ongoing community relations activities include:

- A Restoration Advisory Board that meets at least quarterly and includes community representatives from adjacent counties and towns;

- A mailing list for interested parties in the community;

- A bimonthly newsletter called EnviroNews;

- Visits to nearby schools to discuss environmental issues;

- Community involvement in a noise abatement program;

- Periodic briefings to local City Councils;

- Semiannual town council meetings;

- Opportunities for public comment on remedial activities;

- Support for the community for obtaining technical assistance grants; and

- Administrative record and information repository.

9.3 Summary of Public Comments

9.3.1 Comments on the Proposed Plan

Hill AFB did not receive any formal, written questions or comments on the Proposed Plan for OU 6 (Radian, 1996c) or any other document during the public comment period.

9.3.1 Comments Made During the Pubic Meeting

An open house public meeting for OU 6 was held from 4:00 p.m. until 8:00 p.m. on Wednesday, 11 December 1996 at the Riverdale Mobile Estates Clubhouse in Riverdale, Utah. Representatives from Hill AFB, EPA Region VIII, and UDEQ were available to explain, and answer questions about, the results of the investigations, health issues, and the proposed remedy for OU 6. A list of all participants in the meeting is included in Appendix B.

Mr. Esrafil Rahimzadegan and Ms. Rebecca Rahimzadegan, who attended the open house, asked whether their residence, which is located at 5621 South 1150 West in Riverdale, Utah, was within the area of the OU 6 TCE plume. Using the posters that were displayed at the open house, Mr. Steve Hicken (Hill AFB) pointed out that the plume boundary did not extend to their residence. Mr. and Ms. Rahimzadegan asked whether the person who sold them their house would have known about the TCE in the ground-water in the OU 6 area. After discussing when they bought their house, Mr. Hicken stated that the extent of the TCE plume had not been defined prior to that time, so the seller may not have been aware of the location of the plume.

APPENDIX A

Identification of ARARs

<IMG SRC 97197AW>
<IMG SRC 97197AX>
<IMG SRC 97197AY>
<IMG SRC 97197AZ>
<IMG SRC 97197BA>
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<IMG SRC 97197BN>
<IMG SRC 97197BO>
<IMG SRC 97197BP>
<IMG SRC 97197BQ>
<IMG SRC 97197BR>

APPENDIX B

List of Attendees at the Hill AFB Operable Unit 6 Open House
Riverdale Mobile Estates Clubhouse, Riverdale, Utah
4:00 pm - 8:00 pm, 11 December 1996

Name	Address/Affiliation	Phone Number
Esrafil Rahimzadegan	5621 South 1150 West, Riverdale, UT 84405	(801)393-2060
Rebecca Rahimzadegan	5621 South 1150 West, Riverdale, UT 84405	(801)393-2060
Harold Dunning	EPA Region 8, Denver, CO	(303)312-6633
Robert Stites	EPA Region 8, Denver, CO	(303)312-6664
Jerry Mansfield	UDEQ, Salt Lake City, UT	(801)536-4237
Diane Simmons	UDEQ, Salt Lake City, UT	(801)536-4481
Kevin Bourne	EMR, Hill AFB, UT	(801)777-8790
Steve Hicken	EMR, Hill AFB, UT	(801)775-3648
Len Barry	PA, Hill AFB, UT	(801)777-4435
Pete Breed	Bioenvironmental, Hill AFB, UT	(801)777-9842
SSgt. Joe Emery	Bioenvironmental, Hill AFB, UT	(801)777-4358
SrA. Darci Gamble	Bioenvironmental, Hill AFB, UT	(801)777-1048
Dave Fulton	Montgome. Watson, Salt Lake City, UT	(801)272-1900
Tad Dean	Radian International, Salt Lake City, UT	(801)261-2187
Stephen Fain	Radian International, Austin, TX	(512)419-5240
Clive Mecham	Radian International, Salt Lake City, UT	(801)261-2187
Robert Michna	Radian International, Austin, TX	(512)419-5609
Whitney Wheeless	Radian International, Austin, TX	(512)419-5096