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Record of Decision:

MARCH AIR FORCE BASE
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RIVERSIDE, CA
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MARCH AIR FORCE BASE
OPERABLE UNIT #1
RECORD OF DECISION

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STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial actions for Operable Unit (OU) 1 at March Air Force Base (AFB), Riverside County, California. The Air Force developed this Record of Decision (ROD) in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on information contained in the Remedial Investigation/Feasibility Study (RI/FS) report dated July 1994 and the administrative record for March AFB and complies with 40 Code of Federal Regulations (CFR), Part 300.

The U.S. Air Force (Air Force), has selected remedies in concurrence with the U.S. Environmental Protection Agency (USEPA) Region IX, and the State of California.

ASSESSMENT OF THE SITE

The purpose of this ROD is to set forth the remedial actions to be conducted to remediate soil and groundwater contaminated with polycyclic aromatic hydrocarbons (PAHs) and volatile organic compounds (TCE, PCE) beneath OU1 and adjacent off-base areas.

Actual or threatened releases of hazardous substances from OU1, if not addressed by implementing the response actions selected in this ROD, may present a current or potential threat to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDIES

The response actions address the documented principal public health and environmental threats from OU1. OU1 consists of 14 different sites with the potential for soil and groundwater contamination and a plume of contaminated groundwater. Eight of the sites have no further action planned by the Air Force based on the results of a risk assessment performed as part of the OU1 Remedial Investigation. No further action is planned for Sites 5, 7, 9, 13, 14, 16, 29, and 38 by the Air Force and in concurrence with the USEPA, and the State of California. The remaining six sites require cleanup of either soil, groundwater, or both. Complete site descriptions, including site history and waste types, are provided in Section 2.0 of this ROD.

Due to differences in the nature of contaminants found at each site and variances in site conditions, various applicable cleanup methods were evaluated in the Feasibility Study (FS). Based on this evaluation, the following cleanup methods have been selected:

Soil Cleanup

Site 4. A small volume of surface soil is contaminated with polycyclic aromatic hydrocarbons (PAHs), and subsurface landfill wastes are the apparent source of chlorinated hydrocarbons in groundwater. The preferred cleanup method for soils and solid wastes at Site 4 is closure of the landfill in accordance with California regulations (Title 23, Chapter 15, Article 8). This will include installation of a cap over the landfill, protection of the cap from erosion, long-term maintenance of the cap, and groundwater monitoring.

Site 10. A small volume of surface soils contaminated with polycyclic aromatic hydrocarbons (PAHs) at Site 10 require cleanup. The preferred method of cleanup for these soils is excavation and low temperature thermal desorption.

Site 15. At Site 15 a small volume of surface soil is contaminated with PAHs and requires cleanup. The preferred method of cleanup for these soils is excavation and low temperature thermal desorption.

Site 18. The subsurface soils at Site 18 are contaminated with jet fuel and its components. The preferred method of cleanup for the soils is soil vapor extraction (SVE). Soil will be treated by extracting vapors from the same wells used to extract contaminated groundwater (see Site 18 groundwater plume). Extracted vapors will be treated at the surface using the Purus PADRETM system.

Site 31. For PAH surface soil contamination at Site 31, the preferred method of cleanup is excavation and low temperature thermal desorption. The preferred method for cleanup of subsurface soils contaminated with trichloroethene (TCE) at Site 31 is SVE with carbon adsorption. Soil vapors will be extracted from the same wells used to extract contaminated groundwater (see Site 31 groundwater plume) and brought to the ground surface for treatment by granular activated carbon (GAC).

Site 34. Surface soils at Site 34 are contaminated with PAHs and the preferred method of cleanup is excavation and low temperature thermal desorption. Subsurface soils at Site 34 are contaminated with fuels. The preferred method for cleanup of the soils is bioventing. Bioventing consists of injecting oxygen (air) into the soil to stimulate the growth of hydrocarbon degrading microbes. These microbes use the hydrocarbons as an energy source and break them down into nonhazardous compounds.

Groundwater

The occurrence of groundwater contaminants is discussed within the context of "plumes" of contaminants that share a common source area, geographic distribution, and composition. These plumes cross site boundaries, so site-specific discussions are not practical. Any remedial response actions undertaken will be applied to each plume as an entity, without consideration for site boundaries. Four plumes have been identified: The OU1 groundwater plume, the Site 4 groundwater plume, the Site 18 groundwater plume, and the Site 31 groundwater plume.

OU1 Groundwater Plume. The OU1 groundwater plume extends from the area of Site 31 to the south and east and offbase. The preferred method for cleanup of the plume is to withdraw groundwater using extraction wells and treat the groundwater using liquid phase GAC adsorption to remove TCE and related compounds. The groundwater extraction system will use existing extraction wells located along the eastern base perimeter, supplemented with additional wells to assure complete containment of that portion of the plume presently underlying the base. Groundwater from the OU1 groundwater plume will be combined with groundwater from Site 4 for treatment. Treated water will be discharged either to the base wastewater treatment plant, to the Heacock Storm Drain or reinjected into the aquifer. In accordance with California Health and Safety Code Section 25230, deed restrictions will be implemented as an institutional control to prohibit the installation of wells to restrict groundwater use in onbase contaminated areas, until groundwater cleanup standards have been achieved in onbase contaminated areas. Groundwater monitoring will be conducted to ensure that migration of the plume offbase has stopped, that offbase water supplies are not threatened, and that the concentrations of contaminants offbase are decreasing. If contaminant concentrations in offbase portions of the plume do not decrease or migration has not stopped, the Air Force will take action to cleanup these portions of the plume, including installation of offbase extraction wells as necessary. Groundwater monitoring will be conducted to ensure that the onbase portion of the plume does not migrate offbase, to ensure that the maximum concentration of offbase contaminants continues to fall, and to ensure that the offbase plume does not threaten offbase water supplies.

Site 4 Groundwater Plume. The preferred method for cleanup is to withdraw water using extraction wells and treat the water using liquid phase GAC adsorption to remove tetrachloroethene (PCE), TCE, and other volatile organics. Groundwater from the Site 4 groundwater plume will be combined with groundwater from the OU1 groundwater plume for treatment. Treated water will be discharged either to the base wastewater treatment plant, to the Heacock Storm Drain or reinjected into the aquifer. In addition, deed restrictions will be implemented to restrict groundwater use in onbase contaminated areas. Groundwater monitoring will be conducted to ensure that the plume does not threaten offbase water supplies.

Site 18 Groundwater Plume. The groundwater at Site 18 is contaminated with jet fuel and its components. The preferred method of groundwater cleanup is total fluids recovery followed by oil/water separation. Groundwater and jet fuel will be removed using extraction wells and free-phase product will be recovered for recycling. Contaminated groundwater will be treated by air stripping to remove volatile contaminants, followed by liquid-phase carbon polishing to remove any remaining fuel components. Treated water will be discharged either to the base wastewater treatment plant, or to the Heacock Storm Drain.

Site 31 Groundwater Plume. Site 31 is a likely source for much of the TCE found in the groundwater beneath OU1. The preferred method for cleanup of groundwater at Site 31 is extraction and treatment. Groundwater will be extracted and treated at the surface using liquid phase GAC adsorption to remove TCE and related compounds. Treated water will be discharged to the base wastewater treatment plant or to the Heacock Storm Drain.

STATUTORY DETERMINATION/DECLARATION

The selected remedies for groundwater at the Site 4 plume, groundwater at the Site 18 plume, groundwater at the OU1 plume, groundwater at the Site 31 plume, and subsurface soils at Sites 18, 31 and 34 are protective of human health and the environment, comply with Federal and state requirements that are legally applicable or relevant and appropriate to the remedial actions, and are cost-effective. These remedies utilize permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable and satisfy the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume of contaminants as a principal element. For remedies that do not achieve numerical cleanup goals within five years, a review of implemented technologies will be conducted to ensure that the remedies continue to provide adequate protection of human health and the environment.

The selected surface soil remedies for Sites 10, 15, 31, and 34 are protective of human health and the environment, comply with federal and state requirements that are legally applicable or relevant and appropriate to the remedial actions, and are cost-effective. These remedies utilize permanent solutions and alternative treatment technologies to the maximum extent practicable and satisfy the statutory preferences for remedies that employ treatment that reduces toxicity, mobility, or volume of contaminants as a principal element. Since the selected remedies for these sites will result in permanent destruction of the contaminants, a five-year review will not be required.

The selected surface soil remedy for Site 4 is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable. However, because treatment of the principal site contaminants was not found to be practicable, this remedy does not satisfy the statutory preference for treatment as a principal element. Because this remedy will result in hazardous substances remaining onsite above health-based levels, a review will be conducted within five years after commencement of the remedial action, and at each five year period in the future to ensure that the remedy continues to provide adequate protection of human health and the environment.

This Record of Decision (ROD) presents the selected remedial actions for Operable Unit 1 (OU1), March Air Force Base, California, developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA).

This ROD may be executed and delivered in any number of counterparts, each of which when executed and delivered shall be deemed to be an original, but such counterparts shall together constitute one and the same document.

<IMG SRC 0996148>

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<IMG SRC 0996148A>

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<IMG SRC 0996148B>

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1.0 SITE NAME, LOCATION & DESCRIPTION

1.1 LOCATION

March Air Force Base (AFB) is located in the northern end of the Perris Valley, east of the city of Riverside, in Riverside County, California. The base is approximately 60 miles east of Los Angeles and 90 miles north of San Diego (Figure 1-1). The base lies in sections of Township 3 South, Range 4 West.

1.2 POPULATION

The population of Riverside County is 1,700,413 (U.S. Census, 1990) and consists primarily of English- and Spanish-speaking citizens.

1.3 LAND USE

Current land use on March AFB is classified as residential and light industrial. Maintenance facilities, warehouses, and administrative centers support the mission.

The land surrounding March AFB includes areas of residences, light industry, and agriculture. Light industrial areas are located to the north. Agriculture is located to the east and south. Residential areas are locate in all directions around March AFB.

1.4 CLIMATE

The climate of the March AFB area is characterized as Mediterranean to semi-arid. The climate in the region varies according to elevation and distance from the Pacific Ocean. The weather generally consists of warm to hot, dry summers and mild winters.

1.5 GEOLOGY

The Main Base lies in the Perris Valley where alluvium is found at the surface. The Perris Valley is characterized as a broad, nearly flat surface dotted with bedrock hills. The numerous bedrock hills that interrupt this flat surface are described as erosional remnants of the underlying crystalline basement rocks. Surficial alluvial deposits are composed of alternating layers of varying amounts of clay, silt, sand, and gravel. In general, the deposits consist of silty sand and sandy silt with varying amounts of clay. Based on drilling information to date, thickness of the alluvial deposits ranges from zero to over 150 feet.

1.6 SOIL

Two major soil associations exist in the March AFB area: the Cieneba-Rockland-Fallbrook association and the Monserate-Arlington-Exeter association. The Cieneba-Rockland-Fallbrook association is derived from granitic rock and occurs on the western portion of the base. These soils are typically 1 to 3 feet thick, have a surface layer of sandy loam to fine sandy loam, are well drained, are coarse- to medium-grained, and have slopes ranging from 2 to 50 percent. The Monserate-Arlington-Exeter association is derived from granitic alluvium and occurs on the eastern portion of the base. These soils have a surface layer of sandy loam to loam, are well drained, are fine- to medium-grained, and are gently sloping.

1.7 SURFACE WATER AND WETLANDS

With the exception of small surface water impoundments that are used for agricultural purposes, there are two permanent surface water bodies within 3.5 miles of March AFB. Lake Perris, located 4 miles southeast of the base, provides approximately 130,000 acre feet of storage for State Project Water brought in by the California Aqueduct which runs north and east of the base. An east-west portion of the Colorado River Aqueduct is located approximately 3.5 miles south of the base. This aqueduct flows into Lake Matthews, which is located about 10 <IMG SRC 0996148D> miles west of March AFB. A very small recreation lake is located approximately 2 miles east of the Base. It is maintained by the Moreno Valley Ranch homeowners association and is located just south of Iris Street and west of Lasselle Street in the City of Moreno Valley.

A number of wetlands and riparian areas have been identified on and in the immediate area of the base. Most are located on West March, outside OU1. The U.S. Army Corp of Engineers (USACE) has performed a delineation of jurisdictional wetlands associated with the Cactus and Heacock flood control channels (USACE, 1992). Though these are artificial channels excavated in uplands, they act as ephemeral streams, support some scattered wetland vegetation and are considered waters of the United States. The USACE determined that approximately 2.17 acres of jurisdictional wetlands exist in the Heacock Storm Drain channel with 0.8 acres of wetlands adjacent to the Site 4 landfill. The wetlands are not continuous but are localized patches of wetland vegetation that change position each year due to the high volume, high velocity storm water flow from the spring rains through these channels which causes scouring of the earthen bottom and sides.

1.8 HYDROGEOLOGY

The Main Base is located in the Perris Valley where coarse-grained alluvial deposits form the main aquifer. These deposits are highly permeable and capable of yielding large amounts of water under unconfined conditions. Based on previous studies and the results of the Operable Unit (OU1) Remedial Investigation/Feasibility Study (RI/FS), the permeability of the alluvium varies both laterally and vertically. Boring logs indicate that the general stratigraphy consists of silty sands and sandy silts from the surface to depths of approximately 50 feet below ground surface (bgs). Below a depth approximately 50 feet bgs, boring logs from OU1 reveal highly permeable clean sands ranging in thickness from a few inches to tends of feet alternating with relatively impermeable clays, silts, and silty sands of similar thickness. These clays and silts act as local leaky confining units.

Bedrock is found at depths ranging from zero to over 150 feet bgs. In some areas, competent rock is overlain by a mantle of fractured and weathered rock. Water-bearing properties of the weathered rock are highly variable, depending on the degree of fracturing and weathering. Underlying competent rock is considered non-water bearing, except in located fracture zones.

1.9 WATER USE AND WELL INVENTORY

Many wells exist in the Perris Valley south, east, and north of March AFB. These wells have been used for industrial, agricultural, and domestic water supplies. Figure 1-2 shows the locations of existing and abandoned wells for which data are available through the Eastern Municipal Water District and the California Department of Water Resources. Several water wells are also located southwest of March AFB in Mead Valley. It is possible that low-yield, domestic wells are not on file with government agencies.

Four on-base (BPW-1 through BPW-4) and two off-base (BPW-5 and BPW-6) wells southeast of March AFB were formerly used for the base water supply. BPW-2, which was located just north of BPW-3 in the middle of Building 100, was abandoned in 1937, and no data are available.

BPW-1, BPW-3, and BPW-4 are located in the northeast portion of the base, near the intersection of Graeber Road and Meyer Drive. Use of BPW-3 and BPW-4 was discontinued in July 1978 because yields from these wells were not sufficient to meet water supply demands. Although BPW-1 has not been abandoned, it has not been used as a source of water since February 1984 due to trichloroethylene (TCE) contamination.

Two high-capacity wells, BPW-5 and BPW-6, are located on Markham street, southeast of the base. These wells were drilled in areas of greater aquifer thickness and permeability than the on-base production wells. These wells are located in the center of Perris Valley. Although both wells are operative, BPW-5 is not currently being used. BPW-6 is occasionally used for emergency water supplies. The base water supply is currently provided by the Eastern Municipal Water District. The Final Installation Restoration Program, Remedial Investigation/Feasibility Study Report for Operable Unit 1, published in July 1994 provides detailed well characteristics for each of the wells shown in Figure 1-2.

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1.10 THREAT OF SITE

Base operations have resulted in contamination of soil and groundwater at a number of sites within OU1. Contaminants include chlorinated solvents, fuels, and polycyclic aromatic hydrocarbons (PAHs). The selected remedy for each site addresses the principal threat from contaminants found at that site.

2.0 SITE HISTORY & ENFORCEMENT ACTIVITIES

March AFB is located on 7,123 acres in the northern end of the Perris Valley, east of the City of Riverside, and south of the City of Moreno Valley in Riverside County, California. The base is approximately 60 miles east of Los Angeles and 90 miles north of San Diego (Figure 1-1).

March AFB was officially opened on March 1, 1918. The base, originally a 640-acre facility called the Allesandro Aviation Field, was initially used to train "Jenny" pilots during World War I. Following World War I, the base closed for about four years, then reopened in 1927. By 1938, March AFB was considered to be the central location for West Coast bombing and gunnery training. In 1949, the Strategic Air Command took control of March AFB. Since that time, the base has hosted bombers, refuelers, and cargo aircraft. In June 1992, March AFB became an Air Mobility Command installation. Its primary mission is air refueling but reserve and guard units have cargo and fighter missions as well.

In September 1993, March AFB was designated by Congress to realign its forces. Active duty Air Force personnel and aircraft will transfer to Travis AFB, California, by March 1996. Air Force Reserve and Air National Guard units will remain at March, and the base will be redesignated "March Air Reserve Base." In addition, the base is expected to decrease to about one-third of its present size. After the base realignment, property that is not retained by the base will be available for transfer to the local community. Figure 2-1 shows the base as it is today, with areas to be retained by the Air Force and areas likely to be available for transfer.

The U.S. Air Force, due to its primary mission in national defense, has long been engaged in a wide variety of operations that involve the use, storage, and disposal of hazardous materials. In 1980, the Installation Restoration Program (IRP) was developed by the Department of Defense (DoD) to located and clean up hazardous waste sites. At March AFB, aircraft maintenance, fuel storage operations, fire-training exercises, and base operations have generated a variety of hazardous wastes. Past waste disposal practices have resulted in contamination of soil and groundwater at several areas onbase. The March AFB IRP process began in September of 1983. Six studies have been completed at March AFB in support of the IRP. The initial study consisted of employee interviews and reviewing aerial photographs and base records. The records search identified 30 potentially contaminated sites for further investigation. A second study, completed in March 1987, consisted of the collection of soil, water, and soil gas samples. This study indicated that further investigation was needed at 5 of the 30 sites to determine the type and extent of contamination in the soil and groundwater. In June 1987, further investigation was conducted. This investigation indicated that additional work was required to better define the extent of soil and groundwater contamination and to research possible offbase migration of trichloroethene (TCE) in groundwater.

In November 1989, March AFB was listed on the USEPA's National Priorities List (NPL) primarily due to the presence of contamination in groundwater beneath the base. The NPL is a list of sites that are considered by the USEPA to be of special interest and require immediate attention. In September 1990, a Federal Facility Agreement (FFA) was signed by the Air Force, U.S. Environmental Protection Agency (USEPA), and the State of California to establish procedures for involving Federal and state regulatory agencies and the public in the March AFB environmental restoration process. Three separate OUs were created in order to facilitate the environmental restoration of March AFB. OUs were created based on geographic location of sites, similarity of contaminants, and location of groundwater contaminant plumes.

The subject of this ROD is OU1. OU1 sites include Sites 4, 5, 7, 9, 10, 13, 14, 15, 16, 18, 29, 31, 34, and 38 (Figure 2-2). OU1 sites originally included Sites 21 and 23, but these sites have been reassigned to OU2. The latest investigation at OU1 was performed from November 1991 to November 1993. The overall objectives of the investigation were to collect additional data to confirm contaminant source areas, better define contamination boundaries, assess potential risks to human health or the environment, and evaluate the feasibility of different remedies at OU1 sites. Groundwater at Site 4, Site 18, Site 31 and within the OU1 groundwater plume and soil at Sites 4, 10, 15, 18, 31, and 34 require remedial action. Descriptions of the sites are presented below.

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2.1 SITES WITH NO FURTHER ACTION PLANNED

Based on currently existing data collected under previous studies, no unacceptable risk has been identified and therefore, no further action is required at the following sites:

Site 5 (Landfill No. 3). This site covers approximately 5 acres and is located southeast of the present flightline. The landfill was reportedly operated from the late 1940s to approximately 1960. Landfill wastes consist primarily of sanitary waste and construction rubble.

Site 7 (Fire Training Area No. 2). This site is located on the eastern part of the Base, north of the Alert Facility. Between 1954 and 1978, fire training exercises were conducted in unlined training pits. Three distinct burn pits were identified in historic aerial photographs of the Base. A portion of this site may have been used for crash rescue training. Wastes used in training exercises reportedly included contaminated fuel, waste solids, and spent solvents.

Site 9 (Main Oil/Water Separator). Site 9 is located north of Site 5 at the southeast end of the flightline apron. The facility was constructed in 1974 and serves the main storm drainage system for the flightline apron and the flightline shops. The storm drains have reportedly received waste oils, hydraulic fluids, diesel fuel, waste paints, spent solvents, paint strippers, paint thinners, and battery acids. The oil/water separator is of earth construction with a large baffle that divides the separator into two compartments. The separated oil is picked up by a skimmer and pumped to a holding tank for off-base disposal. This facility drains into the Flightline Drainage Channel (Site 10) and then to the Perris Valley Storm Drain Lateral A.

Site 13 (Tank Truck Spill Site). Site 13 is located along the eastern perimeter road of the Base, within the northern portion of Site 5. In 1973, approximately 5,000 gallons of JP-4 jet fuel spilled from a tank truck to the ground at this location. The accidental discharge resulted from a mechanical malfunction. There was no reported spill containment or spill clean-up.

Site 14 (Liquid Fuel Pump Station Overflow). Site 14 is located southeast of the flightline apron and about 50 to 100 feet west of the East March Sludge Drying Beds (Site 16). In 1973, approximately 1,000 gallons of JP-4 jet fuel spilled onto the ground. The spill occurred due to an overflow of the liquid fuels pump station at Building 1245. The spill was contained in the unpaved area south of the pump station and allowed to percolate into the ground.

Site 16 (East March Sludge Drying Beds). Site 16 is located on the eastern part of the Base, at the south end of the flight line parking apron, and near the former East March Wastewater Treatment Plant. The treatment plant was constructed in 1938 and provided secondary treatment for sanitary and industrial waste-water. Primary and secondary sludges were digested anaerobically, dewatered on unlined sludge drying beds, and disposed of in an on-base landfill. The sludge may have contained heavy metals and organics resulting from discharges of industrial wastes to the sanitary sewer system. These drying beds operated from 1938 to 1977, when the plant was destroyed in place.

Site 29 (Fire Training Area No. 1). Site 29 is located on the eastern part of the Base, north of Site 9. The area was used as a fire training pit prior to 1951. Suspected contaminants at the site include contaminated fuel, waste oil, and spent solvents.

Site 38 (PCB Contamination, Building 1311). Building 1311 is located at the southeast end of the taxiway, northwest of IRP Site 23. In 1984, soils from four areas contaminated with transformer oils were sampled. Soils from two of the areas (Buildings 317 and 1305) were determined to be PCB-contaminated. The soils were excavated and removed from the Base. Records to verify the cleanup have not been located.

2.2 SITES REQUIRING SOIL REMEDIATION

Site 4 (Landfill No. 6). This site covers approximately 8.5 acres and is located along the eastern boundary of the base, south of the East Gate (Figure 2-2). The landfill operated from 1955 to 1969. The landfill is up to 25 feet deep, containing primarily sanitary waste, construction rubble, and debris. Small amounts of medical wastes and empty fuel containers were also present. RI sampling data indicated the presence of very low concentrations of chlorinated solvents in soils and soil gas beneath the site. A groundwater monitoring well situated in the southeast corner of the site has consistently contained elevated concentrations of tetrachloroethene (PCE) and TCE. Both PCE and TCE are found in solvents which were used to clean and degrease military equipment. In addition, vinyl chloride also has been detected in Site 4 groundwater. Vinyl chloride is a breakdown product of TCE and PCE. The landfill is considered the source of contaminants detected in groundwater downgradient of the site.

Site 10 (Flightline Drainage Channel). This site is located southeast of the flightline aircraft maintenance areas (Figure 2-2). The drainage channel, which was installed prior to 1940, has reportedly received various waste oils, hydraulic fluids, diesel fuel, jet fuel, waste paints, paint strippers, paint thinners, battery acids and solvents (including TCE). The drainage channel is concrete lined (since the 1960s) up to the eastern boundary of the base where it discharges to the Perris Valley Storm Drain. The Perris Valley Storm Drain flows east approximately 2 miles, where it joins another drainage and flows south approximately 6 miles to the San Jacinto River. Prior to 1974, wastes disposed of in the drainage channel may have been discharged directly to the Perris Valley Storm Drain. Since 1974, the main oil/water separator

(Site 9) has pretreated the runoff before its discharge offbase. Primary contaminants of concern are PAHs, which were detected in drainage ditch sediments. PAHs are a series of petroleum derivatives found in many fuel and asphalt compounds.

Site 15 (Fire Protection Training Area No. 3). This site is located southeast of the end of runway 12-30 and between Sites 5 and 7 (Figure 2-2). The area was developed in 1978 and was reportedly constructed by placing an underdrain system and gravel over a clay liner. Firefighting water, solutions of Aqueous Film Forming Foam (AFFF), and residual fuel used during training exercises were drained to a formerly unlined water holding pond located adjacent to Site 15. Approximately 6,000 gallons per year of contaminated JP-4 have been burned in training exercises since the facility was constructed in 1978. This site is no longer being used as a fire training area. The primary contaminant of concern is phenanthrene, a PAH.

Site 18 (Engine Test Cell). Site 18 is located on the flightline, south of Taxiway No. 2 (Figure 2-2). The test cell was constructed in 1957 for the purpose of testing aircraft engines. The test cell has been inactive for several years. An oil/water separator was installed at the test cell in 1976. Water from the separator was discharged to the base wastewater treatment plant. Oil was collected by a contractor for offbase disposal. Prior to 1976, spills of oil, fuels, or solvents were drained to a nearby ditch. Fuel has been detected in four of the ten monitoring wells installed to date. Potential source(s) of the fuel include overflow of tanker trucks and fuel tanks on aircraft that have been parked on the site in the past.

Site 31 (Unconfirmed Solvent Disposal). Site 31 is located off Graeber Street on the east side of Building 1211 (Figure 2-2). The practice of discharging solvents on the ground reportedly occurred from about the mid-1950s to the mid-1970s. In addition, floor drains from maintenance shops may have leaked solvents to the subsurface. Groundwater sampling at the site has indicated TCE concentrations which exceed Federal and State drinking water standards.

Site 34 (Pritchard Aircraft Fueling System). Site 34 is located next to Building 1245, at the southeast end of Taxiway No. 1 (Figure 2-2). In 1962, six 50,000-gallon tanks were moved to this site from the Panero Fueling System. During a geological investigation (July 1988) for a construction project just south of the site, stained soils and fuel odors were observed. In 1990, use of this system was discontinued, and in 1991, the tanks and system were removed.

2.3 SITES REQUIRING GROUNDWATER REMEDIATION

The occurrence of groundwater contaminants is discussed within the context of "plumes" of contaminants that share a common source area, geographic distribution, and composition. These plumes cross site boundaries, so site-specific discussions are not practical. Any remedial response actions undertaken will be applied to each plume as an entity, without consideration for site boundaries. Four plumes have been identified: OU1 groundwater plume, Site 4 groundwater plume, Site 18 groundwater plume, and Site 31 groundwater plume (Figure 2-3).

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OU1 Groundwater Plume. The OU1 groundwater plume is the most widespread plume at the base, extending from Site 31 south and east through the area of Sites 34, 9, and 5, and extending to a maximum of approximately 1300 feet to the east of the eastern base boundary and 1500 feet south of site 5 offbase (Figure 2-3). The most widespread contaminant detected in TCE, detected at a maximum concentration of 1,400 µg/l in monitoring well 31 -PW1 at Site 31 on base and 42 µg/l in monitoring well 5-MW11 300 feet southeast of Site 5, off base. The following contaminants were also detected above cleanup standards: bis(2-ethylhexl)phthalate (maximum 130 µg/l); 1,1-dichloroethene (maximum 260 µg/l); benzene (maximum 420 µg/l); carbon tetrachloride

(maximum 3 µg/l); cis-1, 2-dichloroethene (maximum 30 µg/l); methylene chloride (maximum 45 µg/l); tetrachloroethene (PCE), maximum 19 µg/l); 1,2-dichloroethane (maximum 25 µg/l) and total phenols (Maximum 79 µg/l).

Site 4 Groundwater Plume. This plume is localized in the vicinity of Site 4 with the apparent source area near the southern end of Site 4 (Figure 2-3). The contaminants with the highest concentrations are PCE and TCE.

Site 18 Groundwater Plume. This plume is localized in the vicinity of Site 18 with the apparent source area west of the engine test cell in the center of Site 18 (Figure 2-3). Fuel has been detected in four of the ten monitoring wells installed to date. Up to 10 feet of fuel has been identified in one well. Potential source(s) of the fuel include overflow of tanker trucks and fuel tanks on aircraft that have been parked on the site in the past.

Site 31 Groundwater Plume. Concentrations of contaminants at Site 31 (primarily TCE) are much higher than those in the rest of the OU1 plume, and these high concentrations are confined to a relatively small area. These conditions coupled with the history of Site 31 (reported solvent disposal) indicate that Site 31 is a likely source area for much of the TCE found in OU1 groundwater. Therefore, even though the Site 31 plume has the same contaminants and is contiguous with the OU1 plume, it is appropriate to treat Site 31 separately from the remainder of the OU1 plume, in order to eliminate the source of contamination.

3.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

The RI/FS report and Proposed Plan for OU1 were released to the public on April 28, 1994. These two documents were made available to the public in the Administrative Record, the information repositories at the Moreno Valley and March AFB libraries, and at the Moreno Valley Chamber of Commerce. The notice of availability of these documents was published in the Press-Enterprise on April 27, 1994. A fact sheet, condensed from the Proposed Plan, was sent to everyone on the March AFB mailing list, which includes Restoration Advisory Board (RAB) members. An OU1 RI/FS subcommittee, formed by the RAB, provided oral comments to the RAB at its April 26, 1994 meeting. The Final FI/FS Report was published in July 1994.

A public comment period was held from April 28 to May 28, 1994. In addition, a public meeting was held on May 12, 1994 at 7 p.m. at the Best Western Image Suites in Moreno Valley. Representatives of the U.S. Air Force, USEPA, Department of Toxic Substances Control, and California Regional Water Quality Control Board, Santa Ana, attended the public meeting to address any questions about the RI/FS and Proposed Plan.

A response to the comments received during the public comment period is included in the Responsiveness Summary, contained in this Record of Decision. This decision document presents the remedial actions for the OU1 sites, located at March AFB, California, which were selected in accordance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by Superfund Amendments and Reauthorization Act (SARA), and the National Contingency Plan (NCP). The cleanup decisions for the OU1 sites are based on the Administrative Record. The Administrative Record Index is provided in Appendix B.

Public participation in the decision-making process for OU1 complies with the requirements of CERCLA §113(k)(2)(B)(i-v), 117, and the NCP §300.430(f)(3).

OU1 represents one component of the comprehensive environmental investigation and cleanup program presently being performed at March AFB. The investigations are being performed to comply with CERCLA and the Air Force's IRP. As part of the comprehensive cleanup program, the Air Force is presently evaluating cleanup alternatives as related to these IRP sites. Plans are currently being developed for the proper cleanup and closure of all sources of soil and groundwater contamination that have been shown to pose unacceptable health or environmental risks.

At March AFB, aircraft maintenance, fuel storage operations, fire-training exercises, and base operations have generated a variety of hazardous wastes. Past waste disposal practices have resulted in contamination of soil and groundwater at several areas on base. March AFB was added to USEPA's National Priorities List of hazardous waste sites primarily due to the presence of TCE in groundwater beneath the base.

Three separate OUs were created in order to facilitate the environmental restoration of March AFB. OUs were created based on geographic location of sites, similarity of contaminants, and location of groundwater contaminant plumes (See Figure 4-1). Sites included in each OU are as follows:

- OU1. OU1 encompasses Sites 4, 5, 7, 9, 10, 13, 14, 15, 16, 18, 29, 31, 34, and 38. Sites 21 and 23 were initially included in OU1, but were transferred to OU2. OU1 also includes the off-base plume area along the Eastern boundary of March AFB.

- OU2. OU2 includes the remaining sites not in Operable Units 1 or 3. It includes all of the area known as West March, The Hawes site, and the sites in the northern portion of the Main Base west of Riverside Drive: Sites 1, 2, 3, 6, 8, 11, 12, 17, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 30, 32, 35, 36, 37, 39, 40, 41, and 42.

- OU3. OU3 consists of IRP Site 33 (Panero Aircraft Fueling System). Soils and groundwater in OU3 have been contaminated by jet fuel.

OU1 was created based on geographic location of sites, similarity of contaminants (primarily TCE) and commingling of groundwater contaminant plumes migrating southeastward offbase. The scope of the operable unit includes groundwater containing TCE and other compounds over the majority of OU1 sites and offbase, groundwater containing primarily PCE at Site 4, groundwater containing jet fuel at Site 18, and sources of these contaminants in soils above the groundwater that have caused the plumes. The remedial investigation identified a possible source for TCE contamination at Site 31 although other sites within the OU1 groundwater plume area may be contributing TCE to groundwater. The scope of the operable unit also includes soils containing PAHs at Sites 4, 10, 15, 31, and 34. By cleaning up the groundwater and soil, the operable unit will address the principal threats posed by environmental contamination at the base.

<IMG SRC 0996148I>

5.0 SUMMARY OF SITE CHARACTERISTICS

Elevated levels of solvents, fuel components, and metals were detected in soil and groundwater at several OU1 sites. OU1 geology, aquifer characteristics, and occurrences of groundwater and soil contamination for each site are discussed below.

5.1 GEOLOGY AND AQUIFER CHARACTERISTICS

Beneath OU1 the lithology consists predominantly of alluvial deposits composed of alternating layers of silty sands, sandy silts, clay, sand and gravel. The alluvial deposits range in thickness from a few feet at site 18 to over 300 feet in the southeast corner of OU1. Beneath the alluvial deposits granitic bedrock is present. A significant zone of weathered bedrock overlies the competent bedrock. The weathered bedrock zone varies in thickness from a few feet to 70 feet at Site 29. Depth to component bedrock varies from a few feet bgs at site 18 to greater than 300 feet bgs in the southeast corner of OU1, and the bedrock surface is undulating.

Below a depth of approximately 50 feet bgs, highly permeable clean sands ranging in thickness from a few inches to tens of feet are found alternating with relatively impermeable clays, silts and silty sands. This zone of vertically and laterally discontinuous sands is capable of yielding large amounts of water, but the amount of water yielded is highly variable based on the thickness and permeability of the sand zones. The weathered bedrock zone beneath the alluvial deposits yields highly variable amounts of water which is controlled by the degree of weathering, fracturing, and thickness of the zone. The unweathered bedrock underlying the weathered bedrock is considered non-water bearing, with the exception of groundwater occurring in joints or fracture zones.

The groundwater gradient gently slopes (approximately 0.003) southeast over the majority of OU1. For a more detailed discussion of the OU1 lithology and aquifer characteristics please refer to the March Air Force Base OU1 RI/FS (The Earth Technology Corporation, July 1994).

5.2 GROUNDWATER CONTAMINATION

The occurrence of groundwater contaminants is discussed within the context of "plumes" of contaminants that share a common source area, geographic distribution, and composition. Four plumes have been identified: OU1 groundwater plume, Site 4 groundwater plume, Site 18 groundwater plume, and Site 31 groundwater plume (Figure 5-1). Cleanup standards for groundwater are based on Federal and State Applicable or Relevant and Appropriate Requirements (ARARs). The rationale and approach used for establishing cleanup standards are presented in Section 6.0. The compounds that most frequently exceed applicable standards in groundwater in OU1 are chlorinated hydrocarbons (TCE, PCE, and others) and aromatic hydrocarbons (benzene, toluene, ethylbenzene, and xylenes (BTEX) compounds) (Table 5-1). Each of the four groundwater contaminant plumes is described below:

- OU1 Groundwater Plume. The OU1 groundwater plume is the most widespread plume at the base. It has been divided into the onbase OU1 groundwater plume, and the offbase OU1 groundwater plume. The onbase OU1 plume extends from Site 31 south and east through the area of Sites 34, 9, and 5 and has TCE levels ranging from 1,400 μg/l at Site 31 to 76 μg/l at Site 5. The offbase OU1 groundwater plume extends south and east from the Site 5 boundary with TCE levels gradually decreasing to non-detect 2500 feet southeast of Site 5. The primary contaminants are TCE and other chlorinated volatile hydrocarbons.

- Site 4 Groundwater Plume. This plume is localized in the vicinity of Site 4 with the apparent source area near the southern end of the landfill (Figure 5-1). The primary contaminants are PCE and TCE.

- Site 18 Groundwater Plume. This plume is localized in the vicinity of Site 18 with the apparent source area to the west of the test engine cell in the center of Site 18 (Figure 5-1). Fuel as been detected in four of the ten monitoring wells installed to date. Up to 10 feet of fuel has been identified in one well. Potential source(s) of the fuel include overflow of tanker trucks and fuel tanks on aircraft that have been parked on the site in the past.

- Site 31 Groundwater Plume. Concentrations of contaminants at Site 31 (primarily TCE) are much higher than those in the rest of the OU1 plume,and these high concentrations are confined to a relatively small area. These conditions coupled with the history of Site 31 (reported solvent disposal) indicate that Site 31 is a likely source area for much of the TCE found in OU1 groundwater. Therefore, even though the Site 31 plume has the same contaminants and is contiguous with the OU1 plume, it is appropriate to treat Site 31 separately from the remainder of the OU1 plume, in order to eliminate the source of contamination.

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TABLE 5-1
GROUNDWATER CONTAMINANTS

Plume	Contaminant	Maximum Concentration (µg/l)
Site 4	Methylene Chloride	9
	Tetrachloroethene (PCE)	260
	Trichloroethene (TCE)	85
	Vinyl Chloride	8
	Bis(2-ethylhexyl)phthalate	290
	cis-1,2-Dichloroethene	21
Site 18	Benzene	12,000
	Toluene	11,000
	Ethylbenzene	1,500
	Methylene Chloride	440
	Phenols, Total	73
	Xylenes, Total	7,700
Site 31	Bis(2-ethylhexyl)phthalate	63
	1,1-Dichloroethene	260
	Trichloroethene	1,400
OU1	Bis(2-ethylhexyl)phthalate	130
	Benzene	420
	Carbon Tetrachloride	3
	Trichloroethene (TCE)	1,400
	1,1-Dichloroethene	260
	cis-1,2-Dichloroethene	30
	Methylene Chloride	45
	Tetrachloroethene (PCE)	19
	1,2-Dichloroethane	25
	Phenols, Total	79

Note: Maximum concentrations are from the basewide groundwater monitoring data as of Summer 1994.

Key:
µg/l = Micrograms per liter
RWQCB = California Regional Water Quality Control Board, Santa Ana Region
MCL = Maximum Contaminant Level

5.2.1 Organic Contaminants

For the Site 4 plume, a total of six organic contaminants were detected at concentrations exceeding applicable cleanup standards. PCE was detected at a maximum concentration of 260 micrograms per liter (µg/l), exceeding the cleanup standard of 5 µg/l. TCE was detected at a concentration of 85 µg/l, exceeding the cleanup standard of 5 µg/l. Vinyl chloride was detected at a concentration of 8 µg/l, exceeding the cleanup standard of 5 µg/l. Methylene chloride was detected at a concentration of 9 µg/l, exceeding the cleanup standard of 5 µg/l. Bis (2-ethylhexyl)phthalate and cis-1,2-dichloroethene were also detected at concentrations exceeding the cleanup standards of 4 µg/l and 6 µg/l, respectively. The Site 4 plume and OU1 plume overlap near the southern edge of the Site 4 plume.

For the Site 18 plume, organic contaminants exceeding applicable cleanup standards consisted primarily of jet fuel components. Benzene (12,000 µg/l), toluene (11,000 µg/l), ethylbenzene (1,500 µg/l), and total xylenes (7,700 µg/l), exceeded the respective cleanup standards of 1 µg/l, 10 µg/l, 10 µg/l, and 10 µg/l. Total phenols (73 µg/l) exceed the cleanup standard of 40 µg/l. A methylene chloride concentration of 440 µg/l detected at site 18 was determined to be a laboratory contaminant. Methylene chloride was detected in associated blanks and has not been historically detected at site 18.

For the OU1 groundwater plume, several organic contaminants exceeded applicable standards. The most widespread and concentrated contaminant was TCE, detected at a maximum concentration of 1,400 µg/l. This sample was collected at Site 31. Site 31 is a likely source area for TCE in the OU1 plume and therefore is treated separately. The maximum concentrations of contaminants which exceed cleanup standards are provided in Table 5-1.

For the Site 31 groundwater plume, a total of three individual organic contaminants exceeded applicable cleanup standards. As previously discussed, the maximum concentration of TCE in the OU1 plume was at Site 31 with a concentration of 1,400 µg/l. Bis(2-ethylhexyl)phthalate and 1,1-dichloroethene were also detected at maximum concentrations of 63 µg/l and 260 µg/l, respectively.

5.2.2 Inorganic Contaminants

Several metals also exceeded State or Federal drinking water standards in the groundwater contaminant plumes. However, most of these metals occur naturally at elevated concentrations, as indicated by background sampling data. Therefore, most of these metals do not require cleanup. Of these metals, thallium was the only metal detected above background levels, and was only detected in the Site 18 plume. Thallium concentrations were determined by analytical method SW6010 (Inductively Coupled Plasma, ICP). This method often shows false positives because of interference from other analytes in the sample, mainly iron and aluminum. In addition, analytical precision is difficult to maintain so close to the detection limit (detection limit for thallium is reported as 0.100 mg/L). Therefore, the presence of thallium in the filtered samples but not in the associated unfiltered samples suggests that the reported thallium values are an artifact of the analytical program, and thallium was determined not to require cleanup.

In addition to metals, other inorganic water quality criteria were exceeded. California Regional Water Quality Control Board (RWQCB), Santa Ana Region water quality objectives for hardness, chloride, sulfate, and total dissolved solids (TDS) were exceeded in all four groundwater plumes as well as in OU1 background samples. The water quality objective for surfactants was exceeded in the Site 4 and OU1 plumes. TDS is the subject of an ongoing basewide groundwater study. Insufficient water quality data are currently available to determine cleanup requirements. A basewide groundwater monitoring program is currently being conducted. The results of this program will be included in the basewide ROD. The Basewide ROD will address cleanup requirements of the water quality objectives for hardness, chloride, sulfate, and TDS.

5.3 SOIL CONTAMINATION

Concentrations of analytes detected in the surface soil (0- to 2-foot) interval were compared to Region IX Preliminary Remediation Goals (PRGs). The PRGs are based on the amount of contaminant that a person may ingest, inhale, or contact, and are designed to be protective of human health and the environment. Contaminants that exceed PRGs warrant further evaluation. However, a contaminant concentration that exceeds a PRG does not necessarily indicate an unacceptable health risk. In determining the cleanup standards and goals for OU1, both the results of the PRG comparisons and the results of the risk assessment were considered. See Section 6.6 for a final site-specific list of contaminants that require remediation, based on the risk assessment.

For each analyte detected in the surface soil at a site, the maximum concentration was compared to the residential soil PRG for that analyte. The following contaminants do not have a PRG: calcium, iron, magnesium, mercury, potassium, sodium, benzo(g,h,i)perylene, phenanthrene, 2-methylnaphthalene, alpha-chlordane, gamma-chlordane, endosulfan sulfate, and endrin aldehyde. For some of these contaminants, surrogates were applied. The PRG for anthracene, a non-carcinogenic polynuclear aromatic hydrocarbon (PAH), was selected as a surrogate for benzo(g,h,i)perylene and phenanthrene, which are also non-carcinogenic PAHs. The PRG for naphthalene was used for 2-methylnaphthalene. The PRG for chlordane was used for alpha-chlordane and gamma-chlordane. The PRG for endosulfan was selected as a surrogate for endosulfan sulfate and endrin was used for endrin aldehyde.

EPA Region IX has calculated a PRG only for one dioxin, 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD), which is the most toxic of the dioxin isomers. However, California EPA has determined Toxicity Equivalency Factors (TEFs) that consider the relative toxicity of each of the dioxin isomers. These TEFs were applied to the 2,3,7,8-TCDD PRG and the maximum concentration of each dioxin directed at a site was compared to the modified PRG.

Table 5-2 presents maximum surface soil concentrations of site contaminants, where the maximum concentrations exceed Region IX PRGs. The residential land use PRGs were used for all sites. The occurrence of soil analytes at each site are discussed below:

Site 4. In addition to the analytes that exceed PRGs listed in Table 5-2, the following analytes (and the ranges of concentrations) were detected at concentrations below the PRGs: aluminum (3,960.0-9,310.0 mg/kg), barium (73.4-117.0 mg/kg), calcium 1,000.0-6,700.0 mg/kg), chromium, total (6.0-11.3 mg/kg), cobalt (3.7-5.4 mg/kg), copper (5.0-10.9 mg/kg), iron (7,450.0-13,700.0 mg/kg), lead (ND-16.2 mg/kg), magnesium (2,160.0-5,320.0 mg/kg), manganese (149.0- 367.0 mg/kg), nickel (ND-5.3 mg/kg), potassium (2,240.0-4,090.0 mg/kg), sodium (ND-175.0 mg/kg), vanadium (15.9-25.6 mg/kg), zinc (24.7-46.5 mg/kg), fluoranthene (ND-17.0 mg/kg), phenanthrene (ND-3.5 mg/kg), pyrene (ND-8.9 mg/kg), DDE (ND-0.0046 mg/kg), and DDT (ND-0.0057 mg/kg).

Site 5. In addition to the analytes that exceed PRGs listed in Table 5-2, the following analytes (and the ranges of concentrations) were detected at concentrations below the PRGs: aluminum (5,450.0-7,290.0 mg/kg), barium (83.7-150.0 mg/kg), calcium (2,160.0-3,220.0 mg/kg), chromium, total (8.7-9.9 mg/kg), cobalt (3.9-4.9 mg/kg), copper (6.9-10.0 mg/kg), iron (8,570.0-10,800.0 mg/kg), lead (ND-18.1 mg/kg), magnesium (2,540.0-3,400.0 mg/kg), manganese (203.0- 221.0 mg/kg), nickel (ND-4.7 mg/kg), potassium (2,570.0-3,010.0 mg/kg), vanadium (17.2-20.8 mg/kg), zinc (27.0-41.8 mg/kg), di-n-butyl phthalate (ND-0.56 mg/kg), fluoranthene (ND-0.41 mg/kg), DDE (ND-0.0088 mg/kg), and DDT (ND- 0.0041 mg/kg).

TABLE 5-2, SURFACE SOIL CONTAMINANTS EXCEEDING EPA REGION IX PRGs

Site	Chemical	Maximum Site Concentration (mg/kg)	Region IX Residential PRG (mg/kg)
4	Benzo(a)anthracene	5.5	0.61
	Benzo(a)pyrene	8.7	0.061
	Benzo(b)fluoranthene	14.0	0.61
	Benzo(g,h,i)perylene	20.0	19(1)
	Chrysene	9.7	6.1(2)
	Dibenz(a,h)anthracene	4.2	0.061
	Indeno(1,2,3-c,d)pyrene	21.0	0.61
	Beryllium	0.39	0.14
5	Beryllium	0.27	0.14
7	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.00075	0.00038(3)
	Heptachlorinated dibenzo-p-dioxins, total	0.0013	0.00038(3)
	Hexachlorinated dibenzo-p-dioxins, total	0.0001	0.000038(3)
	Beryllium	0.58	0.14
	Lead	855.0	130(2)
	Manganese	449.0	380
9	Beryllium	0.42	0.14
10	Benzo(a)anthracene	3.2	0.61
	Benzo(a)pyrene	3.5	0.061
	Benzo(b)fluoranthene	3.7	0.61
	Benzo(k)fluoranthene	1.8	0.61
	Dibenz(a,h)anthracene	0.96	0.061
	Indeno(1,2,3-c,d)pyrene	3.9	0.61
13	Beryllium	0.27	0.14
15	Benzo(a)pyrene	0.34	0.061
	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.00095	0.00038(3)
	Heptachlorinated dibenzo-p-dioxins, total	0.0016	0.00038(3)

TABLE 5-2. SURFACE SOIL CONTAMINANTS EXCEEDING EPA REGION IX PRGs

Site	Chemical	Maximum Site Concentration (mg/kg)	Region IX Residential PRG (mg/kg)
	Beryllium	0.33	0.14
16	Beryllium	0.41	0.14
	Manganese	654.0	380
18	Beryllium	0.45	0.14
29	1,2,3,4,6,7,87-Heptachlorodibenzo-p-dioxin	0.00079	0.00038(3)
	Heptachlorinated dibenzo-p-dioxins, total	0.0014	0.00038(3)
	Beryllium	0.66	0.14
	Lead	246.0	130(2)
	Manganese	554.0	380
31	Benzo(a)anthracene	0.96	0.61
	Benzo(a)pyrene	1.0	0.061
	Benzo(b)fluoranthene	1.5	0.61
	Indeno(1,2,3-c,d)pyrene	0.85	0.61
	Beryllium	0.79	0.14
	Lead	311.0	130(2)
	Manganese	610.0	380
34	Benzo(a)anthracene	5.8	0.61
	Benzo(a)pyrene	3.2	0.061
	Benzo(b)fluoranthene	4.9	0.61
34	Indeno(1,2,3-c,d)pyrene	2.2	0.61
	Beryllium	0.28	0.14
38	Beryllium	0.29	0.14

(1) A PRG was not available for this non-carcinogenic polynuclear aromatic hydrocarbon (PAH). The PRG for anthracene, which is the most conservative PRG for the non-carcinogenic PAHs, was used as a surrogate.

(2) The California EPA PRG was used for this chemical because it is more restrictive than the Region IX PRG.

(3) 2,3,7,8-TCDD is the only dioxin for which Region IX has calculated PRGs (3.8E-06 for residential soil and 2.4E-05 for industrial soil). Therefore, this PRG has been adjusted using a TEF (See Table 6-3 for a list of TEFs.)

Key:
PRG = Preliminary Remediation Goal
TEF = Toxicity Equivalency Factor

Site 6. In addition to the analytes that exceed PRGs listed in Table 5-2, the following analytes (and the ranges of concentrations) were detected at concentrations below the PRGs: aluminum (4,020.0-10,000.0 mg/kg), barium (35.5-214.0 mg/kg), cadmium (ND-1.9 mg/kg), calcium (817.0-2,780.0 mg/kg), chromium, total (7.4-22.1 mg/kg), cobalt (2.4-8.1 mg/kg), copper (4.3-56.9 mg/kg), iron (127.0-16,600.0 mg/kg), magnesium (1,490.0-4,760.0 mg/kg), nickel (ND-8.6 mg/kg), potassium (1,540.0-5,000.0 mg/kg), silver (ND-35.7 mg/kg), sodium (ND-207.0 mg/kg), vanadium (10.5-33.1 mg/kg), zinc (22.1-87.6 mg/kg), 2,4-dimethylphenol (ND-2.3 mg/kg), 4-methylphenol (ND-3.9 mg/kg), trichloroethylene (ND-0.02 mg/kg), m,p-xylenes (ND-0.0063 mg/kg), xylenes, total (ND-0.0115 mg/kg), DDE (ND-0.0067 mg/kg), DDT (ND-0.014 mg/kg), octachlorodibenzo-p-dioxin (ND-0.0037 mg/kg), and octachlorodibenzofuran (ND-0.00049 mg/kg).

Site 9. In addition to the analytes that exceed PRGs listed in Table 5-2, the following analytes (and the ranges of concentrations) were detected at concentrations below the PRGs: aluminum (6,220.0-11,100.0 mg/kg), barium (97.6-129.0 mg/kg), calcium (2,260.0-3,900.0 mg/kg), chromium, total (8.9-11.8 mg/kg), cobalt (5.0-6.3 mg/kg), copper (8.5-17.4 mg/kg), iron (10,300.0-14,600.0 mg/kg), lead (ND-11.9 mg/kg), magnesium (3,220.0-4,370.0 mg/kg), manganese (230.0- 300.0 mg/kg), nickel (ND-4.5-5.7 mg/kg), potassium (3,100.0-4,200.0 mg/kg), sodium (ND-117.0 mg/kg), vanadium (22.5-28.3 mg/kg), zinc (30.0-44.7 mg/kg), and DDT (ND-0.0038 mg/kg).

Site 10. In addition to the analytes that exceed PRGs listed in Table 5-2, the following analytes (and the ranges of concentrations) were detected at concentrations below the PRGs: aluminum (1,610.0-1,790.0 mg/kg), barium (89.0-222.0 mg/kg), cadmium (ND-0.52 mg/kg), calcium (1,830.0-2,940.0 mg/kg), chromium, total (3.4-8.8 mg/kg), cobalt (1.8-2.2 mg/kg), copper (4.0-4.8 mg/kg), iron (2660.0-2980.0 mg/kg), lead (14-37.4 mg/kg), magnesium (849.0-1,290.0 mg/kg), manganese (93.5-132.0 mg/kg), potassium (593.0-631.0 mg/kg), vanadium (5.6-6.7 mg/kg), zinc (31.1-57.1 mg/kg), bis(2-ethylhexyl)phthalate (ND-1.5 mg/kg), benzo(g,h,i)perylene (3.1-3.6 mg/kg), benzo(k)fluoranthene (1.5-1.8 mg/kg), chrysene (2.9-4.5 mg/kg), fluoranthene (ND-8.8 mg/kg), phenanthrene (3.4-9.9 mg/kg), and pyrene (3.8-8.8 mg/kg).

Site 13. In addition to the analytes that exceed PRGs listed in Table 5-2, the following analytes (for the one sample collected at this site) were detected at concentrations below the PRGs: aluminum (7,290.0 mg/kg), barium (95.5 mg/kg), calcium (2,280.0 mg/kg), chromium, total (8.7 mg/kg), cobalt (4.9 mg/kg), copper (8.2 mg/kg), iron (10,600.0 mg/kg), magnesium (3,170.0 mg/kg), manganese (221.0 mg/kg), potassium (2,790.0 mg/kg), vanadium (20.8 mg/kg), and zinc (27.0 mg/kg).

Site 15. In addition to the analytes that exceed PRGs listed in Table 5-2, the following analytes (and the ranges of concentrations) were detected at concentrations below the PRGs: aluminum (5,730.0-7,980.0 mg/kg), barium (29.7-108.0 mg/kg), calcium (1,880.0-4,790.0 mg/kg), chromium, total (6.9-13.6 mg/kg), cobalt (3.7-5.8 mg/kg), copper (7.3-15.1 mg/kg), iron (9,330.0-17,300.0 mg/kg), lead (ND-10.0 mg/kg), magnesium (3,000.0-5,170.0 mg/kg), manganese (160.0- 372.0 mg/kg), nickel (ND-4.7-11.1 mg/kg), potassium (1,330.0-4,040.0 mg/kg), sodium (ND-228.0 mg/kg), vanadium (18.5- 27.5 mg/kg), zinc (26.8-40.1 mg/kg), benzo(b)fluoranthene (ND-0.54 mg/kg), benzo(g,h,i)perylene (ND-0.4 mg/kg), chrysene (ND-0.41 mg/kg), fluoranthene (ND-0.38 mg/kg), indeno(1,2,3-c,d)pyrene (ND-0.44 mg/kg), 2-methylnaphthalene (ND-5.8 mg/kg), naphthalene (ND-2.0 mg/kg), and phenanthrene (ND-2.1 mg/kg).

Site 16. In addition to the analytes that exceed PRGs listed in Table 5-2, the following analytes (and the ranges of concentrations) were detected at concentrations below the PRGs: aluminum (5,550.0-10,500.0 mg/kg), barium (106.0-172.0 mg/kg), cadmium (ND-0.76 mg/kg), calcium (1,490.0-10,400.0 mg/kg), chromium, total (6.2-27.6 mg/kg), cobalt (3.6-7.7 mg/kg), copper (6.9-18.7 mg/kg), iron (8,590.0-18,000.0 mg/kg), lead (ND-16.5 mg/kg), magnesium (2,390.0-5,990.0 mg/kg), mercury (ND-0.4 mg/kg), nickel (ND-8.5 mg/kg), potassium (2,090.0-5,320.0 mg/kg), silver (ND-17.3 mg/kg), sodium (ND-167.0 mg/kg), vanadium (17.3-38.8

mg/kg), zinc (21.3-88.8 mg/kg), alpha-chlordane (ND-0.0031 mg/kg), gamma-chlordane (ND-0.0041 mg/kg), DDD (ND-0.016 mg/kg), DDE (ND-0.0042 mg/kg), and DDT (ND-0.0098 mg/kg), dieldrin (ND-0.052 mg/kg).

Site 18. In addition to the analytes that exceed PRGs listed in Table 5-2, the following analytes (and the ranges of concentrations) were detected at concentrations below the PRGs: aluminum (6,980.0-9,540.0 mg/kg), barium (101.0-143.0 mg/kg), calcium (2,810.0-10,500.0 mg/kg), chromium, total (11.2-17.3 mg/kg), cobalt (5.1-7.6 mg/kg), copper (10.7-14.0 mg/kg), iron (9,960.0-13,500.0 mg/kg), lead (6.9-38.8 mg/kg), magnesium (3,410.0-5,480.0 mg/kg), manganese (244.0-349.0 mg/kg), mercury (ND-0.14 mg/kg), nickel (5.3-9.2 mg/kg), potassium (3,060.0-4,530.0 mg/kg), vanadium (17.3-21.9 mg/kg), zinc (31.6-45.5 mg/kg), di-n-butyl phthalate (ND-0.56 mg/kg) alpha-chlordane (ND-0.011 mg/kg), gamma-chlordane (ND-0.012 mg/kg), and DDT (ND-0.0041 mg/kg).

Site 29. In addition to the analytes that exceed PRGs listed in Table 5-2, the following analytes (and the ranges of concentrations) were detected at concentrations below the PRGs: aluminum (6,970.0-13,500.0 mg/kg), antimony (ND-7.6 mg/kg), barium (84.8-200.0 mg/kg), cadmium (ND-4.2 mg/kg), calcium (1,820.0-4,790.0 mg/kg), chromium, total (8.1-23.9 mg/kg), chromium, hexavalent (ND-0.19 mg/kg), cobalt (5.0-10.4 mg/kg), copper (9.8-73.5 mg/kg), iron (11,200.0-20,000.0 mg/kg), magnesium (3,280.0-5,970.0 mg/kg), mercury (ND-0.78 mg/kg), nickel (ND-9.5 mg/kg), potassium (3,640.0-6,480.0 mg/kg), silver (ND-27.2 mg/kg), sodium (ND-441.0 mg/kg), vanadium (21.2-42.9 mg/kg), zinc (34.1- 122.0 mg/kg), benzo(b)fluoranthene (ND-0.37 mg/kg), fluoranthene (ND-0.68 mg/kg), alpha-chlordane (ND-0.0063 mg/kg), gamma-chlordane (ND-0.0062 mg/kg), DDD (ND-0.011 mg/kg), DDE (ND-0.0097 mg/kg), and DDT (ND-0.028 mg/kg), and octachlorodibenzo-p-dioxin (ND-0.0029 mg/kg).

Site 31. In addition to the analytes that exceed PRGs listed in Table 5-2, the following analytes (and the ranges of concentrations) were detected at concentrations below the PRGs: aluminum (6,440.0-18,000.0 mg/kg), antimony (ND-8.3 mg/kg), barium (32.6-822.0 mg/kg), calcium (1,930.0-12,400.0 mg/kg), cadmium (ND-3.2 mg/kg), chromium, total (10.0- 66.9 mg/kg), cobalt (4.2-10.2 mg/kg), copper (8.3-22.9 mg/kg), iron (11,000.0-23,200.0 mg/kg), magnesium (3,350.0-8,590.0 mg/kg), nickel (4.4-10.8 mg/kg), potassium (1,350.0-7,720.0 mg/kg), sodium (ND-446.0 mg/kg), vanadium (21.9- 54.1 mg/kg), zinc (29.6-384.0 mg/kg), bis(2-ethylhexyl) phthalate (ND-0.5 mg/kg), benzo(g,h,i)perylene (ND-0.71), chrysene (ND-1.3 mg/kg), fluoranthene (ND-2.4 mg/kg), phenanthrene (ND-2.1 mg/kg), pyrene (ND-2.3 mg/kg), DDT (ND-0.13 mg/kg), endosulfan sulfate (ND-0.046 mg/kg), and endrin aldehyde (ND-0.062 mg/kg).

Site 34. In addition to the analytes that exceed PRGs listed in Table 5-2, the following analytes (and the ranges of concentrations) were detected at concentrations below the PRGs: aluminum (7,260.0-8,760.0 mg/kg), barium (87.5-139.0 mg/kg), calcium (1,910.0-3,170.0 mg/kg), chromium, total (6.4-13.6 mg/kg), cobalt (4.7-6.5 mg/kg), copper (7.7-10.9 mg/kg), iron (13,600.0-16,800.0 mg/kg), lead (5.7-37.8 mg/kg), magnesium (3,140.0-4,430.0 mg/kg), manganese (249.0- 315.0 mg/kg), nickel (ND-4.2 mg/kg), potassium (3,790.0-4,880.0 mg/kg), sodium (128.0-274.0 mg/kg), vanadium (21.5- 30.2 mg/kg), zinc (38.4-71.4 mg/kg), anthracene (ND-3.8 mg/kg), benzo(g,h,i)perylene (ND-2.0 mg/kg), chrysene (ND-6.0 mg/kg), fluoranthene (ND-13.0 mg/kg), phenanthrene (ND-10.0 mg/kg), pyrene (ND-10.0 mg/kg), and DDT (ND-0.045 mg/kg).

Site 38. In addition to the analytes that exceed PRGs listed in Table 5-2, the following analytes (and the ranges of concentrations) were detected at concentrations below the PRGs: aluminum (6,860.0-9,900.0 mg/kg), barium (103.0-148.0 mg/kg), calcium (1,950.0-2,200.0 mg/kg), chromium, total (10.0-14.1 mg/kg), cobalt (5.2-7.0 mg/kg), copper (10.0-13.4 mg/kg), iron (10,900.0-14,700.0 mg/kg), lead (6.3-12.1 mg/kg), magnesium (3,300.0-4,410.0 mg/kg), manganese (214.0- 295.0 mg/kg), nickel (ND-6.1 mg/kg), potassium (3,080-4,280 mg/kg), sodium (ND-118.0 mg/kg), vanadium (24.4-32.8 mg/kg), zinc (33.2-83.8 mg/kg), DDD (ND-0.0077 mg/kg), DDE

(0.025-0.036 mg/kg), DDT (0.018-0.046 mg/kg), and dieldrin (ND-0.017 mg/kg).

6.0 SUMMARY OF SITE RISKS

A human health risk assessment was conducted for March AFB OU1 sites following USEPA Region IX and California EPA guidance. This baseline risk assessment produced estimates of the potential risks to public health from site contaminants as if no cleanup would occur. Exposures to contaminated surface soil, groundwater, and air were addressed by the risk assessment. Although groundwater is not currently used as a source of drinking water in the vicinity of March AFB, the State of California considers the groundwater a potential source of drinking water. Therefore, risk to potential future groundwater consumers (residents and industrial workers) was evaluated. Ecological risks for OU1 sites were not addressed by the baseline risk assessment but will be addressed in an upcoming basewide RI/FS.

6.1 CHEMICALS OF POTENTIAL CONCERN

Soil and groundwater analytical data were used to select chemicals of potential concern in soil, groundwater, and air for sites or groundwater plumes. All organic analytes detected in one or more site samples were retained as chemicals of potential concern for that site. For naturally-occurring inorganic chemicals in the soil, the selection process included statistical comparisons of site inorganic concentrations to OU1 background data. For inorganic chemicals in groundwater, total inorganic concentrations were statistically compared with background data for total inorganics. Selection of a chemical as a potential chemical of concern does not in itself indicate a need for remediation. Chemicals of potential concern were evaluated in the human health risk assessment, and the results of the risk assessment were used to determine the need for remediation.

Soil gas data collected at Sites 4, 5, 18, and 31 were used to select volatile organic compounds (VOCs) of potential concern in air at these sites. All volatile chemicals of potential concern in soil that had a vapor pressure greater than 1 millimeter of mercury were also selected as VOCs of potential concern in air.

The site arithmetic mean concentration and 95% upper confidence limit (UCL) of the arithmetic mean were calculated for chemicals of potential concern in soil, groundwater, and air. The following classes of chemicals were identified as chemicals of potential concern in either surface or subsurface soil:

- Inorganics: All sites.
- PAHs: Sites 4, 5, 10, 15, 29, 31, and 34.
- Organochlorine Pesticides: Sites 4, 5, 7, 9, 16, 18, 29, 31, 34, and 38.
- Dioxins and Furans: Sites 7, 15, and 29.
- Other SVOCs: Sites 4, 5, 7, 10, 18, 29, 31, and 34.
- VOCs: Sites 4, 5, 7, 15, 18, and 31.

For groundwater the following classes of chemicals were identified as chemicals of potential concern:

- Inorganics: All plumes.
- PAHs: OU1 Plume and Site 18 Plume.
- Other SVOCs: All plumes.
- VOCs: All plumes.

For air, VOCs were identified as chemicals of potential concern at the following sites: 4, 5, 7, 15, 18, 31, and 34.

For a complete listing of each chemical of potential concern identified at each side, see Volume I of the Remedial Investigation/Feasibility Study Report for Operable Unit 1.

6.2 EXPOSURE ASSESSMENT

Current and future human receptors were identified by selecting receptors who are or may be exposed to contaminated media (i.e., soil, groundwater, and air) at or migrating from OU1 sites. Human receptors could contact the following contaminated media:

- Contaminated site surface soil.

- Contaminated site subsurface soil.

- Contaminated groundwater (i.e., the OU1 Plume, Site 4 Plume, and Site 18 Plume). Contaminated groundwater is not currently consumed by onbase or offbase receptors.

- Contaminated air (i.e., contaminated dust or airborne VOCs) at an OU1 site or contaminated air that has migrated from an OU1 site to another area without OU1 or offbase.

The following human receptors who may contact contaminated site media were identified: current onsite base workers, current onbase/offsite adults, current offbase resident adults, current offbase school children, current offbase workers, future onsite resident children and adults, future onsite industrial workers, and future onsite construction workers.

Seven pathways were identified for receptors exposed to chemicals in soil, groundwater, or air. These exposure pathways are as follows:

- Dermal absorption of chemicals from the soil.
- Incidental ingestion of chemicals in soil.
- Ingestion of chemicals in drinking water.
- Inhalation of volatilized organic compounds while showering.
- Dermal absorption of chemicals in shower water.
- Inhalation of contaminated fugitive dust.
- Inhalation of volatile organic compounds.

Receptor intake estimates (i.e., exposure estimates) were calculated using receptor contaminant exposure concentrations and U.S. EPA acceptable intake models (i.e., formulas). Specific current receptor exposure information (i.e., receptor exposure frequency and duration) was obtained through interviews of March AFB personnel and offbase contacts. Where receptor-specific information was not available, applicable U.S. EPA and California EPA standard default exposure factors were used. Professional judgment was used for selection of other receptor-specific exposure factors.

6.3 TOXICITY ASSESSMENT

A reference dose, or RfD, is the toxicity value most often used to evaluate non-carcinogenic effects resulting from exposure to contaminants. The U.S. EPA has developed RfDs for both the oral exposure route and reference concentrations (RfCs) for the inhalation exposure route. The first source for RfDs and RfCs (which were converted to inhalation RfDs) was the U.S. EPA's IRIS database. If RfDs or RfCs had not been published in IRIS, the U.S. EPA's Health Effects Assessment Summary Tables (HEAST) was used as a second source. If values were not available from either IRIS or HEAST, Applied Action Levels (AALs) developed by the State of California were used to calculate RfDs. In such cases, the AAL for air or water was assumed to be equivalent to a unit risk concentration and was converted to an inhalation or oral RfD. Only AALs derived from non-carcinogenic endpoints for human receptors were used to convert to RfDs.

A slope factor is an upper 95th percent confidence limit of the probability of a carcinogenic response per unit intake of a chemical over a lifetime. Slope factors were obtained from the U.S. EPA's IRIS as a first source. These slope factors have been verified by the U.S. EPA Carcinogen Risk Assessment Verification Endeavor (CRAVE) work group. If a slope factor could not be retrieved from IRIS, the slope factor was obtained from the HEAST as a second source. Slope factor values developed by the California EPA Standards and Criteria Work Group were used if more conservative than IRIS or HEAST values.

6.4 RISK CHARACTERIZATION AND CONCLUSIONS

Risk is estimated by determining the amount of a chemical in a medium (soil, water, or air) that a person may ingest, inhale, or contact over a period of time (exposure) and comparing the exposure to a dose of the chemical known to cause harm. The risk potential is expressed in terms of the chance of a disease occurring. To calculate this chance, conservative assumptions are made to protect public health.

Because cancer can result from exposure to chemicals at levels lower than that which cause other health problems, the greatest concern is that exposure may result in cancer. Therefore, the exposure is compared to the probability of increasing the risk of cancer. A risk level of 1 in 1,000,000 means that one additional person out of 1 million people exposed could develop cancer as a result of the exposure. To be considered protective of human health, the cancer risk from exposure to a chemical should be within or less than the range of 1 in 10,000 to 1 in 1,000,000. Non-cancer causing effects are measured in terms of their hazard index, which is an index of the potential for adverse, non-cancer health effects. The acceptable hazard index for protection of human health is less than or equal to 1. Risk from exposure to lead in the environment is expressed in terms of predicted blood-lead concentrations rather than increased risk of cancer.

Because March AFB is scheduled for realignment, portions of the base may become available for use by other government agencies or the public. Therefore, the risk assessment considered potential future land uses as well as current land uses in the determination of risks posed by soil, air, and groundwater contaminants.

The populations potentially exposed to contaminants in OU1 include workers currently at the base, current offbase residents and school children, and potential future residents, industrial workers, or construction worker, if the base is redeveloped for residential and/or industrial purposes. Table 6-1 presents the increased risks to current workers and potential future residents, industrial workers, and construction workers as determined by the scenarios discussed below. The increased risks, as presented in Table 6-1, could result from the following:

- Current Risk for Workers, Offbase Residents, and Offbase School/Children from Exposure to Contaminated Soils. A potential exists for current base workers to be adversely exposed to contaminants through dermal contact with or ingestion/inhalation of contaminated soils. Additionally, offbase residents and school children could be adversely exposed to soil contaminants through inhalation of contaminants migrating in air offbase. Current cancer risk was found to be elevated for base workers at Sites 15, 29, and 31. A summary of increased risks from exposure to contaminated soils is presented in Table 6-1.

- Future Risk for Residents from Exposure to Contaminated Soils. This setting assumes that there is unrestricted land use and that the base is redeveloped for resident housing. A potential exists for future residents to be adversely exposed through dermal contact with or ingestion/inhalation of contaminated soils. Increased cancer risk was found for exposure to contaminants in soils at Sites 4, 7, 9, 10, 15, 29, 31, and 34. Table 6-1 presents increased risks for future residents. Increased non-cancer risk was identified for exposure to contaminants in soils at Sites 10, 16, and 29.

- Future Risk for Industrial Workers from Exposure to Contaminated Soils. This setting assumes that the future use of the base is light industrial (such as continued use for aircraft repair). Future workers could be exposed to site chemicals through contact with soil, or through soil ingestion/inhalation. Increased cancer risk was found for exposure to contaminants in soils at Sites 4, 7, 9, 10, 15, 29, 31, and 34. A summary of increased risks from exposure to contaminated soil is presented in Table 6-1.

- Future Risk for Construction Workers from Exposure to Contaminated Soils. Because it is assumed that the base will be redeveloped in the future, construction activities, especially excavation, could cause construction workers to be adversely exposed through dermal contact with or ingestion/inhalation of contaminated soils. Increased cancer risk was found for exposure to contaminants in soil at Sites 4, 10, 15, 31, and 34. A summary of increased risks from exposure to contaminated soils is presented in Table 6-1.

- Future Risk for Residents and Industrial Workers from Drinking and Personal Use of Contaminated Groundwater. The State of California considers groundwater beneath the base a potential source of drinking water. The risk related to drinking and using water (such as showering) from a plume was assessed. A summary of increased risks from exposure to contaminated groundwater is presented in Table 6-1.

TABLE 6-1

SUMMARY OF OU1 RISK

Site	Setting	Hazard Index Adult	Hazard Index Child	Cancer Risk 30-Year Resident	Cancer Risk Adult
	SOIL				
4	Future Industrial Worker				
	Ingestion of Surface Soil	0.002	NA	NA	1 in 10 thousand
	Direct Contact with Surface Soil	0.05	NA	NA	5 in 1 thousand
4	Future Onsite Resident				
	Ingestion of Surface Soil	0.005	0.05	1 in 1 thousand	NA
	Direct Contact with Surface Soil	0.05	0.3	9 in 1 thousand	NA
4	Future Construction Worker				
	Ingestion of Surface Soil	0.02	NA	NA	4 in 1 million
	Direct Contact with Surface Soil	0.07	NA	NA	3 in 100 thousand
7	Future Onsite Resident				
	Ingestion of Surface Soil	0.03	0.3	1 in 100 thousand	NA
	Direct Contact with Surface Soil	0.05	0.3	5 in 100 thousand	NA
7	Future Industrial Worker				
	Direct Contact with Surface Soil	0.05	NA	NA	2 in 100 thousand
9	Future Onside Resident				
	Ingestion of Surface Soil	0.0001	0.001	4 in 1 million	NA
	Direct Contact with Surface Soil	0.002	0.01	5 in 100 thousand	NA
9	Future Industrial Worker				
	Direct Contact with Surface Soil	0.002	NA	NA	2 in 100 thousand
10	Future Industrial Worker				
	Ingestion of Surface Soil	0.01	NA	NA	5 in 100 thousand
	Direct Contact with Surface Soil	0.2	NA	NA	1 in 1 thousand
10	Future Onsite Resident				
	Ingestion of Surface Soil	0.05	0.5	4 in 10 thousand	NA
	Direct Contact with Surface Soil	0.2	1	3 in 1 thousand	NA

TABLE 6-1
SUMMARY OF OU1 RISK (Continued)

Site	Setting	Hazard Index Adult	Hazard Index Child	Cancer Risk 30-Year Resident	Cancer Risk Adult
	SOIL (CONTINUED)				
10	Future Construction Worker				
	Ingestion of Surface Soil	0.07	NA	NA	2 in 100 thousand
	Direct Contact with Surface Soil	0.3	NA	NA	1 in 10 thousand
15	Future Industrial Worker				
	Ingestion of Surface Soil	0.01	NA	NA	4 in 1 million
	Direct Contact with Surface Soil	0.04	NA	NA	1 in 10 thousand
15	Future Onsite Resident				
	Ingestion of Surface Soil	0.03	0.3	4 in 100 thousand	NA
	Direct Contact with Surface Soil	0.04	0.2	3 in 10 thousand	NA
15	Future Construction Worker				
	Direct Contact with Surface Soil	0.1	NA	NA	1 in 100 thousand
15	Current Base Fire Department Worker				
	Direct Contact with Surface Soil	0.004	NA	NA	1 in 100 thousand
16	Future Onsite Resident				
	Ingestion of Surface Soil	0.1	1	1 in 10 million	NA
	Direct Contact with Surface Soil	0.7	4	1 in 10 thousand	NA
29	Future Onside Resident				
	Ingestion of Surface Soil	0.2	1	1 in 100 thousand	NA
	Direct Contact with Surface Soil	0.6	4	1 in 10 thousand	NA
29	Future Industrial Worker				
	Direct Contact with Surface Soil	0.06	NA	NA	2 in 1 million
	Direct Contact with Surface Soil	0.6	NA	NA	5 in 100 thousand
29	Current Worker at Radar Facility				
	Direct Contact with Surface Soil	0.6	NA	NA	5 in 100 thousand
31	Future Industrial Worker				
	Ingestion of Surface Soil	0.01	NA	NA	4 in 1 million
	Direct Contact with Surface Soil	0.1	NA	NA	1 in 10 thousand

TABLE 6-1
SUMMARY OF OU1 RISK
(Continued)

Site	Setting	Hazard Index Adult	Hazard Index Child	Cancer Risk 30-Year Resident	Cancer Risk Adult
	SOIL (CONTINUED)				
31	Future Onsite Resident				
	Ingestion of Surface Soil	0.03	0.3	4 in 100 thousand	NA
	Direct Contact with Surface Soil	0.1	0.7	3 in 10 thousand	NA
31	Future Construction Worker				
	Direct Contact with Surface Soil	0.001	NA	NA	1 in 100 thousand
31	Current Site Worker				
	Ingestion of Surface Soil	0.01	NA	NA	4 in 1 million
	Direct Contact with Surface Soil	0.1	NA	NA	1 in 10 thousand
34	Future Industrial Worker				
	Ingestion of Surface Soil	0.001	NA	NA	4 in 100 thousand
	Direct Contact with Surface Soil	0.02	NA	NA	2 in 1 thousand
34	Future Onsite Resident				
	Ingestion of Surface Soil	0.002	0.02	4 in 10 thousand	NA
	Direct Contact with Surface Soil	0.02	0.1	4 in 1 thousand	NA
34	Future Construction Worker				
	Ingestion of Surface Soil	0.0006	NA	NA	6 in 1 million
	Direct Contact with Surface Soil	0.004	NA	NA	7 in 100 thousand
	GROUNDWATER				
OU1 Plume	Future Industrial Worker				
	Direct Contact with Water While Showering	0.009	NA	NA	4 in 1 million
	Ingestion of Groundwater	0.3	NA	NA	2 in 100 thousand
	Inhalation of Vapors While Showering	10	NA	NA	9 in 10 thousand
OU1 Plume	Future Onsite Resident				
	Direct Contact with Water While Showering	0.1	NA	8 in 1 million	NA
	Ingestion of Groundwater	0.3	NA	NA	1 in 10 thousand
	Inhalation of Vapors While Showering	20	NA	2 in 1 thousand	NA

TABLE 6-1
SUMMARY OF OU1 RISK
(Continued)

Site	Setting	Hazard Index Adult	Hazard Index Child	Cancer Risk 30-Year Resident	Cancer Risk Adult
	GROUNDWATER (CONTINUED)				
Site 4 Plume	Future Industrial Worker				
	Direct Contact with Water While Showering	0.1	NA	NA	3 in 100 thousand
	Ingestion of Groundwater	0.3	NA	NA	1 in 10 thousand
	Inhalation of Vapors While Showering	20	NA	NA	3 in 1 thousand
Site 4 Plume	Future Onsite Resident				
	Direct Contact with Water While Showering	0.3	NA	6 in 100 thousand	NA
	Ingestion of Groundwater	0.5	NA	2 in 10 thousand	NA
	Inhalation of Vapors While Showering	20	NA	4 in 1 thousand	NA
Site 18 Plume	Future Industrial Worker				
	Direct Contact with Water While Showering	4	NA	NA	2 in 1 thousand
	Ingestion of Groundwater	80	NA	NA	7 in 1 thousand
	Inhalation of Vapors While Showering	200	NA	NA	5 in 10
Site 18 Plume	Future Onsite Resident				
	Direct Contact with Water While Showering	5	NA	4 in 1 thousand	NA
	Ingestion of Groundwater	100	NA	1 in 1 hundred	NA
	Inhalation of Vapors While Showering	300	NA	9 in 10	NA

Key: NA = Not Applicable
Note: Only pathways which contributed significantly to risk are included.

Risk From Soils. The findings of the carcinogenic and non-carcinogenic risk assessment for receptor exposure to soil contaminants for each site are discussed briefly below. Current onside base workers and future onsite residents and industrial workers have been assumed to be exposed to the 0- to 2-foot surface soil interval. Future construction workers have been assumed to be exposed to the 0- to 12-foot subsurface soil interval.

- Site 4. No risk to current populations was identified for Site 4. As discussed above, the risk assessment also considered hypothetical future residents, light industrial workers, and construction workers who might live or work on or near Site 4. For hypothetical future residents, industrial workers, and construction workers, an increased cancer risk was identified. The contaminants at Site 4 that most affected risk are PAHs.

- Site 5. No risk to current or future populations was identified for Site 5.

- Site 7. No risk to current populations was identified for Site 7. For hypothetical future residents and industrial workers, an increased cancer risk was identified. The contaminants at Site 7 that most affected risk are beryllium and dioxins.

- Site 9. No risk to current populations was identified for Site 9. For hypothetical future residents and industrial workers, an increased cancer risk was identified. The contaminant at Site 9 that most affected risk are beryllium.

- Site 10. No risk to current populations was identified for Site 10. For hypothetical future residents, industrial workers, and construction workers, an increased cancer risk was identified. The contaminants at Site 10 that most affected cancer risk are PAHs and beryllium. For hypothetical future residents, an increased non-cancer risk was identified. The contaminant that most affected non-cancer risk is manganese.

- Site 13. No risk to current or future populations was identified for Site 13.

- Site 15. A cancer risk was identified for current onsite base workers at Site 15. For hypothetical future residents, industrial workers, and construction workers, an increased cancer risk was identified. The contaminants at Site 15 that most affected risk are PAHs and dioxins.

- Site 16. No risk to current populations was identified for Site 16. For hypothetical future residents, an increased non-cancer risk was identified. The contaminant that most affected risk is manganese.

- Site 18. No risk to current or future populations are identified for Site 18 soils.

- Site 29. An increased cancer risk was identified for current onsite base workers at Site 29. For hypothetical future residents and industrial workers, an increased cancer risk was also identified. The contaminants at Site 29 that most affected cancer risk are beryllium, PAHs and dioxins. For hypothetical future residents, an increased non-cancer risk was identified. The contaminant that most affected non-cancer risk is manganese.

- Site 31. An increased cancer risk was identified for current onsite workers at Site 31. For hypothetical future residents, industrial workers, and construction workers, an increased cancer risk was also identified. The contaminants at Site 31 that most affected risk are PAHs and beryllium.

- Site 34. No risk to current populations was identified for Site 34. For hypothetical future residents, industrial workers, and construction workers, an increased cancer risk was identified. The contaminants at Site 34 that most affected risk were PAHs.

- Site 38. No risk to current or future populations was identified for Site 38. Predicted concentrations of lead in blood (Pb-B) for receptors show that Pb-B concentrations for the following receptors exceed the Pb-B concentration of concern of 10 µg/dL:

- Future Onsite Resident Children (ingestion rate of 200 mg/day).
  - Site 31 (estimated Pb-B concentration of 10.5 µg/dL for the 99th percentile).

These receptors are considered to have borderline risk through exposure to lead.

Risk from Groundwater. Results of the carcinogenic and non-carcinogenic risk assessment for exposure to groundwater contaminants within each plume are discussed briefly below:

- OU1 Groundwater Plume. Throughout the area of the OU1 groundwater plume, there are no current users of groundwater. Therefore, no receptors are currently exposed to groundwater contaminants and there is no increased risk of cancer. However, since the State of California considers all groundwater as potential drinking water, the risk assessment considered the exposure of hypothetical future resident adults and industrial workers who may occupy this area. For future receptors, an increased risk for both resident adults and industrial workers was identified using this assumption. This increased risk was due to exposure to groundwater contaminated with benzene, bromodichloromethane, bromoform, carbon tetrachloride, dibromochloromethane, 1,2-dichloroethane, 1,1-dichloroethene, methylene chloride, tetrachloroethylene, and trichloroethylene. For future resident adults and industrial workers, an increased noncancer risk was identified for exposure to OU1 plume water. The contaminants that most affected noncancer risk were TCE and carbon tetrachloride.

- Site 4 Plume. There are no current users of groundwater from the Site 4 plume. Therefore, no receptors are currently exposed to groundwater contaminants and there is no increased risk of cancer. However, for future receptors, increased risk was identified for both resident adults and industrial workers. This increased risk was due to exposure to groundwater contaminated with tetrachloroethylene, trichloroethylene, benzene, bis(2-ethylhexyl)phthalate, 1,4-dichlorobenzene, 1,2-dichloropropane, cis-1,2-dichloroethene, methylene chloride, and vinyl chloride. For future resident adults and industrial workers, an increased non-cancer risk was identified for exposure to Site 4 plume water. The contaminants that most affected non-cancer risk were TCE, PCE, and cis-1,2-DCE.

- Site 18 Plume. There are no current users of groundwater from Site 18 plume. Therefore, no receptors are currently exposed to groundwater contaminants and there is no increased risk of cancer. However, for future receptors, increased risk was identified for both resident adults and industrial workers. This increased risk was due to exposure to groundwater contaminated with benzene, ethylbenzene, methylene chloride, thallium, toluene, trichloroethylene, and total xylenes. For future resident adults and industrial workers, an increased non-cancer risk was identified for exposure to Site 18 plume water. The contaminants that most affected non-cancer risk were TCE, toluene, xylenes (total), ethylbenzene, and thallium.

- Site 31 Plume. For risk assessment purposes, the Site 31 plume was considered part of th OU1 plume.

Conclusions. Actual or threatened releases of hazardous substances from OU1 sites at March AFB, if not addressed by the response actions selected in this ROD, may present a current or potential threat to public health, welfare, or the environment as discussed in Section 6.4.

6.5 Cleanup Standards and Goals

Section 6.6.1 presents groundwater cleanup standards based on ARARs and Section 6.6.2 presents soil cleanup standards. Surface soil cleanup standards in are based on risk-based PRGs, and subsurface soil cleanup standards are based on protection of groundwater from contaminant sources in subsurface soil.

6.5.1 Groundwater Cleanup Standards and Goals

ARARs are Applicable or Relevant and Appropriate Requirements. A requirement may be "applicable" or "relevant and appropriate". "Applicable" requirements are those promulgated Federal or state requirements that specifically address a hazardous waste site. "Relevant and appropriate" requirements are those promulgated Federal or state requirements that, while no legally applicable, are designed to apply to problems sufficiently similar to those encountered at CERCLA sites that their application is appropriate. Relevant and appropriate requirements are applied in the same manner as applicable requirements.

For those situations or chemicals were no ARAR exists, or where the ARAR is not protective of human health and the environment, to-be-considered (TBC) information is evaluated. There are a number of guidance documents and non-promulgated standards that can be used in the development of "criteria" for remedial action. This step of the ARARs process involves review of advisory, guidance, and nonpromulgated standards documents to aid in the development of other considerations for site remedial actions.

There are three types of ARARs: chemical-specific, location-specific, and action-specific. In addition to the chemical-specific standards used as cleanup standards, CERCLA requires that site cleanups comply with other location-specific and action-specific ARARs. Location-specific ARARs govern activities in certain environmentally sensitive areas, such as floodplains, wetlands, endangered species habitats, or historically significant resources. Action-specific ARARs are restrictions that define acceptable treatment and disposal procedures for hazardous substances. These ARARs generally set performance, design, or other similar action-specific controls or restrictions particular kinds of activities related to management of hazardous substances or pollutants. These chemical-, location-, and action-specific ARARs are discussed in Chapter 8.0 and the accompanying tables.

Although there are no current users of groundwater in the immediate vicinity of March AFB, the State of California considers groundwater beneath the base to be a source of drinking water. Therefore, Federal and State MCLs, which are chemical- specific ARARs and drinking water standards, are considered to be protective of human health, and appropriate as cleanup standards. The Federal MCLs are established in 40 CFR 141.61(a) and the California MCLs are established in Title 22 CCR 64444.5. Where the Federal and State MCLs for a contaminant are not the same, the more stringent of the two is used as a cleanup standard.

Table 6-2 presents maximum concentrations of groundwater contaminants in each plume identified and the associated groundwater cleanup standards.

6.5.2 Soil Cleanup Standards and Goals

The standard of soil cleanup is twofold: to protect human health by preventing exposure to contaminated soils, and to prevent future degradation of groundwater from contaminants migrating downward through the soil. Cleanup levels necessary to meet these two standards were determined by considering two soil zones: surface soil (0-2 feet below ground surface) and subsurface (from the ground surface to groundwater level). For the surface soil interval, cleanup standards were based on U.S. EPA Region IX risk-based PRGs; for subsurface soil, the standards were based on results of computer modeling. Section 6.6.2.1 discusses cleanup for surface soil, and Section 6.6.2.2 discusses cleanup for subsurface soil.

6.5.2.1 Surface Soil Cleanup Standards and Goals

Surface soil cleanup standards at March AFB are based on U.S. EPA Region IX residential scenario PRGs; residential PRGs were used because they are considered protective of human health. These PRGs were determined to be appropriate for all sites with the exception of Sites 7 and 29. At these sites, rather than basing remediation goals on unrestricted (residential) land use, the remediation goals were set for industrial land use. The reasons for using industrial land use scenario PRGs are discussed below.

The following is a discussion, by site, of the chemicals that exceed U.S. EPA Region IX PRGs. Table 6-3 presents concentrations of chemicals that exceed Region IX PRGs at each site. It also presents U.S. EPA Region IX residential PRGs for all sites as well as industrial PRGs for Sites 7 and 29. As discussed in Section 5.0, a contaminant does not necessarily require remediation even though it may be detected at concentrations greater than the PRG. Contaminants that require remediation were determined by considered chemicals that exceed PRGs as well as by considering the results of the risk assessment (see Section 6.4 Risk Characterization and Conclusions) and other relevant site-specific information.

TABLE 6-2

GROUNDWATER CLEANUP STANDARDS

Plume	Contaminant	Maximum Concentration (µg/l)	Cleanup Standard (State or Federal MCL) (µg/l)
Site 4	Methylene Chloride	9	5 (federal)1
	Tetrachloroethene (PCE)	260	5 (state and federal)1,2
	Trichloroethene (TCE)	85	5 (state and federal)1,2
	Vinyl Chloride	8	0.5 (state)2
	Bis(2-ethylhexyl)phthalate	290	4 (state)2
	cis-1,2-Dichloroethene	21	6 (state)2
Site 18	Benzene	12,000	1 (state)2
	Toluene	11,000	10 (federal)4
	Ethylbenzene	1,500	10 (federal)4
	Methylene Chloride	440	5 (federal)
	Phenols, Total	73	40 (state RWQCB)3
	Xylenes, Total	7,700	10 (federal)4
Site 31	Bis(2-ethylhexyl)phthalate	63	4 (state)2
	1,1-Dichloroethene	260	6 (state)2
	Trichloroethene	1,400	5 (state and federal)1,2
OU1	Bis(2-ethylhexyl)phthalate	130	4 (state)2
	Benzene	420	1 (state)2
	Carbon Tetrachloride	3	0.5 (state)2
	Trichloroethene (TCE)	1400	5 (state and federal)1,2
	1,1-Dichloroethene	260	6 (state)2
	cis-1,2-Dichloroethene	30	6 (state)2
	Methylene Chloride	45	5 (federal)1
	Tetrachloroethene (PCE)	19	5 (state and federal)1,2
	1,2-Dichloroethane	25	0.5 (state)2
	Phenols, Total	79	40 (state RWQCB)3

Key: µg/l = Micrograms per liter
RWQCB = California Regional Water Quality Control Board, Santa Ana Region
MCL = Maximum Contaminant Level

1 40 Code of Federal Regulations (CFR) 141.12 and 141.61 Maximum Contaminant Levels for Organic Contaminants.
2 Title 22, California Code of Regulations (CCR), Division 4, Chapter 15, Article 5.5, Section 64444.5, Maximum Contaminant Levels for Organic Chemicals.
3 Water Quality Control Plan, Santa Ana River Basin, 1984. Water Quality Objectives.
4 NPDES Permit, CAG918001, 14 March 1995

Site 4. Beryllium and several PAHs were detected in surface soil at concentrations greater than U.S. EPA Region IX residential PRGs (see Table 6-3). The results of the risk assessment indicate that beryllium at this site does not require remediation. However, the risk assessment indicates that the following PAHs, which also exceed PRGs, present a potential health, risk and, therefore, require remediation: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene. The estimated area requiring remediation at Site 4 is 435,164 squire feet. See Figure 6-1.

Site 5. Beryllium was detected at concentrations greater than the U.S. EPA Region IX PRG (see Table 6-3). The results of the risk assessment indicate that beryllium does not require remediation. Consequently, no contaminants at this site require remediation.

Site 7. Beryllium, lead, manganese, and several dioxins were detected at concentrations greater than U.S. EPA Region IX residential PRGs (see Table 6-3). For lead, a method developed by the California EPA, Department of Toxic Substances Control was used to estimate blood-lead concentrations, based on exposure to lead by multiple pathways. Results of this method indicate that lead does not require remediation. The results of the risk assessment indicate that manganese does not require remediation. U.S. EPA Region IX industrial PRGs, rather than residential PRGs, were used to determine the need for cleanup at Site 7 for the following reasons:

- Site 7 is located in an area to be retained by March Air Force Base, and to which the public does not have access.

- It is unlikely that Site 7 will be used for residential purposes in the future.

- Cleanup of Site 7 is considered cost-prohibitive in light of the minor risk reduction that would be achieved. The combined cost for Site 7 and Site 29 (which has also been selected for remediation based on industrial PRGs) would be $22 million.

The Air Force will ensure that this site is used appropriately in the future by implementing deed restrictions prohibiting residential land use. Based on U.S. EPA Region IX industrial land use PRGs, beryllium and dioxins do not require remediation at this site. Consequently, no contaminants at this site require remediation.

TABLE 6-3. CONCENTRATIONS OF SURFACE SOIL CONTAMINANTS EXCEEDING EPA REGION IX PRGs

Site	Chemical	Range of Concentration at Site (mg/kg)	95% Upper Confidence Limit (mg/kg)	Region IX Residential PRG(1) (mg/kg)	Region IX Industrial PRG(1) (mg/kg)
4	Benzo(a)anthracene	ND-5.5	5.5	0.61	-
	Benzo(a)pyrene	ND-8.7	8.7	0.061	-
	Benzo(b)fluoranthene	ND-14.0	14.0	0.61	-
	Benzo(g,h,i)perylene	ND-20.0	20.0	19(2)	-
	Chrysene	ND-9.7	9.7	6.1(3)	-
	Dibenz(a,h)anthracene	ND-4.2	4.2	0.061	-
	Indeno(1,2,3-c,d)pyrene	ND-21.0	21.0	0.61	-
	Beryllium	ND-0.39	0.39	0.14	-
5	Beryllium	ND-0.27	0.27	0.14	-
7	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	ND-0.00075	0.00075	0.00038(4)	0.0024(4)
	Heptachlorinated dibenzo-p-dioxins, total	ND-0.0013	0.0013	0.00038(4)	0.0024(4)
	Hexachlorinated dibenzo-p-dioxins, total	ND-0.0001	0.000089	0.000038(4)	0.00024(4)
	Beryllium	ND-0.58	0.38	0.14	1.1
	Lead	ND-855.0	80.6	130(3)	1000
	Manganese	111.0-449.0	256.7	380	7800
9	Beryllium	0.26-0.42	0.39	0.14	-
10	Benzo(a)anthracene	2.0-3.2	3.2	0.61	-
	Benzo(a)pyrene	2.9-3.5	3.5	0.061	-
	Benzo(b)fluoranthene	3.3-3.7	3.7	0.61	-
	Benzo(k)fluoranthene	1.5-1.8	1.8	0.61	
	Dibenz(a,h)anthracene	ND-0.96	0.96	0.061	-
	Indeno(1,2,3-c,d)pyrene	3.6-3.9	3.9	0.61	-
13	Beryllium	0.27(5)	0.27	0.14	-
15	Benzo(a)pyrene	ND-0.34	0.34	0.061	-
	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	ND-0.00095	0.00095	0.00038(4)	-
	Heptachlorinated dibenzo-p-dioxins, total	ND-0.0016	0.0016	0.00038(4)	-

TABLE 6-3. CONCENTRATIONS OF SURFACE SOIL CONTAMINANTS EXCEEDING EPA REGION IX PRGs

Site	Chemical	Range of Concentration at Site (mg/kg)	95% Upper Confidence Limit (mg/kg)	Region IX Residential PRG(1) (mg/kg)	Region IX Industrial PRG(1) (mg/kg)
	Beryllium	ND-0.33	0.3	0.14	-
16	Beryllium	ND-0.41	0.41	0.14	-
	Manganese	186.0-654.0	450.1	380	-
18	Beryllium	0.23-0.45	0.42	0.14	-
29	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	ND-0.00079	0.00079	0.00038(4)	0.0024(4)
	Heptachlorinated dibenzo-p-dioxins, total	ND-0.0014	0.0014	0.00038(4)	0.0024(4)
	Beryllium	0.27-0.66	0.45	0.14	1.1
	Lead	5.3-246.0	82.9	130(3)	1000
	Manganese	250.0-554.0	351.5	380	7800
31	Benzo(a)anthracene	ND-0.96	0.30	0.61	-
	Benzo(a)pyrene	ND-1.0	0.34	0.061	-
	Benzo(b)fluoranthene	ND-1.5	0.53	0.61	-
	Indeno(1,2,3-c,d)pyrene	ND-0.85	0.26	0.61	-
	Beryllium	ND-0.79	0.39	0.14	-
31	Lead	ND-311.0	121.0	130(3)	-
	Manganese	188.0-610.0	307.1	380	-
34	Benzo(a)anthracene	ND-5.8	5.8	0.61	-
	Benzo(a)pyrene	ND-3.2	3.20	0.061	-
	Benzo(b)fluoranthene	ND-4.9	4.90	0.61	-
	Indeno(1,2,3-c,d)pyrene	ND-2.2	2.20	0.61	-
34	Beryllium	0.22-0.28	0.27	0.14	-
38	Beryllium	ND-0.29	0.29	0.14	-

(1) Region IX residual soil PRGs were used for all sites except sites 7 and 29. At sites 7 and 29, industrial soil PRGs were used.

(2) A PRG was not available for this non-carcinogenic polynuclear aromatic hydrocarbon (PAH). The PRG for anthracene, which is the most conservative PRG for the non-carcinogenic PAHs, was used as a surrogate.

(3) The California EPA PRG was used for this chemical because it is more restrictive than the Region IX PRG.

(4) 2,3,7,8-TCDD is the only dioxin for which Region IX has calculated PRGs (3.8E-0.6 for residential soil and 2.4E-05 for industrial soil). Therefore, this PRG has been adjusted using a TEF listed in the table below. This adjusted value was compared to site concentrations.

Toxicity Equivalency Factors for Dioxins

Congener	TEF
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.01
Heptachlorinated dibenzo-p-dioxins, total	0.01
Hexachlorinated dibenzo-p-dioxins, total	0.1
Octachlorodibenzo-p-dioxin	0.001
Octachlorodibenzofuran	0.001

TEFs were obtained from "Supplemental Guidance for Human Health Multimedia Risk Assessments of Hazardous Waste Sites and Permitted Facilities", State of California Environmental Protection Agency, Department of Toxic Substances Control, Office of the Science Advisor, July 1992.

Key: PRG = Preliminary Remediation Goal
TEF = Toxicity Equivalency Factor

(5) Only one sample was collected at this site.

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Site 9. Beryllium was detected at concentrations that exceed the U.S. EPA Region IX residential PRG (see Table 6-3); the risk assessment also indicates increased risk for beryllium at this site. The average surface soil (0-2 ft. bgs) concentrations of beryllium (0.34 mg/kg) slightly exceeded the average background concentration (0.27 mg/kg). However, concentrations of beryllium observed at Site 9 are considered naturally-occurring for the reasons outlined below, and do not require remediation:

(1) There is no current or historical information indicating that beryllium was used, stored, or disposed of at Site 9.

(2) The range of beryllium concentrations observed at Site 9 falls within the range of background concentrations observed, i.e., the maximum site concentration (0.42 mg/kg) is less than the maximum background concentration (0.43 mg/kg).

(3) Background concentrations of beryllium exceed the U.S. EPA Region IX PRG for unrestricted land use, indicating naturally-elevated concentrations of beryllium at March AFB.

(4) The spatial distribution of beryllium concentrations at Site 9 is fairly uniform; there are no obvious "hot spots" or areas of elevated concentrations.

(5) Levels of beryllium found at Site 9 are within the acceptable range for cancer risk (10-4 to 10-6 cancer risk) for unrestricted land use. There are no other contaminants detected at Site 9 that would contribute to unacceptable risk.

Consequently, no contaminants at this site require remediation.

Site 10. Several PAHs were detected in surface soil at concentrations that exceed U.S. EPA Region IX PRGs (see Table 6-3) and were also identified by the risk assessment as presenting a potential health risk. The PAHs that require remediation are: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene. The estimated volume of PAH contaminated soil is 76 cubic yards. See Figure 6-2.

In addition to the PAHs, manganese was detected at Site 10 at concentrations that indicate potential risk. However, the maximum concentration of manganese (132.0 mg/kg) is less than the U.S. EPA Region IX PRG for residential land use (380 mg/kg). Furthermore, the concentrations of manganese at Site 10 are considered naturally-occurring for the reasons outlined below, and do not require remediation:

- There is no current or historical information indicating that manganese was used, stored, or disposed of at Site 10.

- The range of manganese concentrations observed at Site 10 falls within the range of background concentrations observed, i.e., the maximum site concentration (132.0 mg/kg) is less than the maximum background concentration (402.0 mg/kg).

- The mean concentration at the site (112.8 mg/kg) is less than the mean background concentration (266.1 mg/kg).

- The spatial distribution of manganese is fairly uniform, with no apparent patterns of elevated concentrations.

Site 13. Beryllium was detected at concentrations greater than the U.S. EPA Region IX PG (see

Table 6-3). The results of the risk assessment indicate that beryllium at this site does not require remediation. Consequently, no contamination at this site require remediation.

Site 15. Beryllium, benzo(a)pyrene, and two dioxins were detected at concentrations greater than U.S. EPA Region IX resident PRGs (see Table 6-3). The risk assessment indicates that beryllium does not require remediation at this site. Although dioxin concentrations exceed the U.S. EPA Region IX PRG for unrestricted land use, cancer risk from dioxins is within the acceptable range for cancer risk (10-4 to 10-6 cancer risk) and therefore dioxins do not require remediation at Site 15. Other contaminants present at Site 15 (PAHs) will be remediated and will not contribute to excess cancer risk. The estimated volume of PAH-contaminated soil is 15 cubic yards. See Figure 6-3.

Site 16. Beryllium and manganese were detected at concentrations that exceed U.S. EPA Region IX PRGs (see Table 6-3). The risk assessment indicates that beryllium does not require remediation at this site; manganese was detected at concentrations that indicated potential risk. For manganese, the average surface soil concentration of 366.5 mg/kg slightly exceeds the average background concentration of 266.1 mg/kg. However, concentrations of manganese detected at Site 16 are considered naturally-occurring for the reasons outlined below, and do not require remediation:

- There is no current or historical information indicating that manganese was used, stored or disposed of at Site 16.

- Of the 10 surface soil samples collected at Site 16, all but one fall within the range of background concentrations. The one sample that exceeds the range of background concentrations was 654.0 mg/kg, compared to the maximum background concentration of 502.0 mg/kg.

- The maximum background concentration (402.0 mg/kg) exceeds the U.S. EPA Region IX PRG for unrestricted land use, indicating naturally-elevated concentrations of manganese at March AFB.

- The spatial distribution of manganese is fairly uniform, with no apparent patterns of elevated concentrations.

- The mean concentration of manganese (366.5 mg/kg) is less than the U.S. EPA Region IX PRG for residential land use. The 95% UCL of the mean (450.1 mg/kg) only slightly exceeds the PRG. There are no other contaminants at Site 16 that would contribute to unacceptable risk.

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Consequently, no contaminants at this site require remediation.

Site 18. Beryllium was detected at concentrations greater than the U.S. EPA Region IX PRG (see Table 6-3); however, the results of the risk assessment indicate that beryllium at this site does not require remediation. Consequently, no surface soil contaminants at this site require remediation.

Site 29. Beryllium, lead, manganese, and two dioxins were detected at concentrations that exceed U.S. EPA Region IX residential land use PRGs (see Table 6-3). For lead, the method developed by the California EPA, Department of Toxic Substances Control, was used to estimate blood-lead concentrations, based on exposure to lead by multiple pathways. Results indicate that lead does not require remediation.

U.S. EPA Region IX industrial PRGs, rather than residential PRGs, were used at Site 29 for the following reasons:

- Site 29 is located in an area to be retained by March Air Force Base, and to which the public does not have access.

- It is unlikely that Site 29 will be used for residential purposes in the future.

- Cleanup of Site 29 is considered cost-prohibitive in light of the minor risk reduction that would be achieved. The combined cost for Site 29 and Site 7 (which has also been selected for remediation based on industrial PRGs) would be $22 million.)

The Air Force will ensure that this site is used appropriately in the future by implementing deed restrictions prohibiting residential land use.

Based on U.S. EPA Region IX industrial land use PRGs, no chemicals at this site require remediation.

Site 31. Concentrations of beryllium, lead, manganese, and several PAHs exceed U.S. EPA Region IX PRGs (see Table 6-3). For lead, the method developed by the California EPA, Department of Toxic Substances Control was used to estimate blood-lead concentrations. Results indicated that lead does not require remediation. The results of the risk assessment indicate that manganese at this site does not require remediation.

Beryllium was detected at Site 31 in concentrations that exceed the U.S. EPA Region IX PRG for unrestricted land use. The average surface soil concentration of beryllium (0.35 mg/kg) slightly exceeds the average background concentration of beryllium (0.27 mg/kg). However, concentrations of beryllium at the site are considered naturally-occurring for the reasons outlined below, and do not require remediation:

- Thee is no current or historical information indicating that beryllium was used, stored, or disposed of at Site 31. Site 31 is a solvent spill area. Chlorinated solvents were discharged to the ground through a leaking drain pipe and potentially through surface spillage. Soils data show no anomalous values for beryllium in the areas contaminated by chlorinated solvents, indicating that beryllium occurrences in Site 31 soils are unrelated to past waste handling activities.

- Of the 58 surface soil samples collected at Site 31, the maximum concentration of beryllium (0.79 mg/kg) was only slightly higher than the maximum background concentration (0.43 mg/kg).

- Background concentrations of beryllium exceed the U.S. EPA Region IX PRG for unrestricted land use, indicating naturally-elevated levels of beryllium at March AFB.

- Concentrations of beryllium detected at Site 31 are within the acceptable range for cancer risk (10-4 to 10-6 cancer risk) for unrestricted land use. Other contaminants at Site 31 that could contribute to cancer risk (chlorinated solvents and polynuclear aromatic hydrocarbons) will be remediated and will not contribute to unacceptable risk.

The risk assessment indicates that the following PAHs, which also exceed PRGs, present a potential health risk and therefore require remediation: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-c,d)pyrene. The estimated volume of surface soil requiring clean-up is 1,700 cubic yards. See Figure 6-4.

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Site 34. Beryllium and several PAHs were detected at concentrations that exceed U.S. EPA Region IX PRGs (see Table 6-3). The results of the risk assessment indicate that beryllium at this site does not require remediation. The following PAHs, which also exceed PRGs, present a potential health risk and, therefore, require remediation: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-c,d)pyrene. The estimated volume of soil requiring remediation at Site 34 is 440 cubic yards. See Figure 6-5.

Site 38. Beryllium was detected at concentrations that exceed the U.S. EPA Region IX PRG (see Table 6-3). However, the results of the risk assessment indicate that beryllium at this site does not require remediation. Consequently, no contaminants at this site require remediation.

6.5.2.2 Subsurface Soil Cleanup Standards and Goals

For the protection of groundwater, the California Regional Water Quality Control Board, Santa Ana Region, requested that the Air Force develop and propose cleanup criteria for soils that would be protective of groundwater. Cleanup criteria for subsurface soils were developed such that soil contaminants would not be expected to leach into groundwater at concentrations greater than applicable groundwater standards (Federal and State MCLs).

Impacts of contaminant migration from soil to groundwater were assessed by modeling the entire soil column from the ground surface to groundwater. Two models were used: VLEACH, a vadose zone contaminant transport model, and MIXCELL, a mixing cell model that calculates groundwater contaminant concentrations from contaminant fluxes supplied by VLEACH. Based on modeling results, Site 18 is the only site at which soil contaminants could be expected to leach into groundwater at concentrations that exceed MCLs.

Subsurface soils at Sites 31 and 34 were also evaluated for potential contributions to groundwater contamination. Neither site exceeded allowable limits predicted using the VLEACH/MIXCELL methodology. However, due to the existing groundwater contamination at these sites and the potential for subsurface soil contaminants to provide a continuing source of groundwater contaminants, the California Regional Water Quality Control Board requested that these two sites be included in subsurface soil remediation strategies.

Site 18. The primary subsurface soil contaminants of concern are jet fuel and its components. Since jet fuel as migrated to the water table and impacted groundwater with concentrations of contaminants above MCLs (i.e., benzene), the California Regional Water Quality Control Board, Santa Ana Region requires soil remediation. Contaminants detected include volatile jet fuel components (BTEX compounds) as well as oil and grease, and semivolatiles (naphthalene, bis(2-ethylhexl)phthalate, and Di-n-butyl phthalate). The volatile components of jet fuel (BTEX compounds) are the most mobile in soil and groundwater and are therefore of greatest concern. Maximum concentrations detected were 97 mg/kg for benzene, 69 mg/kg for toluene, 36 mg/kg for ethylbenzene, and 238 mg/kg for xylenes. Figure 6-6 presents subsurface soil contamination at Site 18 and an approximate area requiring remediation (337,500 square feet).

Site 31. TCE was detected in groundwater at Site 31 at concentrations exceeding the established ARARs and, therefore, is a contaminant of concern. The California Regional Water Quality Control Board, Santa Ana Region requires soil cleanup to prevent degradation of the groundwater through migration of contaminants from soil to groundwater. Since the groundwater at Site 31 is currently being degraded, the Air Force has chosen to address the soil contamination at Site 31 in order to prevent further groundwater degradation. See Figure 6-7 for the approximate area requiring remediation.

Site 34. Subsurface soil contaminants consisted primarily of benzene, ethylbenzene, and xylenes. Benzene was detected in groundwater at Site 34 at concentrations exceeding the established ARARs and, therefore, is a contaminant of concern. The California Regional Water Quality Control Board, Santa Ana Region requires soil cleanup to prevent degradation of the groundwater through migration of contaminants from soil to groundwater. Since the groundwater at Site 34 is currently being degraded, the Air Force has chosen to address the soil contamination at Site 34 in order to prevent further groundwater degradation. See Figure 6-8 for the approximate area require remediation.

Cleanup of contaminants in the vadose zone will be implemented at Sites 18, 31, and 34. The modeled subsurface soil cleanup criteria is based on controlling impacts to groundwater exposure pathways. Therefore, MCLs are used as indirect endpoints for estimating the likelihood that existing soil contaminant concentrations will result in an unacceptable groundwater impact. However, predicting contaminant migration based on soils data alone has been found to underestimate contaminant loading due to unaccounted for volatilization of contaminants during sampling and analysis. Therefore, additional soil gas sampling will be performed during the Remedial Action phase for use in the model.

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<IMG SRC 0996148Q>
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Vadose zone cleanup (SVE and bioventing) will be implemented in combination with contaminant transport modeling. The process of cleanup and evaluation will be iterative so that cleanup effectiveness is maximized. Cleanup system operation will be followed by model application to predict vadose zone contaminant migration potential. The results of model application will be used to determine if cleanup should continue or if monitoring for contaminant rebound should begin.

This decision will be made using the Decision Tree for Vadose Zone Remediation (see Figure 6-9). The Decision Tree is a tool for directing operation of vadose zone cleanup systems. Vadose zone cleanup will be initiated and will operate until SVE system influent concentrations drop to predetermined target concentrations. Soil gas (and other samples, as necessary) will then be collected. The results of this post-cleanup sampling will be used to calculate contaminant concentration input to VLEACH and MIXCELL models (or similar, mutually agreed upon models). The models will be used to predict groundwater contaminant concentrations for comparison with groundwater cleanup standards and will determine whether the vadose zone cleanup system will be restarted or rebound monitoring will be initiated.

Contaminant input to VLEACH will be based on total-phase concentrations. Total-phase concentrations include soil gas, adsorbed soil, and liquid phases. Soil gas results will be used to calculate total-phase concentrations, based on mutually agreed-upon equilibrium calculations, when other phase sampling results are not available. Implementation specifics (e.g., the length of initial cleanup system operation and the length of time of monitor rebound) will be determined during the Remedial Action phase.

6.5.2.3 Summary of Soil Cleanup Standards and Goals

Table 6-4 lists chemicals in surface and subsurface soil that require remediation, and their cleanup goals. U.S. EPA Region IX residential PRGs are used as cleanup goals for all sites listed in Table 6-4. As stated previously, based on U.S. EPA Region IX industrial PRGs, remediation is not required at Sites 7 and 29.

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TABLE 6-4. CLEANUP GOALS FOR SOIL CONTAMINANTS REQUIRING REMEDIATION

Site	Chemical	Maximum Site Concentration (mg/kg)	Cleanup Standard Region IX PRG(1) (mg/kg)
4	Benzo(a)anthracene	5.5	0.61
	Benzo(a)pyrene	8.7	0.061
	Benzo(b)fluoranthene	14.0	0.61
	Chrysene	9.7	6.1
	Dibenz(a,h)anthracene	4.2	0.061
	Indeno(1,2,3-c,d)pyrene	21.0	0.61
10	Benzo(a)anthracene	3.2	0.61
	Benzo(a)pyrene	3.5	0.061
	Benzo(b)fluoranthene	3.7	0.61
	Benzo(k)fluoranthene	1.8	0.61
	Dibenz(a,h)anthracene	0.96	0.061
	Indeno(1,2,3-c,d)pyrene	3.9	0.61
15	Benzo(a)pyrene	0.34	0.061
18	Benzene	97	6.8(2)
31	Benzo(a)anthracene	0.96	0.61
	Benzo(a)pyrene	1.0	0.061
	Benzo(b)fluoranthene	1.5	0.61
	Indeno(1,2,3-c,d)pyrene	0.85	0.61
34	Benzo(a)anthracene	5.8	0.61
	Benzo(a)pyrene	3.2	0.061
	Benzo(b)fluoranthene	4.9	0.61
	Indeno(1,2,3-c,d)pyrene	2.2	0.61

(1) Residential soil PRGs were used for all sites listed on this table.
(2) Target remediation concentrations were derived using VLEACH, a soil to groundwater partitioning model.

7.0 DESCRIPTION OF ALTERNATIVES

A Feasibility Study (FS) was conducted to develop and evaluate remedial alternatives for Operable Unit 1. The following sections present summaries of cleanup alternatives evaluated for both groundwater and soil during the FS. The FS was approved by the USEPA on August 23, 1994.

7.1 REMEDIAL ALTERNATIVES FOR GROUNDWATER

In this section, potential cleanup technologies are identified for each groundwater plume in OU1. A variety of treatment methods were evaluated, and are described below.

Alternative 1G - No Action. Every site must be evaluated for the no action alternative to provide a basis for comparison of existing site conditions with other proposed alternatives. Under this alternative, no action would be taken to address groundwater contamination or to minimize further contaminant releases.

Alternative 2G - Limited Action. Under the limited action response, groundwater monitoring is implemented to check whether contaminants are migrating or increasing in concentration.

Alternative 3B - Direct Treatment with Liquid Phase Granular Activated Carbon Adsorption. Activated carbon adsorption is a proven technology for removing organic compounds from groundwater. Contaminated groundwater, once extracted from a well, is passed through a carbon filter which traps the contaminants. The treated water is then discharged to the base wastewater treatment system, the ground surface, or returned to the aquifer via injection wells. Once the carbon becomes saturated with contaminants, the carbon is replaced. The organic compounds identified in OU1 groundwater can be effectively removed by activated carbon adsorption.

Alternative 4G - Ultraviolet (UV) and Chemical Oxidation Treatment. UV and chemical oxidation uses a combination of UV radiation, hydrogen peroxide, and ozone to destroy contaminants. Groundwater is introduced to the UV and chemical oxidation unit, where hydrogen peroxide is injected. The groundwater then enters a reaction chamber. Ozone is bubbled through the water while it is exposed to UV light in the reaction chamber. The UV light increases the chemical reaction rate and thus reduces the time required for treatment. Contaminants are rendered harmless with no toxic residuals requiring treatment. Treated wastewater is discharged to the base treatment plant, the ground surface, or returned to the aquifer via injection wells.

Alternative 5G - Total Fluids Recovery. Total fluids recovery can be used in combination with other technologies to treat groundwater contaminated with immiscible fluids, such as the jet fuel found at Site 18. The method includes the retrieval of groundwater and floating product simultaneously using recovery wells. Jet fuel would be separated from the groundwater in an above-ground oil/water separator and disposed of offsite or recycled. The remaining contaminated groundwater would be treated using a groundwater cleanup technology, such as air stripping.

Alternative 6G - Air Stripping with Carbon Adsorption. Air stripping is a proven technology for removal of VOCs from groundwater. Groundwater is sprayed into a tank filled with packing material. As the water flows downward by gravity it comes into contact with air blown upward into the tank from below. The packing material has a large surface area to increase water/air contact. Contaminants are volatilized from the water and transferred to the air stream. Contaminant-laden air is drawn out through the top of the tank and run through a carbon filter before being discharged to the atmosphere. Depending on contaminant concentrations remaining in the treated wastewater following air stripping, liquid phase granular activated carbon (GAC) may be used to remove trace contaminants. Treated wastewater is then discharged to th base treatment plant, the ground surface, or returned to the aquifer via injection wells.

Alternative 7G - Air Stripping with Catalytic Oxidation. Under this alternative air stripping would take place as described in Alternative 6G. Contaminants that are volatilized from the groundwater enter the air stream and require further treatment. The catalytic oxidation process removes contaminants from the contaminated air stream. The contaminated air stream is preheated; then the hot air is passed over a catalyst. The contaminants adsorb to the surface of the catalyst where they oxidize to form carbon dioxide and water. The treated air stream is then cooled and vented to the atmosphere.

Alternative 8G - Air Stripping with Purus PADRETM System. Under this alternative air stripping would take place as described in Alternative 6G. Contaminants that are volatilized from the water enter the air stream and require further treatment. The PADRETM System removes contaminants from the contaminated air stream by adsorption onto a proprietary resin. The system is operated with two parallel resin beds. Contaminants are adsorbed onto one resin bed while the other bed is regenerated. The beds are regenerated by heating the resin to desorb the contaminants back into a vapor. The vapors are then condensed to a liquid, collected in storage containers, and recycled or disposed of offbase.

Alternative 9G - Ex-Situ Bioremediation. In this process, conventional biological wastewater treatment processes are used to remove organic contaminants from groundwater. The groundwater is pumped to the surface where it is passed through a sedimentation basin to remove particular matter. The groundwater then flows to biological reactors such as a trickling filter, rotating biological disk, or aeration basin where microbes biologically degrade the organic contaminants. The treated water then passes through another settling tank where the microbial mass is removed. The water may be disinfected with chlorine or ozone prior to discharge to surface water or reinjection into the aquifer.

A variety of remedial alternatives were evaluated for remediation of groundwater at Site 4/OU1 plume, Site 18 plume and the Site 31 plume. The following sections summarize remedial technologies considered for each site. The implementation of the various technologies, including the estimated costs, is discussed below.

In order to compare costs of the alternatives, the alternatives were evaluated using present worth analysis. The present worth of each alternative represents the total project costs in present day dollars based on the capital costs and annual operating costs.

Site 4/OU1 Groundwater Plume. An alternative for full treatment of the entire groundwater plume was considered (out to the 5ppb isopleth), however, the $12 million cost was so disproportionate, this alternative was not included in subsequent drafts of the FS. Groundwater extracted from these two plumes will be combined for treatment to increase cost-effectiveness. Remedial alternatives considered have been limited to those that have been successfully implemented at sites with similar contaminants and site conditions. The remedial alternatives evaluated were as follows:

- 1G - No Action
- 2G - Limited Action
- 3G - Direct Treatment with Liquid Phase GAC
- 4G - UV and Chemical Oxidation Treatment
- 6G - Air Stripping with Carbon Adsorption

Alternative 1G - No Action. The purpose of presenting the no action alternative is to provide a basis for comparison of existing site conditions with other proposed remedial alternatives. No remedy is implemented under the no action alternative. The no action alternative must be considered in order to comply with the provisions of the National Contingency Plan (NCP).

The no action alternative does not provide protection of human health and the environment since no remedial action is implemented. Further, compliance with ARARs is not required for a no-action decision and therefore applicable or relevant and appropriate chemical-, action-, and location-specific requirements are not summarized in Appendix C (Tables C-1 and C-2).

Implementation of the no action alternative would result in a continuation of risk posed by the presence of TCE, vinyl chloride, PCE, and other contaminants at concentrations greater than the cleanup standards for groundwater at these sites. This alternative does not reduce the toxicity, mobility or volume of contamination since no treatment is involved.

Cost: The no action alternative is by definition a no cost alternative.

Alternative 2G - Limited Action. The limited action alternative provides some protection to human health through groundwater monitoring to detect further migration of groundwater contaminants. The limited action alternative does not reduce contaminant concentrations and therefore does not comply with applicable or relevant and appropriate chemical-, action-, and location-specific requirements as summarized in Appendix C (Tables C-1 and C-2). This alternative does not reduce the toxicity, mobility or volume of contamination since no treatment is involved.

Capital Cost:	$	209,415
Total Project Cost/Present Worth:		1,148,000.
Annual O&M Cost:	$	90,508 (30 years required)

Alternative 3G - Direct Treatment with Liquid Phase GAC. Activated carbon adsorption is a proven technology for removing VOCs from groundwater, and has been successfully implemented at March AFB. This technology is capable of removing greater than 99 percent of contaminants from groundwater and reducing the levels of contaminants to below cleanup standards. The remedy will comply with all applicable or relevant and appropriate chemical-, action-, and location-specific requirements as summarized in Appendix C (Tables C-1 and C-2).

Capital Cost:	$	736,216
Total Project Cost/Present Worth:		1,839,000.
Annual O&M Cost:	$	106,348 (30 years required)

Alternative 4G - Ultraviolet and Chemical Oxidation Treatment. Oxidation of organics in groundwater using UV radiation, hydrogen peroxide and ozone is a proven technology. This technology is capable of removing 99 percent of contaminants from groundwater, and reducing the levels of contaminants to below cleanup standards. The remedy will comply with all applicable or relevant and appropriate chemical-, action-, and location-specific requirements as summarized in Appendix C (Tables C-1 and C-2). Implementation may be somewhat limited due to the small number of vendors.

Capital Cost:	$	1,851,216
Total Project Cost/Present Worth:		6,014,000.
Annual O&M Cost:	$	401,506 (30 years required)

Alternative 6G - Air Stripping with Carbon Adsorption. Air stripping is a proven technology for removal of VOCs from groundwater. This technology is capable of removing greater than 99 percent of contaminants from groundwater and reducing the levels of contaminants to below cleanup standards. Contaminant-laden air is run through carbon filters prior to discharge to the atmosphere. The remedy will comply with all applicable or relevant and appropriate chemical-, action-, and location- specific requirements as summarized in Appendix C (Tables C-1 and C-2).

Capital Cost:	$ 769,716
Total Project Cost/Present Worth:	2,494,000.
Annual O&M Cost:	$ 166,288 (30 years required)

Site 18 Groundwater Plume. Remedial alternatives considered for Site 18 have been limited to those that have been successfully implemented at sites with similar contaminants and site conditions. Remedial alternatives evaluated are as follows:

- 1G - No Action
- 2G - Limited Action
- 3G/5G - Direct treatment with Liquid Phase GAC/Total Fluids Recovery
- 7G/5G - Air Stripping with Catalytic Oxidation/Total Fluids Recovery
- 8G/5G - Air Stripping with Purus PADRETM System/Total Fluids Recovery

Alternative 1G - No Action. The purpose of presenting the no action alternative is to provide a basis for comparison of existing site conditions with other proposed remedial alternatives. No remedy is implemented under the no action alternative. The no action alternative does not protect human health and the environment since no remedial action is implemented. Further, compliance with ARARs is not required for a no-action decision, and therefore applicable or relevant and appropriate chemical-, action-, and location-specific requirements are not summarized in Appendix C (Tables C-3 and C-4).

Implementation of the no action alternative would result in a continuation of risk posed by the presence of jet fuel contaminants (primarily BTEX compounds). This alternative does not reduce the toxicity, mobility or volume of contaminations since no treatment is involved.

Cost: The no action alternative is by definition a no cost alternative.

Alternative 2G - Limited Action. The limited action alternative provides some protection to human health through groundwater monitoring to detect further migration of groundwater contaminants. The limited action alternative does not reduce contaminant concentrations, and therefore does not comply with applicable relevant and appropriate chemical-, action-, and location-specific requirements as summarized in Appendix C (Tables C-3 and C-4). This alternative does not reduce the toxicity, mobility or volume of contamination since no treatment is involved.

Capital Cost:	$ 54,477
Total Project Cost/Present Worth:	$ 400,000
Annual O&M Cost:	$ 33,124 (30 years required)

Alternative 3G/5G - Direct Treatment with Liquid Phase GAC/Total Fluids Recovery. Total fluids recovery will be used to extract groundwater and free-phase fuel. Fuel will be removed in an oil/water separator and recycled. Contaminated groundwater will require further treatment. Activated carbon adsorption is a proven technology for removing organic compounds from groundwater, and has been successfully implemented at March AFB. This technology is capable of removing greater than 99 percent of contaminants from Site 18 groundwater, and reducing the levels of contaminants to below cleanup standards. The remedy will comply with all applicable or relevant and appropriate chemical-, action-, and location-specific requirements as summarized in Appendix C (Tables C-3 and C-4).

Capital Cost: $ 274,271
Total Project Cost/Present Worth: 1,027,000.
Annual O&M Cost: $ 72,608 (30 years required)

Alternative 7G/5G - Air Stripping with Catalytic Oxidation/Total Fluids Recovery. Total fluids recovery will be used to extract groundwater and free-phase fuel. Fuel will be removed in an oil/water separator and recycled. Contaminated groundwater will require further treatment. Air stripping is a proven technology for removal of VOCs from groundwater. This technology is capable of removing greater than 99 percent of contaminants from Site 18 groundwater and reducing the levels of contaminants to below cleanup standards. The catalytic oxidation process converts contaminants in the contaminated air stream to nonhazardous compounds, carbon dioxide and water. The remedy will comply with all applicable or relevant and appropriate chemical-, action-, and location-specific requirements as summarized in Appendix C (Tables C-3 and C-4).

Capital Cost: $ 531,771
Total Project Cost/Present Worth: 3,006,000.
Annual O&M Cost: $ 238,604 (30 years required)

Alternative 8G/5G - Air Stripping with Purus PADRETM System/Total Fluids Recovery. Total fluids recovery will be used to extract groundwater and free-phase fuel. Fuel will be removed in an oil/water separator and recycled. Contaminated groundwater will require further treatment. Air stripping is a proven technology for removal of VOCs from groundwater. This technology is capable of removing greater than 99 percent of contaminants from Site 18 groundwater, and reducing the levels of contaminants to below cleanup standards. The PADRETM System removes contaminants from the contaminated air stream by adsorption onto a proprietary resin. Liquid wastes are later condensed and disposed of or recycled. The remedy will comply with all applicable or relevant and appropriate chemical-, action-, and location-specific requirements as summarized in Appendix C (Tables C-3 and C-4). This system is proprietary and implementation is limited to one vendor.

Capital Cost: $ 504,036
Total Project Cost/Present Worth: 1,288,000.
Annual O&M Cost: $ 75,613 (30 years required)

Site 31 Groundwater Plume. Remedial alternatives considered for Site 31 have been limited to those that have been successfully implemented at sites with similar contaminants and site conditions. Remedial alternatives evaluated are as follows:

- 1G - No Action
- 2G - Limited Action
- 3G - Direct treatment with Liquid Phase GAC
- 4G - Ultraviolet (UV) and Chemical Oxidation Treatment
- 6G - Air Stripping with Carbon Adsorption

Alternative 1G - No Action. The purpose of presenting the no action alternative is to provide a basis for comparison of existing site conditions with other proposed remedial alternatives. No remedial action is implemented under the no action alternative.

The no action alternative does not protect human health and the environment since no remedy is implemented. Further, compliance with ARARS is not required for a no-action decision and therefore applicable or relevant and appropriate chemical-, action-, and location-specific requirements are not summarized in Appendix C (Tables C-5 and C-6).

Implementation of the no action alternative would result in a continuation of risk posed by the presence of TCE at concentrations greater than the MCLs for groundwater at Site 31. This alternative does not reduce the toxicity, mobility or volume of contamination since no treatment is involved.

Cost: The no action alternative is by definition a no cost alternative.

Alternative 2G - Limited Action. The limited action alternative provides some protection to human health through groundwater monitoring to detect further migration of groundwater contaminants. The limited action alternative does not reduce contaminant concentrations, and therefore does not comply with applicable or relevant and appropriate chemical-, action-, and location-specific requirements as summarized in Appendix C (Tables C-5 and C-6). This alternative does not reduce the toxicity, mobility or volume of contamination since no treatment is involved.

Capital Cost:	$	57,477
Total Project Cost/Present Worth:		400,000.
Annual O&M Cost:	$	33,124 (30 years required)

Alternative 3G - Direct Treatment with Liquid Phase GAC. Activated carbon adsorption is a proven technology for removing organic compounds from groundwater, and has been successfully implemented at March AFB. This technology is capable or removing greater than 99 percent of contaminants from Site 31 groundwater and reducing the levels of contaminants to below cleanup standards. The remedy will comply with all applicable or relevant and appropriate chemical-, action-, and location-specific requirements as summarized in Appendix C (Tables C-5 and C-6).

Capital Cost:	$	349,446
Total Project Cost/Present Worth:		1,103,000.
Annual O&M Cost:	$	72,664 (30 years required)

Alternative 4G - Ultraviolet (UV) and Chemical Oxidation Treatment. Oxidation of organics in groundwater using UV radiation, hydrogen peroxide and ozone is a proven technology. This technology is capable or removing greater than 99 percent of contaminants from Site 31 groundwater and reducing the levels of contaminants to below cleanup standards. The remedy will comply with all applicable or relevant and appropriate chemical-, action-, and location-specific requirements as summarized in Appendix C (Tables C-5 and C-6). Implementation may be somewhat limited due to the small number of vendors.

Capital Cost:	$	479,782
Total Project Cost/Present Worth:		1,549,000.
Annual O&M Cost:	$	103,124 (30 years required)

Alternative 6G - Air Stripping with Carbon Adsorption. Air stripping is a proven technology for removal of VOCs from groundwater. This technology is capable or removing greater than 99 percent of contaminants from Site 31 groundwater and reducing the levels of contaminants to below cleanup standards. Contaminant-laden air is run through a carbon filters prior to discharge to the atmosphere. The remedy will comply with all applicable or relevant and appropriate chemical-, action-, and location-specific requirements as summarized in Appendix C (Tables C-5 and C-6).

Capital Cost:	$	296,478
Total Project Cost/Present Worth:		1,068,000.
Annual O&M Cost:	$	74,403 (30 years required)

7.2 REMEDIAL ALTERNATIVES FOR SOIL

In this section, potential cleanup technologies are identified for each site requiring soil cleanup. A variety of treatment methods were evaluated and are described below.

Alternative 1S - No Action. Every site must be evaluated for the no action alternative to provide a basis for comparison of existing site conditions with other proposed alternatives. Under this alternative, no action would be taken to address soil contamination or to minimize further contaminant releases.

Alternative 2S - Limited Action. Under the limited action response, mechanisms to prevent access to the site and direct contact with the contaminants are implement such as fences and deed restrictions. Access to the site is controlled. For sites with surface soil contamination, periodic monitoring of the soil contaminant concentrations is conducted. For sites with subsurface soil contamination, periodic monitoring of groundwater is conducted to assess potential health impacts. This alternative reduces risk by limiting exposure to contaminants.

Alternative 3S - Resource Conservation and Recovery Act (RCRA) Capping. Capping protects human health and the environment by controlling exposure from ingestion, inhalation, and dermal contact with the contaminants. It also reduces migration of contaminants from the site through air, surface water, and groundwater. This alternative includes installing a low-permeability cap over the existing wastes, protecting the cap from erosion, and long-term maintenance to ensure cap integrity.

Alternative 4S - Landfill Closure. This alternative implements final closure of the existing landfill at Site 4, in accordance with the California Water Regulations (California Code of Regulations, Title 23, Waters, Division 3). Closure of the landfill includes construction of a cover, installation of an impermeable barrier to isolate landfill materials from surface water drainage, water quality monitoring and response programs, closure maintenance activities, and post-closure maintenance activities.

Alternative 5S - Excavation and Low Temperature Thermal Desorption. In a thermal desorption process, soils are excavated and heated to volatilize and drive off contaminants. The volatilized contaminants are destroyed in an afterburner. Contaminated soils may be heated in a screw auger dryer, a rotary kiln, or a series of externally heated distillation chambers.

Alternative 6S - Soil Washing/Ion Exchange. Under this alternative, soil washing would be conducted as described above for Alternative 5S. Metal contaminants washed from soil would be removed from the wash solution using ion exchange. Dissolved metals are removed from solution by exchanging the metal ions with an ion of the same charge, such as hydrogen, bound to a resin surface. The hydrogen ion goes into solution and the metal ion is bound to the resin. The resin is regenerated using a concentrated wash solution which releases the bound metal ions from the resin. The wash solution requires further treatment or disposal.

Alternative 7S - Excavation and Offsite Treatment. This alternative involves the excavation of contaminated soil and treatment/reuse at an offsite location. The contaminated soils are mixed with asphalt, which is then used as a sub-base for pavement. This is especially effective for PAH-contaminated soils which bond with the asphalt, thereby reducing migration and minimizing risk.

Alternative 8S - Excavation and Onsite Consolidation. Under this alternative, excavated soils would be added to other solid wastes and consolidated beneath a low-permeability cap. Before placement under the cap, the soils must pass the toxic characteristics leaching procedure (TCLP) and California leachate tests. Capping minimizes contaminant migration from buried wastes by preventing water infiltration and controlling surface water runoff. This alternative involves installation of a low-permeability cap, protection of the cap from erosion, and long-term maintenance to ensure cap integrity.

Alternative 9S - Excavation and Offsite Disposal. This alternative involves the excavation of contaminated soil and placement of the soil in an approved offsite landfill.

Alternative 10S - Bioventing. Bioventing is an in-situ treatment technology for petroleum contaminated soils. It consists of subsurface injection or withdrawn of air to stimulate biodegradation of non-halogenated organic contaminants by native microbes. These microbes use the petroleum hydrocarbons as an energy source and break them down into carbon and water. Air flow through contaminated soils is controlled through the use of air injection or air extraction wells. Flow rates are maintained at low levels to minimize volatilization of contaminants.

Alternative 11S - Ex-Situ Bioremediation. This treatment alternative is applicable to soils contaminated with non-halogenated organic compounds. Contaminated soils are excavated and aerated to stimulate biodegradation. Contaminants are converted to carbon dioxide and water, as a result of biodegradation processes. Nutrient amendments and microbial cultures may also be added to the soils to enhance biodegradation rates.

Alternative 12S - Soil Vapor Extraction with Catalytic Oxidation. Soil vapor extraction (SVE) is generally used to remove VOCs with vapor pressures greater than 1 millimeter of mercury from soil. Air flow is induced through contaminated soils by extracting air through wells installed in the soil column. Air flow may be enhanced by using air injection wells in conjunction with extraction wells. VOCs are stripped from the soils into the air as the air flows through the soil column. The contaminated vapors are then brought to ground surface for treatment using catalytic oxidation. The contaminated air stream is preheated and the hot air is passed over a catalyst. Contaminants adsorb to the surface of the catalyst where they are oxidized to carbon dioxide and water. The treated air stream is then cooled and vented to the atmosphere.

Alternative 13S - Soil Vapor Extraction with Purus PADRETM System. Under this alternative SVE would be performed as described above for alternative 12S. The contaminated vapors are then brought to ground surface for treatment by the Purus PADRETM System. The PADRETM System removes contaminants from the extracted vapor stream by adsorption onto a proprietary resin. The system is operated with two resin beds. Contaminants are adsorbed onto one resin bed while the other bed is regenerated. The beds are regenerated by heating the resin to desorb the contaminants which are condensed to a liquid and collected in storage containers. The resulting liquid wastes require disposal or recycling.

Alternative 14S - Soil Vapor Extraction with Carbon Adsorption. Under this alternative SVE also would be performed as described in Alternative 12S. The contaminated vapors are then brought to ground surface for treatment by GAC. GAC removes contaminants from the extracted vapor stream by adsorption onto the carbon. The carbon may be regenerated onsite or offsite using steam to desorb the contaminants.

A variety of remedial alternatives were evaluated for remediation of soils at Sites 4, 10, 15, 18, 31, and 34. The following section summarize remedial technologies for remediating soil at each site. The implementation of the various technologies, including the estimated costs, is discussed below.

Site 4 Soil. Site 4 alternatives were identified based upon contaminant types and concentrations, and current plans for site restructuring. The remedial alternatives evaluated were as follows:

- 1S - No Action
- 2S - Limited Action
- 3S - RCRA Capping
- 4S - Landfill Closure
- 9S - Excavation and Offsite Disposal

Alternative 1S - No Action. The purpose of presenting a no action alternative is to provide a basis for comparison of other proposed remedial alternatives. Under a no action alternative the landfill would be left in its current state. This alternative would not reduce the potential for waste migration due to precipitation or surface drainage, and therefore provides no overall protection of human health and the environment.

Compliance with ARARs is not required for a no-action decision, therefore, ARARs are not summarized in Appendix C (Table C-7). The potential for migration of contaminants to groundwater is not reduced and the potential for erosion of landfill materials would remain. In addition, this alternative does not control contaminant migration to groundwater and does not provide a mechanism for monitoring contaminant migration.

Cost: The no action alternative is by definition a no cost alternative.

Alternative 2S - Limited Action. The limited action alternative provides some protection to human health by limiting the potential for direct site contact and monitoring contaminant migration. The limited action alternative does not comply with ARARs as summarized in Appendix C (Table C-7). This alternative does not reduce the toxicity, mobility or volume of contamination since no treatment is involved.

Capital Cost:	$ 209,415
Total Project Cost/Present Worth:	$ 1,148,000.
Annual O&M Cost:	$ 90,508 (30 years required)

Alternative 3S - RCRA Capping. Capping protects human health and the environment by minimizing exposure from ingestion, inhalation, and dermal contact with the contaminants. It also reduces migration of contaminants from the site through air, surface water, and groundwater. The remedy will comply with ARARs as summarized in Appendix C (Table C-7).

Capital Cost:	$ 1,816,059
Total Project Cost/Present Worth:	$ 2,853,000.
Annual O&M Cost:	$ 100,008 (30 years required)

Alternative 4S - Landfill Closure. The closure alternative would involve closure of the landfill in accordance with California Water Regulations (California Code of Regulations, Title 23, Waters, Division 3). Closure of the landfill would include construction of a cover, isolation of landfill materials from surface water drainage, water quality monitoring and response programs, closure maintenance activities, post-closure maintenance activities. The remedy will comply with ARARs as summarized in Appendix C (Table C-7).

Capital Cost:	$ 1,390,102
Total Project Cost/Present Worth:	$ 2,427,000.
Annual O&M Cost:	$ 100,008 (30 years required)

Alternative 9S - Excavation and Offsite Disposal. This alternative involves the excavation of contaminated soil and placement of the soil in an approved offsite landfill. The remedy will comply with ARARs as summarized in Appendix C (Table C-7). This alternative does not reduce the toxicity or volume of the contaminants.

Capital Cost:	$	96,712,000
Total Project Cost/Present Worth:	$	96,712,000.
Annual O&M Cost:	$	0 (not applicable)

Site 10 Surface Soil. Site 10 surface soil alternatives were identified based upon contaminant types and concentrations. The remedial alternatives evaluated were as follows:

- 1S - No action
- 2S - Limited Action
- 5S - Excavation and Low Temperature Thermal Desorption
- 7S - Excavation and Offsite Treatment
- 8S - Excavation and Onsite Consolidation
- 11S - Ex-Situ Bioremediation

Alternative 1S - No Action. The purpose of presenting a no action alternative is to provide a basis for comparison of other proposed remedial alternatives. Under this scenario, PAH-contaminated soils would remain in th drainage channel and continue to pose potential risk. Because the drainage channel leads offbase, contaminants could eventually migrate offbase.

This alternative does not mechanism for reduction of toxicity, mobility or volume of contaminants. Compliance with ARARs is not required for a no-action decision, therefore, ARARS are not summarized in Appendix C (Table C-8).

Cost: The no action alternative is by definition a no cost alternative.

Alternative 2S - Limited Action. The limited action alternative provides some protection to human health by limiting the potential for direct site contact. The limited action alternative provides no reduction in contaminant concentrations and does not control offsite migration. The limited action alternative complies with ARARs as summarized in Appendix C (Table C- 8).

This alternative does not reduce the toxicity, mobility or volume of contamination since no treatment is involved.

Capital Cost:	$	51,004
Total Project Cost/Present Worth:	$	87,000.
Annual O&M Cost:	$	3,480 (30 years required)

Alternative 5S - Excavation and Low Temperature Thermal Desorption. Under this alternative, contaminated soils are excavated and heated to volatilize and drive off contaminants. The process removes contaminants from the soil and destroys them in an afterburner. The remedy will comply with ARARs as summarized in Appendix C (Table C-8).

Capital Cost:	$	37,000
Total Project Cost/Present Worth:	$	37,000.
Annual O&M Cost:	$	0 (not required)

Alternative 7S - Excavation and Offsite Treatment. This alternative involves the excavation of contaminated soil from the drainage ditch for treatment/reuse at an offsite location. The offsite facility will mix contaminated soils with asphalt. The mixture is used as sub-base for pavement. The PAH-contaminated soils bond with the asphalt, thereby reducing migration and minimizing risk. The remedy will comply with ARARs as summarized in Appendix C (Table C-8).

Capital Cost: $ 22,000
Total Project Cost/Present Worth: $ 22,000.
Annual O&M Cost: $ 0 (not required)

Alternative 8S - Excavation and Onsite Consolidation. Under this alternative, soils excavated from Site 10 would be added to the Site 4 wastes, beneath a low permeability cap. The principal threats from exposure to PAH-contaminated soils would be controlled by emplacement beneath the cap. The remedy will comply with ARARs as summarized in Appendix C (Table C-8).

Capital Cost: $ 7,000
Total Project Cost/Present Worth: $ 7,000.
Annual O&M Cost: $ 0 (not required)

Alternative 11S - Ex-Situ Bioremediation. Under this alternative, contaminated surface soils are excavated and aerated to stimulate biodegradation. Nutrient amendments may also be required. Contaminants are converted to carbon dioxide and water as a result of biodegradation process. The remedy will comply with ARARs as summarized in Appendix C (Table C-8).

Capital Cost: $ 50,000
Total Project Cost/Present Worth: $ 50,000.
Annual O&M Cost: $ 0 (not required)

Site 15 Surface Soil. Site 15 surface soil alternatives were identified based upon contaminant types and concentrations. The remedial alternatives evaluated were as follows:

- 1S - No action
- 2S - Limited Action
- 5S - Excavation and Low Temperature Thermal Desorption
- 7S - Excavation and Offsite Treatment
- 8S - Excavation and Onsite Consolidation
- 11S - Ex-Situ Bioremediation

Alternative 1S - No Action. The purpose of presenting a no action alternative is to provide a basis for comparison of other proposed remedial alternatives. Under this scenario, PAH-contaminated soils would remain in place and continue to pose potential risk. This alternative provides no mechanism for reduction of toxicity, mobility or volume through treatment. Compliance with ARARs is not required for a no-action decision, therefore, ARARs are not summarized in Appendix C (Table C-9).

Cost: The no action alternative is by definition a no cost alternative.

Alternative 2S - Limited Action. The limited action alternative provides some protection to human health by limiting the potential for direct site contact. The limited action alternative provides no reduction in contaminant concentrations. This alternative does reduce the toxicity, mobility or volume of contamination since no treatment is involved. No ARARs apply for the limited action alternative as summarized in Appendix C (Table C-9).

Capital Cost: $ 32,348
Total Project Cost/Present Worth: $ 68,000.
Annual O&M Cost: $ 3,480 (30 years required)

Alternative 5S - Excavation and Low Temperature Thermal Desorption. Under this alternative, contaminated soils are excavated and heated to volatilize and drive off contaminants. The process removes contaminants from the soil and destroys them in an afterburner. The remedy will comply with ARARs as summarized in Appendix C (Table C-9).

Capital Cost:	$	26,000
Total Project Cost/Present Worth:	$	26,000.
Annual O&M Cost:	$	0 (not required)

Alternative 7S - Excavation and Offsite Treatment. This alternative involves the excavation of contaminated soil for treatment/reuse at an offsite location. The facility will mix contaminated soils with asphalt. The mixture is used as sub-base for pavement. The PAH-contaminated soils bond with the asphalt, thereby minimizing risk. The remedy will comply with ARARs as summarized in Appendix C (Table C-9).

Capital Cost:	$	7,000
Total Project Cost/Present Worth:	$	7,000.
Annual O&M Cost:	$	0 (not required)

Alternative 8S - Excavation and Onsite Consolidation. Under this alternative, soils excavated from Site 15 would be added to the Site 4 wastes, beneath a low permeability cap. The principal threats from exposure to PAH-contaminated soils would be controlled by emplacement beneath the cap. The remedy will comply with ARARs as summarized in Appendix C (Table C-9).

Capital Cost:	$	4,000
Total Project Cost/Present Worth:	$	4,000.
Annual O&M Cost:	$	0 (not required)

Alternative 11S - Ex-Situ Bioremediation. Under this alternative, contaminated soils are excavated and aerated to stimulate biodegradation. Contaminants are converted to carbon dioxide and water as a result of biodegradation process. The remedy will comply with ARARs as summarized in Appendix C (Table C-9).

Capital Cost:	$	43,000
Total Project Cost/Present Worth:	$	43,000.
Annual O&M Cost:	$	0 (not required)

Site 18 Subsurface Soil. Remedial alternatives evaluated for Site 18 subsurface soil have been limited to those that have been successfully implemented at sites with similar contaminants and site conditions. Remedial alternatives evaluated were as follows:

- 1S - No Action
- 2S - Limited Action
- 10S - Bioventing
- 12S - Soil Vapor Extraction with Catalytic Oxidation
- 13S - Soil Vapor Extraction with Purus PADRETM System

Alternative 1S - No Action. The purpose of presenting the no action alternative is to provide a basis for comparison of existing site conditions with proposed remedial alternatives. No remedy is implemented under the no action alternative.

The no action alternative does not protect human health and the environment since no remedial action is implemented. Implementation of the no action alternative would result in a continuation of risk posed by the presence of fuel contaminants. This alternative does not reduce the toxicity, mobility or volume of contamination since no treatment is involved. Compliance with ARARs is not required for a no-action decision, therefore, ARARS are not summarized in Appendix C (Table C-10).

Cost: There are no costs associated with the no action alternative.

Alternative 2S - Limited Action. The limited action alternative provides some protection to human health by limiting the potential for direct site contact and monitoring contaminant concentrations. The limited action alternative provides no reduction in contaminant concentrations. This alternative does not reduce the toxicity, mobility or volume of contamination since no treatment is involved. No ARARs apply to the limited action alternative as summarized in Appendix C (Table C-10).

Capital Cost: $ 57,477
Total Project Cost/Present Worth: $ 400,000.
Annual O&M Cost: $ 33,124 (30 years required)

Alternative 10S - Bioventing. Bioventing is an in-situ treatment technology for hydrocarbon-contaminated soils including petroleum products. Bioventing is the process of accelerating the natural microbial biodegradation of hydrocarbons in unsaturated zone soils by providing sufficient air flow in these soils to maintain oxygenated conditions. Under aerobic (with oxygen) conditions, indigenous microorganisms that are already acclimatized to using the hydrocarbons as an energy source reduce contaminants to carbon dioxide and water. Either air injection or withdrawal can be used. However, air injection offers the additional benefit of no secondary residuals (i.e., vapor) to control. The remedy will comply with ARARs as summarized in Appendix C (Table C-10).

Capital Cost: $ 863,954
Total Project Cost/Present Worth: $ 891,000.
Annual O&M Cost: $ 26,740 1 year only: (project costs are incurred during 1st year)

Alternative 12S - Soil Vapor Extraction with Catalytic Oxidation. SVE is a proven technology for treatment of soils contaminated with VOCs. The contaminants of concern in subsurface soils at Site 18 are primarily VOCs. SVE removes VOCs from unsaturated soils by mechanically drawing air through the soil pore spaces and transferring the contaminants to the vapor phase. The catalytic oxidation process converts contaminants in the contaminated air stream to carbon dioxide and water. The remedy will comply with ARARs as summarized in Appendix C (Table C-10).

Capital Cost: $ 979,704
Total Project Cost/Present Worth: $ 1,229,000.
Annual O&M Cost: $ 130,000 1 year only: (project costs are incurred during 1st year).

Alternative 13S - Soil Vapor Extraction with Purus PADRETM System. SVE is a proven technology for treatment of soils contaminated with VOCs. The contaminants of concern in subsurface soils at Site 18 are primarily VOCs. SVE removes VOCs from unsaturated soils by mechanically drawing air through the soil pore spaces, transferring the contaminants to the vapor phase. The PADRETM System removes contaminants in the contaminated air stream by adsorption onto a proprietary resin. The remedy will comply with ARARs as summarized in Appendix C (Table C-10).

Capital Cost: $ 1,014,469
Total Project Cost/Present Worth: $ 1,215,000.
Annual O&M Cost: $ 105,170 1 year only: (project costs are incurred during 1st year)

Site 31 Surface Soils. Site 31 surface soil alternatives were identified based on contaminant types and concentrations, and site conditions. The remedial alternatives evaluated were as follows:

- 1S - No Action
- 2S - Limited Action
- 5S - Excavation and Low Temperature Thermal Desorption
- 7S - Excavation and Offsite Treatment
- 8S - Excavation and Onsite Consolidation
- 11S - Ex-Situ Bioremediation

Alternative 1S - No Action. The purpose of presenting a no action alternative is to provide a basis for comparison of other proposed remedial alternatives. Under this scenario, PAH-contaminated soils would remain in place and continue to pose potential risk. This alternative provides no mechanism for reduction of toxicity, mobility or volume through treatment. Compliance with ARARs is not required for a no-action decision, therefore, ARARs are not summarized in Appendix C (Table C-11).

Cost: There are no costs associated with the no action alternative.

Alternative 2S - Limited Action. The limited action alternative provides some protection to human health by limiting the potential for direct site contact. The limited action alternative provides no reduction in contaminant concentrations. This alternative does reduce the toxicity, mobility or volume of contamination since no treatment is involved. No ARARs apply for the limited action alternative as summarized in Appendix C (Table C-11).

Capital Cost:	$	29,085
Total Project Cost/Present Worth:	$	65,000.
Annual O&M Cost:	$	3,480 (30 years required)

Alternative 5S - Excavation and Low Temperature Thermal Desorption. Under this alternative, contaminated soils are excavated and heated to volatilize and drive off contaminants. The process removes contaminants from the soil and destroys them in an afterburner. The remedy will comply with ARARs as summarized in Appendix C (Table C-11).

Capital Cost:	$	372,000
Total Project Cost/Present Worth:	$	372,000.
Annual O&M Cost:	$	0 (not required)

Alternative 7S - Excavation and Offsite Treatment. This alternative involves the excavation of contaminated soil for treatment/reuse at an offsite location. The offsite facility will mix contaminated soils with asphalt. The mixture is used as sub-base for pavement. The PAH-contaminated soils bond with the asphalt, thereby minimizing risk. The remedy will comply with ARARs as summarized in Appendix C (Table C-11).

Capital Cost:	$	374,000
Total Project Cost/Present Worth:	$	374,000.
Annual O&M Cost:	$	0 (not required)

Alternative 8S - Excavation and Onsite Consolidation. Under this alternative, surface soils excavated from Site 31 would be added to the Site 4 wastes, beneath a low permeability cap. The principal threats from exposure to PAH-contaminated soils would be controlled by emplacement beneath the cap. The remedy will comply with ARARs as summarized in Appendix C (Table C-11).

Capital Cost:	$	41,000
Total Project Cost/Present Worth:	$	41,000.

Annual O&M Cost: $ 0 (not required)

Alternative 11S - Ex-Situ Bioremediation. Under this alternative, contaminated surface soils are excavated and aerated to stimulate biodegradation. Nutrient amendments may also be required. Contaminants are converted to carbon dioxide and water as a result of biodegradation process. The remedy will comply with ARARs as summarized in Appendix C (Table C-11).

Capital Cost:	$	81,000
Total Project Cost/Present Worth:	$	81,000.
Annual O&M Cost:	$	0 (not required)

Site 31 Subsurface Soils. Site 31 subsurface soil alternatives were identified based upon contaminant types and concentrations, and site conditions. Remedial alternatives evaluated were as follows:

- 1S - No Action
- 2S - Limited Action
- 12S - Soil Vapor Extraction with Catalytic Oxidation
- 13S - Soil Vapor Extraction with Purus PADRETM System
- 14S - Soil Vapor Extraction with Carbon Adsorption

Alternative 1S - No Action. The purpose of presenting a no action alternative is to provide a basis for comparison of other existing site conditions with proposed remedial alternatives. No remedial action is implemented under the no action alternative.

The no action alternative provides no protection of human health and the environment since no remedial action is implemented. Implementation of the no action alternative would result in a continuation of risk posed by the site contaminants. This alternative does not reduce the toxicity, mobility or volume of contamination since no treatment is involved. Compliance with ARARs is not required for a no-action decision, therefore, ARARs are not summarized in Appendix C (Table C-12).

Cost: There are no costs associated with the no action alternative.

Alternative 2S - Limited Action. The limited action alternative provides some protection to human health by limiting the potential for direct site contact. The limited action alternative provides no reduction in contaminant concentrations. This alternative does reduce the toxicity, mobility or volume of contamination since no treatment is involved. No ARARs apply for the limited action alternative as summarized in Appendix C (Table C-12).

Capital Cost:	$	54,477
Total Project Cost/Present Worth:	$	68,000.
Annual O&M Cost:	$	33,124 (30 years required)

Alternative 12S - Soil Vapor Extraction with Catalytic Oxidation. SVE is a proven technology for treatment of soils contaminated with VOCs. The contaminants of concern in subsurface soils at Site 31 are VOCs. SVE removes VOCs from unsaturated soils by mechanically drawing air through the soil pore spaces, transferring the contaminants to vapor phase. The catalytic oxidation process destroys contaminants in the contaminated air stream. The remedy will comply with ARARs as summarized in Appendix C (Table C-12).

Capital Cost: $ 481,457
Total Project Cost/Present Worth: $ 612,000.
Annual O&M Cost: $ 130,593 1 year only: (project costs are incurred during 1st year)

Alternative 13S - Soil Vapor Extraction with Purus PADRETM System. SVE is a proven technology for treatment of soils contaminated with VOCs. The contaminants of concern in subsurface soils at Site 31 are VOCs. SVE removes VOCs from unsaturated soils by mechanically drawing air through the soil pore spaces, transferring the contaminants to the vapor phase. The PADRETM System removes contaminants from the contaminated air stream by adsorption onto a proprietary resin. The remedy will comply with ARARs as summarized in Appendix C (Table C-12).

Capital Cost: $ 516,222
Total Project Cost/Present Worth: $ 621,000.
Annual O&M Cost: $ 55,579 1 year only: (project costs are incurred during 1st year)

Alternative 14S - Soil Vapor Extraction with Carbon Adsorption. SVE is a proven technology for treatment of soils contaminated with VOCs. The contaminants of concern in subsurface soils at Site 31 are VOCs. SVE removes VOCs from unsaturated soils by mechanically drawing air through the soil pore spaces, transferring the contaminants to the vapor phase. Contaminants are removed from the vapor stream using GAC adsorption. The remedy will comply with ARARs as summarized in Appendix C (Table C-12).

Capital Cost: $ 361,457
Total Project Cost/Present Worth: $ 417,000.
Annual O&M Cost: $ 55,579 1 year only: (project costs are incurred during 1st year)

Site 34 Subsurface Soils. Site 34 surface soil alternatives were identified based upon contaminant types and concentrations, and site conditions. The remedial alternatives evaluated were as follows:

- 1S - No Action
- 2S - Limited Action
- 5S - Excavation and Low Temperature Thermal Desorption
- 7S - Excavation and Offsite Treatment
- 8S - Excavation and Onsite Consolidation
- 11S - Ex-Situ Bioremediation

Alternative 1S - No Action. The purpose of presenting a no action alternative is to provide a basis for comparison of other proposed remedial alternatives. Under this scenario, PAH-contaminated soils would remain in place and continue to pose potential risk. This alternative provides no mechanism for reduction of toxicity, mobility or volume through treatment. Compliance with ARARs is not required for a no-action decision, therefore, ARARs are not summarized in Appendix C (Table C-13).

Cost: There are no costs associated with the no action alternative.

Alternative 2S - Limited Action. The limited action alternative provides some protection to human health by limiting the potential for direct site contact. The limited action alternative provides no reduction in contaminant concentrations. This alternative does reduce the toxicity, mobility or volume of contamination since no treatment is involved. No ARARs apply for the limited action alternative as summarized in Appendix C (Table C-13).

Capital Cost: $ 19,087
Total Project Cost/Present Worth: $ 55,000.
Annual O&M Cost: $ 3,480 (30 years required)

Alternative 5S - Excavation and Low Temperature Thermal Desorption. Under this alternative, contaminated soils are excavated and heated to volatilize and drive off contaminants. The process removes contaminants from the soil and destroys them in an afterburner. The remedy will comply with ARARs as summarized in Appendix C (Table C-13).

Capital Cost: $ 111,000
Total Project Cost/Present Worth: $ 111,000.
Annual O&M Cost: $ 0 (not required)

Alternative 7S - Excavation and Offsite Treatment. This alternative involves the excavation of contaminated surface soils for treatment/reuse at an offsite location. The facility will mix contaminated soils with asphalt. The mixture is used as sub-base for pavement. The PAH-contaminated soils bond with the asphalt, thereby minimizing risk. The remedy will comply with ARARs as summarized in Appendix C (Table C-13).

Capital Cost: $ 101,000
Total Project Cost/Present Worth: $ 101,000.
Annual O&M Cost: $ 0 (not required)

Alternative 8S - Excavation and Onsite Consolidation. Under this alternative, surface soils excavated from Site 34 would be added to the Site 4 wastes, beneath a low permeability cap. The principal threats from exposure to PAH-contaminated soils would be controlled by emplacement beneath the cap. The remedy will comply with ARARs as summarized in Appendix C (Table C-13).

Capital Cost: $ 14,000
Total Project Cost/Present Worth: $ 14,000.
Annual O&M Cost: $ 0 (not required)

Alternative 11S - Ex-Situ Bioremediation. Under this alternative, contaminated surface soils are excavated and aerated to stimulate biodegradation. Nutrient amendments may be required. Contaminants are converted to carbon dioxide and water as a result of biodegradation process. The remedy will comply with ARARs as summarized in Appendix C (Table C-13).

Capital Cost: $ 52,000
Total Project Cost/Present Worth: $ 52,000.
Annual O&M Cost: $ 0 (not required)

Site 34 Subsurface Soils. Remedial alternatives evaluated for Site 34 subsurface soils have been limited to those that have been successfully implemented at sites with similar contaminants and site conditions. Remedial alternatives evaluated were as follows:

- 1S - No Action
- 2S - Limited Action
- 10S - Bioventing
- 12S - Soil Vapor Extraction with Catalytic Oxidation
- 13S - Soil Vapor Extraction with Purus PADRETM System

Alternative 1S - No Action. The purpose of presenting a no action alternative is to provide a basis for comparison of existing site conditions with proposed remedial alternatives. No remedial action is implemented under the no action alternative.

The no action alternative provides no protection of human health and the environment since no remedial action is implemented. Implementation of the no action alternative would result in a continuation of risk posed by the presence of fuel contaminants. This alternative does not reduce the toxicity, mobility or volume of contamination since no treatment is involved. Compliance with ARARs is not required for a no-action decision, therefore, ARARs are not summarized in Appendix C (Table C-14).

Cost: There are no cost associated with the no action alternative.

Alternative 2S - Limited Action. The limited action alternative provides some protection to human health by limiting the potential for direct site contact. The limited action alternative provides no reduction in contaminant concentrations. This alternative does reduce the toxicity, mobility or volume of contamination since no treatment is involved. No ARARs apply for the limited action alternative as summarized in Appendix C (Table C-14).

Capital Cost:	$	55,419
Total Project Cost/Present Worth:	$	992,878.
Annual O&M Cost:	$	83,654 (30 years required)

Alternative 10S - Bioventing. Bioventing is an in-situ treatment technology for hydrocarbon-contaminated soils such as petroleum products. The contaminants of concern in subsurface soils at Site 34 are petroleum components. Bioventing is the process of accelerating the natural microbial biodegradation of hydrocarbons in unsaturated zone soils by providing sufficient air flow in these soils to maintain oxygenated conditions. Under aerobic (with oxygen) conditions, indigenous microorganisms that are already acclimatized to using the hydrocarbons as an energy source reduce contaminants to carbon dioxide and water. Either air injection or withdrawal can be used. However, air injection offers the additional benefit of no secondary residuals (i.e., vapor) to control. The remedy will comply with ARARs as summarized in Appendix C (Table C-14).

Capital Cost:	$	58,717
Total Project Cost/Present Worth:	$	89,000.
Annual O&M Cost:	$	29,545 1 year only: (project costs are incurred during 1st year)

Alternative 12S - Soil Vapor Extraction with Catalytic Oxidation. SVE is a proven technology for treatment of soils contaminated with VOCs. The contaminants of concern in subsurface soils at Site 34 are primarily VOCs. SVE removes VOCs from unsaturated soils by mechanically drawing air through the soil pore spaces, transferring the contaminants to the vapor phase. The catalytic oxidation process destroys contaminants in the contaminated air stream. The remedy will comply with ARARs as summarized in Appendix C (Table C-14).

Capital Cost:	$	159,386
Total Project Cost/Present Worth:	$	223,000.
Annual O&M Cost:	$	63,900 1 year only: (project costs are incurred during 1st year)

Alternative 13S - Soil Vapor Extraction with Purus PADRETM System. SVE is a proven technology for treatment of soils contaminated with VOCs. The contaminants of concern in subsurface soils at Site 34 are primarily VOCs. SVE removes VOCs from unsaturated soils by mechanically drawing air through the soil pore spaces, transferring the contaminants to the vapor phase. The PADRETM System removes contaminants from the contaminated air stream by adsorption onto a proprietary resin. The remedy will comply with ARARs as summarized in Appendix C (Table C-14).

Capital Cost:	$	151,540
Total Project Cost/Present Worth:	$	204,000.
Annual O&M Cost:	$	52,300 1 year only: (project costs are incurred during 1st year)

8.0 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

The nine criteria established by CERCLA and Superfund Amendments and Reauthorization Act (SARA) were used to evaluate the alternatives in detail. The nine criteria encompass statutory and practical factors that assist in gauging the overall feasibility and acceptability of the cleanup alternatives. The nine criteria are summarized as follows:

1. Overall Protection of Human Health and the Environment. This factor addresses whether or not a remedy provides adequate protection of human health and the environment and describes how risks posed through each exposure route are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

2. Compliance with Applicable or Relevant and Appropriate Requirements. This evaluation criterion is used to determine whether each remedy will meet all ARARs or provide grounds for invoking a waiver of the requirements. These include chemical-, location-, and action-specific ARARs. Appendix C provides a detailed analysis of compliance with ARARs for each site/media remedy.

3. Long-term Effectiveness and Permanence. This criterion includes evaluation of the long-term effectiveness of the remedy in maintaining protection of human health and the environment after the response action is complete.

4. Reduction of Toxicity, Mobility, or Volume through Treatment. This criterion addresses the anticipated performance of the specific treatment technologies that an alternative may employ.

5. Short-term Effectiveness. The criterion addresses the effectiveness of alternatives in protecting human health and the environment during the construction and implementation of a remedy until the remedial action is complete.

6. Implementability. This criterion addresses the technical and administrative feasibility of alternatives and the availability of required goods and services.

7. Cost. This criterion addresses the capital and operations and maintenance (O&M) costs of each alternative.

    - Capital Cost. Capital cost consists of direct (construction) and indirect (non-construction and overhead) costs. Direct costs include materials, labor and equipment required to install a remedial system, equipment for the remedial system, land and site-development, buildings and associated utility services. Indirect capital costs include engineering licenses or permit fees, start up costs, and contingency allowances.

    - O&M Cost. O&M costs are post-construction costs necessary to ensure the continued effectiveness of a remedial alternative. These costs include operating labor, maintenance, and materials, auxiliary materials and energy, disposal of residues, purchased services (i.e., analytical laboratory), and administrative services.

- Total Project Cost. The total project cost represent the present worth of each of the alternatives incorporating the capital cost and the annual O&M costs. They project time periods may be varied for the various alternatives and the present worth analysis allows them to be evaluated on an equal basis.

8. State Acceptance. This criterion summarizes the technical and administrative concerns of the State of California for each remedial alternative presented.

9. Community Acceptance. This criterion indicates whether community concerns are addressed by each cleanup method and whether the community has indicated a preferred cleanup method.

8.1 COMPARATIVE ANALYSIS OF ALTERNATIVES

The alternatives presented in Section 7.0 were evaluated against the criteria listed above. Alternatives were ranked against each criterion individually using a numerical system ranging from 1 to 5 (1 being least desirable and 5 being most desirable). Compliance with criteria 8 and 9 were evaluated qualitatively by considering any objections, concerns, or preferences raised by the community or the state. Tables 8-1 through 8-11 presents the ranking for each site. A detailed ARARs analysis for each site/media alternative is presented in the tables in Appendix C.

8.1.1 Groundwater

Site 4 Groundwater Plume/OU1 Groundwater Plume. A comparative analysis was completed using the alternatives and criteria previously identified. The alternatives are:

- 1G - No Action
- 2G - Limited Action
- 3G - Direct Treatment with Liquid Phase GAC
- 4G - Ultraviolet (UV) and Chemical Oxidation Treatment
- 6G - Air Stripping with Carbon Adsorption

Overall Protection of Human Health and the Environment. With the exception of the no action and limited action alternatives, all the potential remedial alternatives will provide overall protection of human health and the environment. The no action and limited action alternatives will not reduce the long-term risk posed by the presence of TCE and PCE in the groundwater, and therefore would result in an unacceptable risk to human health and the environment.

Compliance With ARARs. The no action and limited action alternatives will not comply with ARARs. All three treatment alternatives are capable of treating effluent to below MCLs. However, aquifer restoration is limited by the rate at which contaminants can be extracted from the aquifer.

Long-term Effectiveness and Permanence. As stated previously, the no action and limited action alternatives provide no reduction in risk since contaminants are not removed. The limited action alternative does provide long-term monitoring of the site but provides no protection of human health and the environment. The three groundwater treatment alternatives will reduce the magnitude of risk, by cleanup of the groundwater through contaminant removal. The direct treatment with liquid phase GAC and air stripping with carbon adsorption alternatives require disposal or regeneration of spent or used GAC, whereas the UV and chemical oxidation treatment alternative does not generate a residual waste stream.

Reduction of Toxicity, Mobility, or Volume Through Treatment. The no action and limited action alternatives do not reduce the toxicity, mobility or volume of contaminants in the groundwater while the direct treatment with liquid phase GAC, air stripping with carbon adsorption and UV and chemical oxidation treatment alternatives provide for very similar levels of groundwater withdrawal and contaminant removal efficiencies.

Short-term Effectiveness. The three active remedial action alternatives (3G, 4G, 6G) include treatment of the groundwater to remove contamination and therefore address both current and future risks. However, minor potential risks to the community, workers and the environment through generation of dust may result during installation of the there treatment alternatives. This potential risk can be addressed through implementation of engineering controls such as dust suppression. Residuals handling may also pose risks to workers and the community. These risks can be controlled with proper training of workers and adherence to standard operation procedures for disposal of residual wastes.

TABLE 8-1

COMPARATIVE RANKING OF REMEDIAL ALTERNATIVES FOR GROUNDWATER - SITE 4/OU1 GROUNDWATER PLUME MARCH AIR FORCE

Criteria	Alternative 1G No Action	Alternative 2G Limited Action	Alternative 3G Direct Treatment with Liquid Phase GAC	Alternative 4G UV and Chemical Oxidation
Overall protection of human health and the environment	1	2	5	5
Compliance with ARARs	1	1	5	5
Long-term effectiveness and permanence	1	1	4	5
Reduction of toxicity, mobility, or volume through treatment	1	1	5	5
Short-term effectiveness	1	2	3	3
Implementability	5	5	5	3
Cost	5	4	4	1
Total Score	15	16	31	27

TABLE 8-2

COMPARATIVE RANKING OF REMEDIAL ALTERNATIVES FOR SOIL - SITE 4

MARCH AIR FORCE BASE

Criteria	Alternative 1S No Action	Alternative 2S Limited Action	Alternative 3S RCRA Capping	Alternative 4S Landfill Closure
Overall protection of human health and the environment	1	2	4	4
Compliance with ARARs	1	1	3	4
Long-term effectiveness and permanence	1	2	4	4
Reduction of toxicity, mobility, or volume through treatment	1	1	3	3
Short-term effectiveness	1	2	3	3
Implementability	5	5	4	4
Cost	5	4	3	3
Total Score	15	17	24	25

TABLE 8-3
COMPARATIVE RANKING OF REMEDIAL ALTERNATIVES FOR SURFACE SOIL - SITE 10
MARCH AIR FORCE BASE

Criteria	Alternative 1S No Action	Alternative 2S Limited Action	Alternative 5S Excavation and Low Temperature Thermal Desorption	Alternative 7S Excavation and Offsite Treatment	Alternativ Excavation Onsite Consolida
Overall protection of human health and the environment	1	2	5	5	5
Compliance with ARARs	1	1	5	5	5
Long-term effectiveness and permanence	1	1	5	5	4
Reduction of toxicity, mobility, or volume through treatment	1	1	5	5	4
Short-term effectiveness	1	2	3	3	4
Implementability	5	5	4	4	1
Cost	5	1	2	3	4
Total Score	15	13	29	30	27

TABLE 8-4
COMPARATIVE RANKING OF REMEDIAL ALTERNATIVES FOR SURFACE SOIL - SITE 15
MARCH AIR FORCE BASE

Criteria	Alternative 1S No Action	Alternative 2S Limited Action	Alternative 5S Excavation and Low Temperature Desorption	Alternative 7S Excavation and Offsite Treatment	Alternativ Excavation Onsite Consolida
Overall protection of human health and the environment	1	2	5	5	5
Compliance with ARARs	1	1	5	5	5
Long-term effectiveness and permanence	1	1	5	5	4
Reduction of toxicity, mobility, or volume through treatment	1	1	5	5	4
Short-term effectiveness	1	2	3	3	4
Implementability	5	5	4	3	1
Cost	5	1	3	4	4
Total Score	15	13	30	30	27

TABLE 8-5
COMPARATIVE RANKING OF REMEDIAL ALTERNATIVES FOR SURFACE SOIL - SITE 18
MARCH AIR FORCE BASE

Criteria	Alternative 1G No Action	Alternative 2G Limited Action	Alternatives 3G/5G Direct Treatment with Liquid Phase GAC/Total Fluids Recovery	Alternatives 7G/5G Air Stripping with Catalytic Oxidation/Total Fluids Recovery	Alter Air S Pur Syste
Overall protection of human health and the environment	1	2	5	5	
Compliance with ARARs	1	1	5	5	
Long-term effectiveness and permanence	1	1	4	5	
Reduction of toxicity, mobility, or volume through treatment	1	1	5	5	
Short-term effectiveness	1	2	4	4	
Implementability	5	5	4	3	
Cost	5	4	3	1	
Total Score	15	16	30	28	

TABLE 8-6
COMPARATIVE RANKING OF REMEDIAL ALTERNATIVES FOR SUBSURFACE SOIL - SITE 18
MARCH AIR FORCE BASE

Criteria	Alternative 1S No Action	Alternative 2S Limited Action	Alternative 10S Bioventing	Alternative 12S Soil Vapor Extraction with Catalytic Oxidation	Alte Ext Pur
Overall protection of human health and the environment	1	2	5	5	
Compliance with ARARs	1	1	5	5	
Long-term effectiveness and permanence	1	1	5	5	
Reduction of toxicity, mobility, or volume through treatment	1	1	5	5	
Short-term effectiveness	1	2	3	4	
Implementability	5	5	4	4	
Cost	5	4	3	2	
Total Score	15	16	30	30	

TABLE 8-7
COMPARATIVE RANKING OF REMEDIAL ALTERNATIVES FOR GROUNDWATER - SITE 31
MARCH AIR FORCE BASE

Criteria	Alternative 1G No Action	Alternative 2G Limited Action	Alternative 3G Direct Treatment with Liquid Phase GAC	Alternative 4G UV and Chemical	Alte Air St Oxi
Overall protection of human health and the environment	1	2	5	5	
Compliance with ARARs	1	1	5	5	
Long-term effectiveness and permanence	1	1	4	5	
Reduction of toxicity, mobility, or volume through treatment	1	1	5	5	
Short-term effectiveness	1	2	4	4	
Implementability	5	5	5	3	
Cost	5	4	3	2	
Total Score	15	16	31	29	

TABLE 8-8
COMPARATIVE RANKING OF REMEDIAL ALTERNATIVES FOR SURFACE SOIL - SITE 31
MARCH AIR FORCE BASE

Criteria	Alternative 1S No Action	Alternative 2S Limited Action	Alternative 5S Excavation and Low Temperature Thermal Desorption	Alternative 7S Excavation and Offsite Treatment	Alternativ Excavation Onsite Consolida
Overall protection of human health and the environment	1	2	5	5	5
Compliance with ARARs	1	1	5	5	5
Long-term effectiveness and permanence	1	1	5	5	4
Reduction of toxicity, mobility, or volume through treatment	1	1	5	5	4
Short-term effectiveness	1	2	3	4	4
Implementability	5	5	4	4	1
Cost	5	3	1	1	4
Total Score	15	15	28	29	27

TABLE 8-9
COMPARATIVE RANKING OF REMEDIAL ALTERNATIVES FOR SUBSURFACE SOIL - SITE 31
MARCH AIR FORCE BASE

Criteria	Alternative 1S No Action	Alternative 2S Limited Action	Alternative 12S Soil Vapor Extraction with Catalytic Oxidation	Alternative 13S Soil Vapor Extraction with Purus PADRETM System	Alt Extr Carb
Overall protection of human health and the environment	1	2	5	5	
Compliance with ARARs	1	1	5	5	
Long-term effectiveness and permanence	1	1	5	4	
Reduction of toxicity, mobility, or volume through treatment	1	1	5	5	
Short-term effectiveness	1	2	4	4	
Implementability	5	5	2	3	
Cost	5	4	3	3	
Total Score	15	16	29	29	

TABLE 8-10
COMPARATIVE RANKING OF REMEDIAL ALTERNATIVES FOR SURFACE SOIL - SITE 34
MARCH AIR FORCE BASE

Criteria	Alternative 1S No Action	Alternative 2S Limited Action	Alternative 5S Excavation and Low Temperature Thermal Desorption	Alternative 7S Excavation and Offsite Treatment	Alternativ Excavation Onsite Consolida
Overall protection of human health and the environment	1	2	5	5	5
Compliance with ARARs	1	1	5	5	5
Long-term effectiveness and permanence	1	1	5	5	4
Reduction of toxicity, mobility, or volume through treatment	1	1	5	5	4
Short-term effectiveness	1	2	3	3	4
Implementability	5	5	4	4	1
Cost	5	3	2	2	4
Total Score	15	15	29	29	27

TABLE 8-11
COMPARATIVE RANKING OF REMEDIAL ALTERNATIVES FOR SUBSURFACE SOIL - SITE 34
MARCH AIR FORCE BASE

Criteria	Alternative 1S No Action	Alternative 2S Limited Action	Alternative 10S Bioventing	Alternative 12S Soil Vapor Extraction with Catalytic Oxidation	Alt Ext Pur
Overall protection of human health and the environment	1	2	5	5	
Compliance with ARARs	1	1	5	5	
Long-term effectiveness and permanence	1	1	5	5	
Reduction of toxicity, mobility, or volume through treatment	1	1	5	5	
Short-term effectiveness	1	2	4	5	
Implementability	5	5	5	4	
Cost	5	3	4	2	
Total Score	15	15	33	31	

Implementability. The no action and limited action alternatives are easy to implement but will likely require future groundwater treatment. No permits are required and groundwater sampling and analysis services are readily available for the limited action alternative. The differences in implementability among the three treatment alternatives are inherent in the treatment processes. The likelihood that technical problems will lead to schedule delays is considered low for direct treatment with liquid phase GAC, moderate for air stripping with carbon adsorption and moderate for UV and chemical oxidation. In addition, there are a limited number of vendors for the UV and chemical oxidation system where the oxidation includes both hydrogen peroxide and ozone. Construction of the three treatment alternatives is considered similar.

Cost. No action is by definition a no-cost alternative. Limited action ($1,148,000) and liquid phase carbon treatment ($1,839,000) are the most favorable alternatives in terms of cost, followed by air stripping with vapor-phase GAC ($2,494,000) and UV/chemical oxidation ($6,014,000).

State Acceptance. The State of California was actively involved in the RI/FS and remedy selection process and participated in the public meeting held to inform the public of the proposed plan. While the state concurs with the RI/FS, final state acceptance will occur in the approved ROD.

Community Acceptance. The public comment period for the Proposed Plan was from April 28 to May 28, 1994. In addition, a public meeting was held on May 12, 1994. Representatives of the U.S. Air Force, USEPA, Department of Toxic Substance Control, and California Regional Water Quality Control Board, Santa Ana, attended the public meeting to address any questions concerning the RI/FS and Proposed Plan. A Responsiveness Summary is included as Appendix A.

Site 18 Groundwater Plume. A comparative analysis was completed using the groundwater remedial alternatives and criteria previously identified. The alternatives are:

- 1G - No Action
- 2G - Limited Action
- 3G/5G - Direct treatment with Liquid Phase GAC/Total Fluids Recovery
- 7G/5G - Air Stripping with Catalytic Oxidation/Total Fluids Recovery
- 8G/5G - Air Stripping with Purus PADRETM System/Total Fluids Recovery

Overall Protection of Human Health and the Environment. Implementation of the no action alternative will result in a continuation of risks to the community through the presence of contaminants in groundwater, representing a potential exposure pathway. The limited action alternative will slightly reduce risks to the community by monitoring contaminant migration. The no action and limited action alternatives will not reduce the long-term risk posed by the presence of the volatile petroleum hydrocarbons in groundwater at Site 18, and therefore are considered to pose an unacceptable risk to human health and the environment. The three groundwater treatment remedial alternatives will reduce the contaminant concentrations in groundwater, therefore providing protection to human health and the environment.

Compliance With ARARs. The no action and limited action alternatives will not meet ARARs. All three groundwater treatment alternatives will reduce the contaminants present in treated groundwater at Site 18 to meet ARARs. All three alternatives are capable of treating effluent to below MCLs; however, aquifer restoration is limited by the rate at which contaminants can be extracted.

Long-term Effectiveness and Permanence. The no action and limited action alternatives provide no reduction in risk since contaminants are not removed. The limited action alternative does provide monitoring of the site. The three groundwater treatment remedial alternatives will reduce the magnitude of risk through contaminant removal or destruction, which in all cases is permanent and irreversible. Residuals management will be required for all three treatment alternatives, which involve recycling of recovered fuels.

Reduction of Toxicity, Mobility, or Volume Through Treatment. The no action and limited action alternatives do not reduce the toxicity, mobility or volume of contaminants in the groundwater while the three groundwater treatment remedial alternatives significantly reduce these constituents. All three treatment alternatives provide similar levels of contaminant removal.

Short-term Effectiveness. The three groundwater treatment alternatives include removal and treatment of the groundwater to control plume migration and to reduce contamination to acceptable levels. Short-term risks to workers posed by construction of any of the three treatment systems could be controlled by using dust suppression techniques and personal protective equipment. The air stripping with catalytic oxidation and air stripping with Purus PADRETM System alternatives present a potential risk to the community, workers and the environment through generation of a contaminated gas stream. However, implementation of vapor phase treatment immediately following air stripping will sufficiently address this concern. Liquid residuals generated by the Purus PADRETM Systems can also pose short-term risks to workers, the community or the environment. These risks can be controlled with proper training of workers and adherence to standard operating procedures for transportation, handling and disposal of this waste stream.

Implementability. The no action and limited action alternatives are easy to implement but will likely require future groundwater treatment. The three groundwater treatment alternatives will not require future treatment.

The differences in implementability among the three groundwater treatment alternatives are inherent in the treatment processes. All three groundwater treatment alternatives will result in recovery of the floating product and offsite disposal of recovered fuels. The implementation of air stripping to transfer the contaminants from the liquid to vapor phase prior to adsorption onto activated carbon is advantageous due to the higher efficiency of the vapor phase adsorption process resulting in reduced carbon usage as compared with liquid phase adsorption. However, this transfer results in additional air permitting requirements and increased O&M.

The Purus PADRETM System is a proprietary treatment system. Therefore the timely construction and efficient operation of this system is dependent upon the supplier.

Cost. No action is by definition a no-cost alternative. Limited action ($400,000) is most favorable in terms of cost, followed by liquid-phase GAC treatment/total fluids recovery ($1,027,000), air stripping with Purus PADRETM system/total fluids recovery ($1,288,000), and air stripping with catalytic oxidation/total fluids recovery ($3,006,000).

State Acceptance. The State of California was actively involved in the RI/FS and remedy selection process and participated in the public meeting held to inform the public of the proposed plan. While the state concurs with the RI/FS, final state acceptance will occur in the approved ROD.

Community Acceptance. A public comment period was on the Proposed Plan from April 28 to May 28 1994. In addition, a public meeting was held on May 12, 1994. Representatives of the U.S. Air Force, USEPA, Department of Toxic Substances Control, and California Regional Water Quality Control Board, Santa Ana, attended the public meeting to address any questions concerning the RI/FS and Proposed Plan. A Responsive Summary is included in Appendix A.

Site 31 Groundwater Plume. A comparative analysis was completed using the alternatives and criteria previously identified.

The alternatives are:

- 1G - No action
- 2G - Limited Action
- 3G - Direct Treatment with Liquid Phase GAC
- 4G - Ultraviolet (UV) and Chemical Oxidation Treatment
- 6G - Air Stripping with Carbon Adsorption

Overall Protection of Human Health and the Environment. With the exception of the no action and limited action alternatives, all the potential remedial alternatives will provide overall protection of human health and the environment. The no action and limited action alternatives will not reduce the long-term risk posed by the presence of TCE in the groundwater, and therefore would result in an unacceptable risk to human health and the environment.

Compliance With ARARs. The no action and limited action alternatives will not meet ARARs. All three groundwater treatment alternatives will reduce the contaminants present in treated groundwater at Site 18 to meet ARARs. All three alternatives are capable of treating effluent to below MCLs; however, aquifer restoration is limited by the rate at which contaminants can be extracted.

Long-term Effectiveness and Permanence. The no action and limited action alternatives provide no reduction in risk since contaminants are not removed or treated. The limited action alternative does provide long-term monitoring of the site, but provides no protection of human health and the environment. The three groundwater treatment alternatives will reduce the magnitude of risk through contaminant removal to cleanup standards, and maintain reliable protection of human health and the environment by removing the source. The direct treatment with liquid phase GAC and air stripping with carbon adsorption alternatives require disposal or regeneration of spent or used GAC, whereas the UV and chemical oxidation treatment alternative does not generate a residual waste stream.

Reduction of Toxicity, Mobility, or Volume Through Treatment. The no action and limited action alternatives do not reduce the toxicity, mobility or volume of contaminants in the groundwater. The direct treatment with liquid phase GAC, air stripping with carbon adsorption and UV and chemical oxidation treatment alternatives provide for very similar levels of contaminant removal efficiencies.

Short-term Effectiveness. The three remedial action alternatives include treatment of the groundwater to remove contamination and therefore address this risk. However, a potential risk to the community, workers and the environment through generation of dust may result during installation of the three treatment alternatives. This potential risk can be addressed through implementation of engineering controls such as dust suppression. Residuals handling may also pose risks to workers and the community. These risks can be controlled with proper training of workers and adherence to standard operating procedures for disposal of residual wastes.

Implementability. The no action and limited action alternatives are easy to implement but will likely require future groundwater treatment. No permits are required and groundwater sampling and analysis services are readily available for the limited action alternative.

The differences in implementability among the three treatment alternatives are inherent in the treatment processes. The likelihood that technical problems will lead to schedule delays is considered low for direct treatment with liquid phase GAC, moderate for air stripping with carbon adsorption and moderate for UV and chemical oxidation. There are a limited number of vendors for the UV and chemical oxidation system where the oxidation includes both hydrogen peroxide and ozone.

Cost. No action is by definition a no-cost alternative. Limited action ($400,000) is rated most favorably, followed by air stripping with vapor-phase GAC treatment ($1,068,000), liquid phase GAC treatment ($1,102,000), and UV/chemical oxidation ($1,549,000).

State Acceptance. The State of California was actively involved in the RI/FS and remedy selection process and participated in the public meeting held to inform the public of the proposed plan. While the state concurs with the RI/FS, final state acceptance will occur in the approved ROD.

Community Acceptance. A public comment period was on the Proposed Plan from April 28 to May 28 1994. In addition, a public meeting was held on May 12, 1994. Representatives of the U.S. Air Force, USEPA, Department of Toxic Substances Control, and California Regional Water Quality Control Board, Santa Ana, attended the public meeting to address any questions concerning the RI/FS and Proposed Plan. A Responsive Summary is included in Appendix A.

8.1.2 Soil

Site 4 Surface Soil. A comparative analysis was completed using the alternatives and criteria previously identified. The alternatives are:

- 1S - No Action
- 2S - Limited Action
- 3S - RCRA Capping
- 4S - Landfill Closure
- 9S - Excavation and Offsite Disposal

Overall Protection of Human Health and the Environment. The no action alternative does not provide for overall protection of human health and the environment. The no action alternative will not affect the mobility, toxicity, or volume of Site 4 contaminants which are a continuing source of groundwater contamination. The limited action alternative provides some protection to human health by limiting the potential for direct site contact. RCRA capping, landfill closure, and offsite disposal will provide overall protection of human health and the environment. RCRA capping and landfill closure will provide protection by limiting direct access to wastes and by reducing the mobility of wastes in the groundwater and air pathways. Offsite disposal will provide protection through removal of wastes and placement of wastes in an offsite facility designed for waste management.

Compliance with ARARs. The no action and limited action alternatives would not provide compliance with ARARs because erosion of the landfill and deposition of contaminants into the Heacock Storm Drain would not be prevented. Both the RCRA capping and landfill closure alternatives would provide compliance with ARARs because they prevent landfill erosion and deposition of contaminants into the Heacock Storm Drain. The excavation and offsite disposal alternative removes site contaminants to an approved facility which complies with ARARs.

Long-term Effectiveness and Permanence. The no action alternative does not provide a mechanism to control or monitor the migration of soil contaminants to groundwater. The limited action, RCRA capping and landfill closure alternatives provide for monitoring of the site although only the RCRA capping and landfill closure are proven technologies for controlling migration of soil contamination. Excavation and offsite disposal would removal site contaminants and provide for long-term monitoring at an approved facility offsite.

Reduction of Toxicity, Mobility, or Volume Through Treatment. The no action and limited action alternatives do not reduce the toxicity, mobility or volume of contaminants in the groundwater. The RCRA capping, landfill closure and offsite disposal alternatives would reduce the mobility of soil contaminants, but not reduce contaminant toxicity or volume.

Short-term Effectiveness. The landfill closure, RCRA capping, and offsite disposal alternatives would have an immediate impact on reduction of potential soil contaminant migration. Threats to workers and surrounding community during landfill closure, RCRA capping, or excavation and offsite disposal could be controlled using dust suppression techniques and ongoing contaminant monitoring.

Implementability. The no action and limited action alternatives can be easily implemented. The landfill closure and capping alternatives are essentially construction activities and are easily implemented. The offsite disposal alternative requires the availability of permitted disposal facilities and licensed waste transporters in addition to the excavation of contaminated soil.

Cost. No action is by definition a no-cost alternative. Limited action ($1,148,000) is rated most favorably in terms of cost, followed by landfill closure ($2,427,000), RCRA capping ($2,853,000), and lastly by excavation and offsite disposal ($96,712,000) which is cost-prohibitive.

State Acceptance. The State of California was actively involved in the RI/FS and remedy selection process and participated in the public meeting held to inform the public of the proposed plan. While the state concurs with the RI/FS, final state acceptance will occur in the approved ROD.

Community Acceptance. A public comment period was on the Proposed Plan from April 28 to May 28 1994. In addition, a public meeting was held on May 12, 1994. Representatives of the U.S. Air Force, USEPA, Department of Toxic Substances Control, and California Regional Water Quality Control Board, Santa Ana, attended the public meeting to address any questions concerning the RI/FS and Proposed Plan. A Responsive Summary is included in Appendix A.

Site 10 Soils. A comparative analysis was completed using the alternatives and criteria previously identified. The alternatives are:

- 1S - No action
- 2S - Limited Action
- 5S - Excavation and Low Temperature Thermal Desorption
- 7S - Excavation and Offsite Treatment
- 8S - Excavation and Onsite Consolidation
- 11S - Ex-Situ Bioremediation

Overall Protection of Human Health and the Environment. The excavation and offsite treatment, excavation and onsite consolidation, ex-situ bioremediation, and excavation and low temperature thermal desorption alternatives provide protection from the principal health and environmental threats associated with soils at Site 10. The no action alternative does not reduce the migration of contaminants offsite or reduce onsite concentrations and therefore does not control contaminant exposure. The limited action alternative provides some protection to human health by limiting the potential for direct site contact. However, offsite migration and potential exposure are not addressed by the limited action alternative.

Compliance with ARARs. Excavation and offsite treatment, excavation and onsite consolidation, ex-situ bioremediation, and excavation and low temperature thermal desorption alternatives provide for compliance with the ARARs identified for this site, while the no action and limited action alternatives do not comply with the ARARs.

Long-term Effectiveness and Permanence. The no action alternative does not provide a mechanism to prevent direct access to contaminated soils or to control or monitor the migration of soil contaminants offbase. The limited action, excavation and offsite treatment, excavation and onsite consolidation, ex-situ bioremediation, and excavation and low temperature thermal desorption alternatives provide for long-term risk reduction although only the excavation and offsite treatment, ex-situ bioremediation, and excavation and low temperature thermal desorption alternatives provide permanent treatment. Excavation and onsite consolidation would result in placement of untreated soils on-base, and would therefore require monitoring.

Reduction of Toxicity, Mobility, or Volume Through Treatment. The no action and limited action alternatives do not reduce the toxicity, mobility or volume of contaminants in the groundwater. Excavation and offsite treatment, and excavation and onsite consolidation would effectively reduce the mobility of site contaminants. Only ex-situ bioremediation, and excavation and low temperature thermal desorption reduce the toxicity of the wastes. Blending contaminated soils with asphalt, as presented in the excavation and offsite treatment alternative, increases the total volume of treated material. However, the contaminant concentrations identified are not expected to impede the asphaltic encapsulation process.

Short-term Effectiveness. Due to the potential migration of Site 10 sediments offbase, community exposure could occur if sediments are left onsite. In the excavation and offsite treatment, excavation and onsite consolidation, ex-situ bioremediation, and excavation and low temperature thermal desorption alternatives, worker protection during excavation, transportation and treatment poses a minor concern. Engineering controls can be used for worker protection (i.e., dust suppression, hearing protection) and therefore the short-term risks are judged to be controllable. Community risks presented as a result of the transportation of the sediments either onbase or offsite, are considered negligible. Low temperature thermal desorption presents a risk of contaminated air emissions, however these can easily be controlled.

Implementability. The no action and limited action alternatives have no construction phase and as such implementation is not an issue. The excavation and offsite treatment, excavation and onsite consolidation, ex-situ bioremediation, and excavation and low temperature thermal desorption alternatives are proven technologies, and all are easily implemented.

Cost. No action is by definition a no-cost alternative. Excavation and onsite consolidations ($7,000) is rated most favorably in terms of cost, followed by excavation and offsite treatment ($22,000), excavation and low temperature thermal desorption ($37,000), ex-situ bioremediation ($48,000), and limited action ($87,000).

State Acceptance. The State of California was actively involved in the RI/FS and remedy selection process and participated in the public meeting held to inform the public of the proposed plan. While the state concurs with the RI/FS, final state acceptance will occur in the approved ROD.

Community Acceptance. A public comment period was on the Proposed Plan from April 28 to May 28 1994. In addition, a public meeting was held on May 12, 1994. Representatives of the U.S. Air Force, USEPA, Department of Toxic Substances Control, and California Regional Water Quality Control Board, Santa Ana, attended the public meeting to address any questions concerning the RI/FS and Proposed Plan. A Responsive Summary is included in Appendix A.

Site 15 Surface Soil. A comparative analysis was completed using the alternatives and criteria previously identified. The alternatives are:

- 1S - No action
- 2S - Limited Action
- 5S - Excavation and Low Temperature Thermal Desorption
- 7S - Excavation and Offsite Treatment
- 8S - Excavation and Onsite Consolidation
- 11S - Ex-Situ Bioremediation

Overall Protection of Human Health and the Environment. Excavation and offsite treatment, excavation and onsite consolidation, ex-situ bioremediation, and excavation and low temperature thermal desorption alternatives provide protection from the principal health and environmental threats connected with soils at Site 15. The no action alternative does not reduce the migration of contaminants offsite or reduce onsite concentrations and therefore does not control contaminant exposure. The limited action alternative provides some protection to human health by limiting the potential for direct site contact.

Compliance with ARARs. Excavation and offsite treatment, excavation and onsite consolidation, ex-situ bioremediation, and excavation and low temperature thermal desorption alternatives provide for compliance with the ARARs identified for this site, while the no action and limited action alternatives do not allow compliance with the ARARs.

Long-term Effectiveness and Permanence. The no action alternative does not provide a mechanism to prevent direct access to contaminated soils or to control or monitor the migration of soil contaminants offbase. The limited action, excavation and offsite treatment, excavation and onsite consolidation, ex-situ bioremediation, and excavation and low temperature thermal desorption alternatives provide for long-term risk reduction although only the excavation and offsite treatment, ex-situ bioremediation, and excavation and low temperature thermal desorption alternatives provide permanent treatment. Excavation and onsite consolidation would result in placement of untreated soils on-base, and would therefore require monitoring.

Reduction of Toxicity, Mobility, or Volume Through Treatment. The no action or the limited action alternative do not reduce the toxicity, mobility or volume through treatment. Excavation and offsite treatment, and excavation and onsite consolidation would effectively reduce the mobility of site contaminants. Only ex-situ bioremediation, and excavation and low temperature thermal desorption reduce the toxicity of the wastes. Blending soils with asphalt, as presented in excavation and offsite treatment alternative, increases the total volume of treated material. However, contaminant concentrations identified are not expected to impede the asphaltic encapsulation process.

Short-term Effectiveness. In the excavation and offsite treatment, excavation and onsite consolidation, ex-situ bioremediation, and excavation and low temperature thermal desorption alternatives, worker protection during excavation, transportation and treatment poses a minor concern. Engineering controls can be used for worker protection (i.e., dust suppression, hearing protection) and therefore the short-term risks are judged to be controllable. Community risks presented as a result of the transportation of the sediments either onbase or offsite, are considered negligible. Low temperature thermal desorption presents a risk of contaminated air emissions, however these can easily be controlled.

Implementability. The no action and limited action alternatives have no construction phase and as such implementation is not an issue. The excavation and offsite treatment, excavation and onsite consolidation, ex-situ bioremediation, and excavation and low temperature thermal desorption alternatives are proven technologies, and all are easily implemented.

Cost. The no action alternative is by definition a no-cost alternative. Excavation and onsite consolidation ($4,000) is rated most favorably in terms of cost, followed by excavation and offsite treatment ($7,000) excavation and low temperature thermal desorption ($26,000), ex-situ bioremediation ($43,000), and limited action ($68,000).

State Acceptance. The State of California was actively involved in the RI/FS and remedy selection process and participated in the public meeting held to inform the public of the proposed plan. While the state concurs with the RI/FS, final state acceptance will occur in the approved ROD.

Community Acceptance. A public comment period was on the Proposed Plan from April 28 to May 28 1994. In addition, a public meeting was held on May 12, 1994. Representatives of the U.S. Air Force, USEPA, Department of Toxic Substances Control, and California Regional Water Quality Control Board, Santa Ana, attended the public meeting to address any questions concerning the RI/FS and Proposed Plan. A Responsive Summary is included in Appendix A.

Site 18 Subsurface Soils. A comparative analysis was completed using the alternatives and criteria previously identified. The alternatives are:

- 1S - No Action
- 2S - Limited Action
- 10S - Bioventing
- 12S - Soil Vapor Extraction with Catalytic Oxidation
- 13S - Soil Vapor Extraction with Purus PADRETM System

Overall Protection of Human Health and the Environment. Bioventing, SVE with catalytic oxidation, and SVE with the Purus PADRETM System alternatives provide protection from the principal health and environmental threats associated with soils at Site 18. The no action alternative does not reduce the migration of contaminants to the groundwater and therefore does not control contaminant exposure. The limited action alternative provides some protection to human health by monitoring contaminant migration.

Compliance With ARARs. There are currently no applicable cleanup criteria for the contaminants of concern in soils at Site 18. Preliminary remediation goals for subsurface soils developed for this site are based on groundwater protection. The no action and limited action alternative will not meet the cleanup criteria developed and proposed for this site. Bioventing and SVE remedial alternatives will reduce the concentrations of contaminants present in the soil. These technologies have been used to treat contaminated soils with similar properties. However, due to the potential for site-specific conditions to significantly affect the achievable cleanup standards, pilot-scale treatability testing is required initially to confirm that these technologies can attain the proposed cleanup criteria.

Long-term Effectiveness and Permanence. The no action alternative provides no risk reduction since contaminants are not removed or treated. The limited action alternative provides for monitoring of the site although no contaminants are removed or treated. SVE with catalytic oxidation, SVE with Purus PADRETM System, and bioventing will reduce the magnitude of risk through removal or destruction of contaminants. The final amount of residual contaminant with each of these remedial alternatives will be affected by site-specific conditions; therefore, a reduce level of residual risk ma remain.

Reduction of Toxicity, Mobility, or Volume Through Treatment. The no action and the limited action alternatives do not reduce the toxicity, mobility, or volume of contaminants in the soil, while the SVE with catalytic oxidation, SVE with Purus PADRETM System, and bioventing treatment alternatives significantly reduce toxicity of soils by destroying or removing contaminants. SVE with Purus PADRETM System will generate vapor treatment residual wastes. The bioventing and SVE with catalytic oxidation alternatives will not generate residual wastes requiring further handling.

Short-term Effectiveness. SVE and bioventing remedial alternatives present a potential risk to the community, workers and the environment through generation of dust during installation. This potential risk can be addressed through implementation of engineering controls such as dust suppression. With SVE, there is a potential for release of vapors if the vapor abatement system malfunctions. However, this risk can be minimized by using engineering controls such as automatic shut-offs. SVE will probably require a shorter time period than bioventing for removal of a given mass of contaminants.

Implementability. The primary differences in implementability of the alternatives are those that exist between the no action of limited action alternatives and the treatment alternatives. The no action and limited action alternatives can easily be implemented and the treatment alternatives will be more difficult to implement. The three treatment alternatives will require pilot scale treatability studies in order to demonstrate technical feasibility and to generate data for full-scale system design.

The differences that exist between SVE and bioventing are inherent in the treatment process. SVE is a commonly used technology; however, the subsurface soil characteristics may limit optimum air flow through the soil. Similarly with bioventing, the ability to supply oxygen to the vadose zone may be impeded by fine-grained subsurface materials. SVE generates treatment residuals which require further treatment while bioventing does not. There is little difference in implementability between SVE with catalytic oxidation and SVE with Purus PADRETM System with the exception that the Purus System is proprietary and therefore limited to only one vendor for service and supplies.

Cost. No action is by definition a no-cost alternative. Limited action ($400,000) is rated most favorably in terms of cost, followed by bioventing ($891,000), SVE with Purus PADRETM System ($1,215,000), and SVE with catalytic oxidation ($1,229,000).

State Acceptance. The State of California was actively involved in the RI/FS and remedy selection process and participated in the public meeting held to inform the public of the proposed plan. While the state concurs with the RI/FS, final state acceptance will occur in the approved ROD.

Community Acceptance. A public comment period was on the Proposed Plan from April 28 to May 28 1994. In addition, a public meeting was held on May 12, 1994. Representatives of the U.S. Air Force, USEPA, Department of Toxic Substances Control, and California Regional Water Quality Control Board, Santa Ana, attended the public meeting to address any questions concerning the RI/FS and Proposed Plan. A Responsive Summary is included in Appendix A.

Site 31 Surface Soils. A comparative analysis was completed using the alternatives and criteria previously identified. The alternatives are:

- 1S - No Action
- 2S - Limited Action
- 5S - Excavation and Low Temperature Thermal Desorption
- 7S - Excavation and Offsite Treatment
- 8S - Excavation and Onsite Consolidation
- 11S - Ex-Situ Bioremediation

Overall Protection of Human Health and the Environment. The excavation and offsite treatment, excavation and onsite consolidation, ex-situ bioremediation, and excavation and low temperature thermal desorption alternatives provide protection from the principal health and environmental threats connected with soils at Site 31. The no action alternative does not reduce the migration of contaminants offsite and therefore does not control contaminant exposure. The limited action alternative provides some protection to human health by limiting the potential for direct site contact.

Compliance with ARARs. Excavation and offsite treatment, excavation and onsite consolidation, ex-situ bioremediation, and excavation and low temperature thermal desorption alternatives provide for compliance with the ARARs identified for this site, while the no action and limited action alternatives do not comply with ARARs.

Long-term Effectiveness and Permanence. The no action alternative does not provide a mechanism to prevent direct access to contaminated soils or to control or monitor the migration of soil contaminants offbase. The limited action, excavation and offsite treatment, excavation and onsite consolidation, ex-situ bioremediation, and excavation and low temperature thermal desorption alternatives provide for long-term risk reduction although only the excavation and offsite treatment, ex-situ bioremediation, and excavation and low temperature thermal desorption alternatives provide permanent treatment. Excavation and onsite consolidation would result in placement of untreated soils on-base, and would therefore require monitoring.

Reduction of Toxicity, Mobility, or Volume Through Treatment. The no action or the limited action alternatives do not reduce the toxicity, mobility or volume through treatment. Excavation and offsite treatment, and excavation and onsite consolidation would effectively reduce the mobility of site contaminants. Only ex-situ bioremediation, and excavation and low temperature thermal desorption reduce the toxicity of the wastes. Blending soils with asphalt, as presented in excavation and offsite treatment alternative, increases the total volume of treated material. However, contaminant concentrations identified are not expected to impede the asphaltic encapsulation process.

Short-term Effectiveness. In the excavation and offsite treatment, excavation and onsite consolidation, ex-situ bioremediation, and excavation and low temperature thermal desorption alternatives, worker protection during excavation, transportation and treatment poses a minor concern. Engineering controls can be used for worker protection (i.e., dust suppression, hearing protection) and therefore the short-term risks are judged to be controllable. Community risks presented as a result of the transportation of the sediments either onbase or offsite, are considered negligible. Low temperature thermal desorption presents a risk of contaminated air emissions, however these can easily be controlled.

Implementability. The no action and limited action alternatives have no construction phase and as such implementation is not an issue. The excavation and offsite treatment, excavation and onsite consolidation, ex-situ bioremediation, and excavation and low temperature thermal desorption alternatives are proven technologies, and all are easily implemented.

Cost. No action is by definition a no-cost alternative. Excavation and onsite consolidation ($41,000) is rated most favorably in terms of cost, followed by limited action ($65,000), ex-situ bioremediation ($77,000), excavation and low temperature thermal desorption ($372,000), and excavation and offsite treatment ($374,000).

State Acceptance. The State of California was actively involved in the RI/FS and remedy selection process and participated in the public meeting held to inform the public of the proposed plan. While the state concurs with the RI/FS, final state acceptance will occur in the approved ROD.

Community Acceptance. A public comment period was on the Proposed Plan from April 28 to May 28 1994. In addition, a public meeting was held on May 12, 1994. Representatives of the U.S. Air Force, USEPA, Department of Toxic Substances Control, and California Regional Water Quality Control Board, Santa Ana, attended the public meeting to address any questions concerning the RI/FS and Proposed Plan. A Responsive Summary is included in Appendix A.

Site 31 Subsurface Soils. A comparative analysis was completed using the alternatives and criteria previously identified. The alternatives are:

- 1S - No Action
- 2S - Limited Action
- 12S - Soil Vapor Extraction with Catalytic Oxidation
- 13S - Soil Vapor Extraction with Purus PADRETM System
- 14S - Soil Vapor Extraction with Carbon Adsorption

Overall Protection of Human Health and the Environment. The SVE with catalytic oxidation, SVE with Purus PADRETM System, and SVE with carbon adsorption alternatives provide protection from the principal health and environmental threats associated with subsurface soils at Site 31. The no action alternative does not reduce the migration of contaminants to the groundwater and therefore does not control contaminant exposure. The limited action alternative provides some protection to human health by monitoring the migration of contaminants.

Compliance With ARARs. There are currently no applicable cleanup criteria for the contaminants of concern in soils at Site 31. SVE remedial alternatives will reduce the concentrations of contaminants present in the soil and have been used to treat contaminated soils with similar properties. However, due to the potential for site-specific conditions to significantly affect the achievable cleanup standards, pilot testing is required to confirm technical feasibility of the technologies.

Long-term Effectiveness and Permanence. The no action alternative provides no long-term risk reduction since contaminants are not removed or treated. The limited action alternative provides for monitoring of the site although no contaminants are removed or treated. SVE with catalytic oxidation, SVE with Purus PADRETM System and SVE with carbon adsorption will reduce the magnitude of risk through removal or destruction of contaminants. The final amount of residual contaminant with each of these remedial alternatives will be affected by site-specific conditions; therefore, some residual risk may remain. SVE with Purus PADRETM system and SVE with carbon adsorption will generate treatment residuals requiring further handling.

Short-term Effectiveness. The SVE alternatives present a potential risk to the community, workers and the environment through generation of dust and organic vapors during installation. This potential risk can be addressed through implementation of engineering controls such as dust suppression. With SVE, there is a potential for release of vapors during treatment if the vapor abatement system malfunctions, however, this risk can be minimized by using engineering controls such as automatic shut-offs.

Implementability. The primary differences in implementability of the alternatives are those that exist between the no action or limited action alternatives and the treatment alternatives. These differences are that no action and limited action can easily be implemented, while the treatment alternatives will be somewhat more difficult to implement.

Cost. No action is by definition a no-cost alternative. Limited action ($400,000) is rated most favorably in terms of cost, followed by SVE with GAC treatment ($467,000), SVE with Purus PADRETM System ($717,000), and SVE with catalytic oxidation ($730,000).

State Acceptance. The State of California was actively involved in the RI/FS and remedy selection process and participated in the public meeting held to inform the public of the proposed plan. While the state concurs with the RI/FS, final state acceptance will occur in the approved ROD.

Community Acceptance. A public comment period was on the Proposed Plan from April 28 to May 28 1994. In addition, a public meeting was held on May 12, 1994. Representatives of the U.S. Air

Force, USEPA, Department of Toxic Substances Control, and California Regional Water Quality Control Board, Santa Ana, attended the public meeting to address any questions concerning the RI/FS and Proposed Plan. A Responsive Summary is included in Appendix A.

Site 34 Surface Soils. A comparative analysis was completed using the alternatives and criteria previously identified. The alternatives are:

- 1S - No Action
- 2S - Limited Action
- 5S - Excavation and Low Temperature Thermal Desorption
- 7S - Excavation and Offsite Treatment
- 8S - Excavation and Onsite Consolidation
- 11S - Ex-Situ Bioremediation

Overall Protection of Human Health and the Environment. The excavation and offsite treatment, excavation and onsite consolidation, ex-situ bioremediation, and excavation and low temperature thermal desorption alternatives provide protection from the principal health and environmental threats connected with soils at Site 34. The no action alternative does not reduce the migration of contaminants offsite and therefore does not control contaminant exposure. The limited action alternative provides some protection to human health by limiting the potential for direct site contact.

Compliance with ARARs. Excavation and offsite treatment, excavation and onsite consolidation, ex-situ bioremediation, and excavation and low temperature thermal desorption alternatives provide for compliance with the ARARs identified for this site, while the no action and limited action alternatives do not comply with ARARs.

Long-term Effectiveness and Permanence. The no action alternative does not provide a mechanism to control or monitor the migration of soil contaminants offbase. The limited action, excavation and offsite treatment, excavation and onsite consolidation, ex-situ bioremediation, and excavation and low temperature thermal desorption alternatives provide for long-term risk reduction although only the excavation and offsite treatment, ex-situ bioremediation, and excavation and low temperature thermal desorption alternatives provide permanent treatment. Excavation and onsite consolidation would result in placement of untreated soils on-base, and would therefore require monitoring.

Reduction of Toxicity, Mobility, or Volume Through Treatment. The no action or the limited action alternatives do not reduce the toxicity, mobility or volume through treatment. Excavation and offsite treatment, and excavation and onsite consolidation would effectively reduce the mobility of site contaminants. Only ex-situ bioremediation, and excavation and low temperature thermal desorption reduce the toxicity of the wastes. Blending soils with asphalt, as presented in excavation and offsite treatment, increases the total volume of treated material. However, the contaminant concentrations identified are not expected to impede the asphaltic encapsulation process.

Short-term Effectiveness. In the excavation and offsite treatment, excavation and onsite consolidation, ex-situ bioremediation, and excavation and low temperature thermal desorption alternatives, worker protection during excavation, transportation and treatment poses a minor concern. Engineering controls can be used for worker protection (i.e., dust suppression, hearing protection) and therefore the short-term risks are judged to be controllable. Community risks presented as a result of the transportation of the sediments either onbase or offsite, are considered negligible. Low temperature thermal desorption presents a risk of contaminated air emissions, however these can easily be controlled.

Implementability. The no action and limited action alternatives have no construction phase and as such implementation is not an issue. The excavation and offsite treatment, excavation and onsite consolidation, ex-situ bioremediation, and excavation and low temperature thermal desorption alternatives are proven technologies, and all are easily implemented.

Cost. No action is by definition a no-cost alternative. Excavation and onsite consolidation ($14,000) is rated most favorably in terms of cost, followed by ex-situ bioremediation ($52,000), limited action ($55,000), excavation and offsite treatment ($101,000), and excavation and low temperature thermal desorption ($110,000).

State Acceptance. The State of California was actively involved in the RI/FS and remedy selection process and participated in the public meeting held to inform the public of the proposed plan. While the state concurs with the RI/FS, final state acceptance will occur in the approved ROD.

Community Acceptance. A public comment period was on the Proposed Plan from April 28 to May 28 1994. In addition, a public meeting was held on May 12, 1994. Representatives of the U.S. Air Force, USEPA, Department of Toxic Substances Control, and California Regional Water Quality Control Board, Santa Ana, attended the public meeting to address any questions concerning the RI/FS and Proposed Plan. A Responsive Summary is included in Appendix A.

Site 34 Subsurface Soils. A comparative analysis was completed using the alternatives and criteria previously identified. The alternatives are:

- 1S - No Action
- 2S - Limited Action
- 10S - Bioventing
- 12S - Soil Vapor Extraction with Catalytic Oxidation
- 13S - Soil Vapor Extraction with Purus PADRETM System

Overall Protection of Human Health and the Environment. With the exception of the no action and limited action alternative, all the potential remedial alternatives will provide overall protection of human health and the environment. The no action alternative will not reduce the long-term risk posed by the presence of the petroleum-derived organics in soil at Site 34. The limited action alternative will provide minimal protection to human health and the environment through monitoring of contaminant migration. However, the site would continue to be a source of groundwater contamination.

Compliance With ARARs. There are currently no applicable cleanup criteria for the contaminants of concern in soils at Site 34. Preliminary remediation goals for subsurface soils at this site are based on groundwater protection.

Long-term Effectiveness and Permanence. The no action alternative does not provide a mechanism to control or monitor the migration of soil contaminants offbase. The limited action alternative provides for monitoring of the site. The bioventing alternative and the SVE alternatives will reduce the magnitude of risk through contaminant reduction. The final amount of contaminant reduction with each of these remedial alternatives will be affected by site specific conditions; therefore, some residual risk may remain. The SVE with Purus PADRETM System generates residual wastes requiring further handling; no other alternative generates residual wastes.

Reduction of Toxicity, Mobility, or Volume Through Treatment. No action and limited action alternatives do not reduce the toxicity, mobility, or volume of contaminants in the soil. Both the SVE alternatives and the bioventing alternative reduce waste toxicity by removing or destroying contaminants.

Short-term Effectiveness. Implementation of the no action and limited action alternatives will result in a continuation of risks to the community through the present of the contaminants in soil representing a source of groundwater contamination. The SVE alternatives and bioventing alternative include treatment of the soil to remove this contamination, and therefore address this risk. However, a potential risk to the community, workers, and the environment through the generation of dust and organic vapors may result during installation of any of the treatment remedial alternatives. This potential risk can be addressed through implementation of engineering controls such as dust control. Due to the removal of contaminated vapors in the SVE technique, an additional potential risk to the community, workers, and the environment is possible exposure to contaminated vapors should the vapor treatment system fail. The risk can be reduced through engineering controls, such as automatic shut-offs.

Implementability. The SVE and bioventing alternatives are proven technologies that do not present major implementation problems. However, subsurface soil characteristics may cause operational problems related to the ability to attain optimum air flow or oxygenated conditions in site soils. Pilot studies will be required to demonstrate technical feasibility and to generate data for full-scale system design.

Minimal action is required to implement either the No Action or Limited Action alternative and as such implementability is not considered an issue.

Cost. No action is by definition a no-cost alternative. Bioventing ($89,000) is rated most favorably in terms of cost, followed by limited action ($180,000), SVE with Purus PADRETM System ($252,000), and SVE with catalytic oxidation ($281,000).

State Acceptance. The State of California was actively involved in the RI/FS and remedy selection process and participated in the public meeting held to inform the public of the proposed plan. While the state concurs with the RI/FS, final state acceptance will occur in the approved ROD.

Community Acceptance. A public comment period was on the Proposed Plan from April 28 to May 28 1994. In addition, a public meeting was held on May 12, 1994. Representatives of the U.S. Air Force, USEPA, Department of Toxic Substances Control, and California Regional Water Quality Control Board, Santa Ana, attended the public meeting to address any questions concerning the RI/FS and Proposed Plan. A Responsive Summary is included in Appendix A.

9.0 SELECTED REMEDIES

Modification to the selected remedies may be necessary as a result of remedial design (RD) construction processes. Detailed design specifications, performance evaluations, verification sampling methods, and schedule will be determined during the RD. The selected groundwater and soil remedies will meet the cleanup standards presented in Table 5-1 and Table 5-2. After the selected soil remedies have been completed, soil samples will be taken and analyzed to ensure that the cleanup standards have been achieved. The following are the preferred alternatives for each site to be remediated.

9.1 GROUNDWATER

Site 4/OU1 groundwater plume. There is currently an operational groundwater extraction and treatment system (GETS) located along the eastern base boundary. The system was installed in 1992 as an interim removal action. The extraction component of the system consists of nine wells that were located in order to interdict the Site 4 and OU1 plumes at the base boundary. The treatment system utilizes GAC to remove contaminants of concern.

The preferred remedy for the Site 4/OU1 groundwater plume is to utilize the existing GETS system, supplemented with additional extraction wells and GAC treatment units as necessary (Alternative 3G), and to stop the migration of the onbase plume offbase and to treat the contaminated groundwater in the existing plume. Contaminated groundwater extracted from Site 4 will be combined for treatment with groundwater extracted from the OU1 plume. Treated water will be discharged to either the base wastewater treatment plant, the Heacock Storm Drain downgradient from the wetlands location, or injected into the aquifer. The Heacock Storm Drain discharges to the Perris Valley Storm Drain Lateral A. An unlined infiltration pond will be constructed over the plume area to store treated water during high flow periods in the Heacock Storm Drain, if applicable. Implementation of a groundwater extraction and treatment program will provide for capture of onbase contaminated groundwater and will prevent further escape of onbase contaminated groundwater offbase.

Since there are low concentrations of contaminants (a maximum of 19 µg/l and 43 µg/l, PCE and TCE, respectively) in the downgradient plume, this portion of the plume will be allowed to dissipate. This decision is based on the following three factors:

- First, the predictive modeling performed by the Air Force, as well as recent sampling results, indicate that dissipation may be presently occurring. With the elimination of the source for the downgradient plume through treatment and containment of the upgradient plume, the natural process of dilution, volatilization, adsorption, and/or partitioning to the solid phase, as well as biological degradation of the contaminant will accelerate, resulting in dissipation.

- Second, on completion of the risk assessment, it was determined that the risk from allowing the contaminants in the downgradient plume to naturally dissipate is within EPA's acceptable cancer risk range of 1 x 10-4 to 1 x 10-6. With the existing levels of contaminants, residential use of the groundwater in the downgradient plume is within a cancer risk range of 10-5. Although the Air Force has been advised by the Eastern Municipal Water District that their district provides full water service and that there are no known users of this groundwater, the Air Force will continue to monitor the progress of the dissipation of contaminants. Through this monitoring, it will be possible to determine whether additional measures are necessary to assure that there are no threats to human health or the environment during the period of dissipation of the downgradient plume. As an additional safety precaution, the Air Force is notifying County officials of the identity of property owners whose properties may be affected by the downgradient plume and requesting that the County not issue permits to install wells until the contaminants have been reduced below cleanup standards.

- Third, the existing groundwater data indicate that levels of TCE and PCE contamination in the downgradient plume are minimal (refer to Section 2.3 and Table 6-2 for data and MCL information). Installation of a pump and treat system encircling the entire OU1 contaminant plume (including the downgradient plume) was included in the Draft RI/FS Report for OU1 in July 1993. The system was projected to have a total cost exceeding 12 million dollars, or approximately 10 million dollars more than the chosen alternative. Past experience has indicated that it is difficult to treat such low levels of contamination, and the incremental cost for treatment of the downgradient plume at this site was not considered to be warranted. Thus, the alternative of pumping and treating the entire OU1 plume was deleted from consideration in the Final RI/FS report.

Groundwater monitoring will be conducted to ensure that the onbase portion of the plume does not migrate offbase, to ensure that the maximum concentration of offbase contaminants continues to fall, and to ensure that the offbase plume does not threaten offbase water supplies. Monitoring of the entire offbase plume will be conducted, which will necessitate installation of additional monitoring wells to fully define the horizontal and vertical extent of contamination and monitor its movement through time. Several additional wells will be installed offbase. The actual number and location of these wells will be recommended by the Air Force and approved by the regulatory agencies and will be based on sound scientific information. These wells will be sampled at least twice yearly. Each five year period, the data collected from those samples will be used to evaluate the effectiveness of the augmented GETS system in stopping contaminant migration offbase, and to ensure protection of offbase water supplies.

If monitoring data show that the operation of the GETS system combined with dissipation is not reducing the maximum concentration of contaminants in the downgradient plume, or is not stopping migration of the onbase plume offbase, or if offbase water supplies are threatened, then expansion of active treatment into the downgradient plume will be initiated. If at the end of 30 years the contaminants have not dissipated to cleanup standards, then the Air Force will expand active treatment of all Air Force related contamination into the downgradient plume. Sampling shall be accomplished on a semi-annual basis for VOCs (EPA Method 8260) and annually for total metals (EPA Method 6010), semivolatile organics (EPA Method 8270), and California Title 22 General Minerals. Groundwater measurements, to the nearest 0.01 foot, shall be obtained quarterly. All groundwater samples shall be collected using the techniques described in Chapter 5 of the RCRA Groundwater Monitoring Technical Enforcement Guidance Document (EPA 1986b) as modified for the existing March AFB Basewide Groundwater Monitoring Program.

Analytical data from each semi-annual round of sampling will be tabulated and summarized in a brief report. Following data verification by the Air Force, the semi-annual reports will be forwarded to signatories of the FFA and other interested parties. These reports will include semi-annual groundwater contour maps. At the conclusion of each five years of sampling, all data generated will be compiled, reviewed, interpreted, and summarized in a report.

The estimated cost for continuation of the GETS is approximately $1,839,000. The cost breakdown is as follows:

COST SUMMARY BREAKDOWN

INSTALLED CAPITAL:	
Site Preparation	$ 29,471
Installation of Wells	$ 206,900
Construction Oversite	$ 43,560
Extraction System	$ 198,380
Groundwater Treatment	$ 110,662
Subtotal Installed Capital	$ 588,973
Annual O&M Costs:	$ 106,348
PRESENT WORTH OF O&M COSTS:	$1,102,787
TOTAL PROJECT COSTS:	$1,839,000

Because the selected remedy requires long-term O&M, it will require five year reviews. At the end of each 5-year period, a collective decision between the regulating agencies and the Air Force on whether to continue monitoring and/or conduct cleanup of the groundwater will be made.

Site 18 Groundwater Plume. The preferred alternative for Site 18 involves a combination of soil and groundwater treatment technologies. This combination is preferred because both soil and groundwater are contaminated, free-phase fuel is present, and contaminated soils have become submerged beneath a rising water table. Dual-purpose wells will be installed in order to simultaneously extract groundwater and contaminated soil vapors. Dual extraction of soil vapors and groundwater will enhance groundwater cleanup in several ways. Most importantly, the continuing source of contaminants from the vadose zone will be removed. In addition, application of a vacuum to the dual-purpose wells will increase groundwater flow to the wells. Lastly, by lowering the water table and exposing contaminated aquifer materials to air flow, contaminant mass removal rates will be increased. This is because contaminants of concern are volatile, and are removed much more efficiently in the vapor phase than in groundwater.

Groundwater will be remediated using total fluids recovery followed by oil/water separation and air stripping for groundwater remediation (Alternatives 8G/5G). Free-phase product will be recovered in an above-ground oil/water separator for recycling. Contaminated groundwater will be treated by air stripping to remove volatile contaminants, followed by liquid phase carbon polishing to remove any remaining fuel components. Treated water will be discharged either to the base wastewater treatment plant, to the Heacock Storm Drain downgradient from the wetlands location, or reinjected to the aquifer. An unlined infiltration pond will be constructed over the plume area to store treated water during high flow periods in the Heacock Storm Drain, if applicable. Contaminant-laden air from the SVE process and the air stripper will be cleaned using the Purus PADRETM System (Alternative 13S).

The estimated cost for dual extraction at Site 18 is approximately $1,027,188. The cost breakdown is as follows:

COST SUMMARY BREAKDOWN

INSTALLED CAPITAL:	
Site Preparation	$ 27,871
Installation of Wells	$ 54,990
Construction Oversight	$ 9,410
Extraction System	$ 67,030
Groundwater Treatment	$ 60,116
Design/Contingencies	$ 54,855
Subtotal Installed Capital:	$ 274,271
Annual O&M Costs:	$ 72,608
PRESENT WORTH OF O&M COSTS:	$ 752,916
TOTAL PROJECT COSTS:	$1,027,188

Site 31 Groundwater Plume. Site 31 is a likely source for much of the TCE found in groundwater beneath OU1. The preferred method for cleanup of groundwater at Site 31 is to use groundwater extraction and treatment (Alternative 3G) in combination with SVE. Dual-purpose wells will be installed in order to simultaneously extract groundwater and contaminated soil vapors. Dual extraction of soil vapors and groundwater will enhance groundwater cleanup in several ways. Most importantly, the continuing source of contaminants from the vadose zone will be removed. In addition, application of a vacuum to the dual-purpose wells will increase groundwater flow to the wells. Lastly, by lowering the water table and exposing contaminated aquifer materials to air flow, contaminant mass removal rates will be increased. This is because contaminants of concern are volatile, and are removed much more efficiently in the vapor phase than in groundwater.

Extracted groundwater will be treated at the surface using activated carbon to remove the TCE and related compounds. Treated water will be discharged either to the base wastewater treatment plant, to the Heacock Storm Drain downgradient from the wetlands location, or reinjected to the aquifer. An unlined infiltration pond will be constructed over the plume area to store treated water during high flow periods in the Heacock Storm Drain, if applicable. Soil vapors will be treated using vapor phase GAC. GAC removes contaminants from the extracted vapor stream by adsorption on the carbon. When the carbon becomes saturated, it will be shipped offsite for regeneration. The estimated cost for groundwater extraction and treatment at Site 31 is approximately $1,103,000. The cost breakdown is as follows:

COST SUMMARY BREAKDOWN

INSTALLED CAPITAL:	
Site Preparation	$ 19,576
Installation of Wells	$ 74,400
Construction Oversight	$ 9,410
Extraction Systems	$ 120,275
Groundwater Treatment	$ 55,896
Design/Contingencies	$ 69,890
Subtotal Installed Capital:	$ 349,446
Annual O&M Costs:	$ 72,664
PRESENT WORTH OF O&M COSTS:	$ 753,497
TOTAL PROJECT COSTS:	$1,103,000

9.2 SOIL

Site 4. The preferred cleanup method for solid wastes is closure of the landfill in accordance with California regulations (Alternative 4S). This will include installation of a cap over the landfill, protecting the cap from erosion, long-term maintenance, and long-term monitoring. Closure of the landfill will minimize the potential for leachate generation and further groundwater contamination.

Site 10. A small volume of contaminated soil at Site 10 requires cleanup. The preferred method of cleanup of these soils is excavation and low-temperature thermal desorption (Alternative 5S). Low-temperature thermal desorption will destroy the contaminants of concern, thereby eliminating risk and the requirements for long-term monitoring.

Site 15. The preferred method of cleanup of these soils is excavation and low-temperature thermal desorption (Alternative 5S). Low-temperature thermal desorption will destroy the contaminants of concern, thereby eliminating risk and the requirement for long-term monitoring.

Site 18. Subsurface soil remediation (Alternative 13S) at Site 18 has been combined with the remediation of the Site 18 groundwater plume. See the Site 18 groundwater plume discussion above for a detailed discussion of both soil and groundwater remediation.

Site 31. The preferred method of cleanup of these soils is excavation and low-temperature thermal desorption (Alternative 5S). Low-temperature desorption will destroy the contaminants of concern, thereby eliminating risk and the requirement for long-term monitoring.

Site 34. The preferred method of cleanup of these soils is excavation and low-temperature thermal desorption (Alternative 5S). Low-temperature desorption will destroy the contaminants of concern, thereby eliminating risk and the requirement for long-term monitoring.

10.0 STATUTORY DETERMINATIONS

Under its legal authorities, EPA's involvement at Superfund sites is to undertake remedial actions that achieve adequate protection of human health and the environment. In addition, section 121 of CERCLA establishes several other statutory requirements and preferences. These specify that when complete, the selected remedial action for OU1 must comply with applicable or relevant and appropriate environmental standards established under Federal and state environmental laws unless a statutory waiver is justified. The selected remedy also must be cost-effective and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Finally, the statute includes a preference for remedies that employ treatment technologies that permanently and significantly reduce the volume, toxicity, or mobility of hazardous wastes as their principal element. The following sections discuss how the selected remedies meet the statutory requirements.

10.1 GROUNDWATER

Site 4/OU1 Groundwater Plume - Direct Treatment with Liquid Phase GAC

Protection of Human Health and the Environment. The selected remedy provides protection of human health and the environment through recovery of contaminated groundwater and subsequent removal of the contaminants. The alternative provides both short-term and long-term solutions to contaminant migration by removal of these constituents from the groundwater. This alternative utilizes extraction and treatment technologies that have been successfully implemented at other sites with similar conditions as well as at March AFB. Residuals from treatment (i.e., saturated activated carbon) will require regeneration or offsite disposal.

Recovery of contaminated groundwater and subsequent removal of contaminants will provide long-term effective remediation of the groundwater. The remedy will permanently and significantly reduce the volume of the volatile organics present in the treated groundwater. Based on successful application at similar sites, the technology is capable or removing at least 99 percent of the organic contaminants from the extracted groundwater and will reduce the concentrations of volatile organics to below currently acceptable levels. In addition, the remedy provides permanent, irreversible treatment of the groundwater.

Implementation of deed restrictions to prohibit the use of groundwater, until groundwater cleanup standards have been achieved, will reduce or eliminate the threat of exposure to human health. The installation of the remedy will be completed using conventional techniques, and no adverse impact to the community, workers, or the environment is anticipated during site preparation (i.e. grading the area) or installation of the treatment system. Engineering controls, such as dust suppression, will be employed as necessary to mitigate exposure to and migration of contaminants during the implementation of the technology.

Compliance with Applicable or Relevant and Appropriate Requirements. The selected remedy will comply with all applicable or relevant and appropriate chemical-, action-, and location-specific ARARs (refer to Appendix C, Tables C-1 and C-2).

Cost-Effectiveness. The selected remedy was chosen because of the three remedies that provide effective overall protection of human health and the environment, it is the least expensive.

Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Practicable. The selected remedy represents the maximum extent practicable to which permanent solutions and treatment technologies can be utilized in a cost-effective manner for the Site 4 and OU1 groundwater plumes. Direct treatment with GAC provides the best balance of tradeoffs in terms of long-term effectiveness and permanence; reduction in toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost.

Preference for Treatment as a Principal Element. The selected remedy satisfies the statutory preference for remedies that employ treatment as a principal element. By treating the VOC-contaminated groundwater with GAC, the selected remedy addresses the principal threat posed by the Site 4 and OU1 groundwater plumes through the use of a proven treatment technology.

Site 18 Groundwater Plume - Air Stripping with Purus PADRETM System Total/Fluids Recovery

Protection of Human Health and the Environment. The selected remedy provides protection of human health and the environment through recovery of contaminated groundwater and subsequent removal of the contaminants. Free-phase product will also be recovered for recycling. The remedy provides both short-term and long-term solutions by removing the contaminants from the groundwater. This alternative utilizes groundwater extraction and treatment technologies that have been successfully implemented at sites with similar conditions. The selected remedy is a permanent solution to the existing problem.

The process efficiency of the selected remedy has been demonstrated. Recovery of contaminated groundwater and subsequent removal of contaminants will provide long-term effective remediation of the groundwater. The remedy will permanently and significantly reduce the volume of the volatile organics present in the treated groundwater. Based on successful application at similar sites, the technology is capable of reducing the concentration of volatile organics present in the extracted groundwater to below currently acceptable levels. In addition, the remedy provides permanent, irreversible treatment of the groundwater.

Implementation of deed restrictions to prohibit the use of groundwater, until groundwater cleanup standards have been achieved, will reduce or eliminate the threat of exposure to human health. The installation of the remedy will be completed using conventional techniques, and no adverse impact to the community, workers, or the environment is anticipated during site preparation (i.e. grading the area) or installation of the treatment system. Engineering controls, such as dust suppression, will be employed as necessary to mitigate exposure to and migration of contaminants during the implementation of the technology.

Compliance with Applicable or Relevant and Appropriate Requirements. The selected remedy will comply with all applicable or relevant and appropriate chemical-, action-, and location-specific ARARs (refer to Appendix C, Tables C-3 and C-4).

Cost-Effectiveness. Two alternatives were rated equally on all evaluation criteria. The Purus PADRETM system was chosen because it can be used to treat not only contaminated vapors from the air stripper, but also contaminated vapors from the SVE system, thereby minimizing costs for combined treatment of soil and groundwater.

Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Practicable. The selected remedy represents the maximum extent practicable to which permanent solutions and treatment technologies can be utilized in a cost-effective manner for the Site 18 groundwater plume. Groundwater treatment through air stripping with treatment of the vapor stream with the Purus PADRETM System provides the best balance of tradeoffs in terms of long-term effectiveness and permanence; reduction in toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost. Additionally, free-phase product will be recovered and recycled.

Preference for Treatment as a Principal Element. The selected remedy satisfies the statutory preference for remedies that employ treatment as a principal element. By treating the fuel-contaminated groundwater with an air stripper, the selected remedy addresses the principal threat posed by the Site 18 groundwater plume through the use of a proven treatment technology.

Site 31 Groundwater Plume - Direct Treatment with Liquid Phase GAC

Protection of Human Health and the Environment. The selected remedy provides protection of human health and the environment through recovery of contaminated groundwater and subsequent removal of the contaminants. The remedy provides both short-term and long-term solutions to contaminant migration by removing of these constituents from the groundwater. The selected remedy utilizes groundwater extraction and treatment technologies that have been successfully implemented at sites with similar conditions. Residuals from treatment (i.e. saturated activated carbon) will require regeneration or offsite disposal.

Recovery of contaminated groundwater and subsequent removal of contaminants will provide long-term effective remediation of the groundwater. The selected remedy will reduce the concentration of volatile organics present in the treated effluent to acceptable levels. The remedy will permanently and significantly reduce the volume of the volatile organics present in the extracted groundwater. Based on successful application at numerous similar sites, at least 99 percent of the organic contaminants from the extracted groundwater. In addition, the remedy provides permanent, irreversible treatment of the groundwater.

Implementation of deed restrictions to prohibit the use of groundwater, until groundwater cleanup standards have been achieved, will reduce or eliminate the threat of exposure to human health. The installation of the remedy will be completed using conventional techniques, and no adverse impact to the community, workers, or the environment is anticipated during site preparation (i.e. grading the area) or installation of the treatment system. Engineering controls, such as dust suppression, will be employed as necessary to mitigate exposure to and migration of contaminants during the implementation of the technology.

Compliance with Applicable or Relevant and Appropriate Requirements. The selected remedy will comply with all applicable or relevant and appropriate chemical-, action-, and location-specific

ARARs (refer to Appendix C, Tables C-5 and C-6).

Cost-Effectiveness. The selected remedy was chosen because it was rated highest overall in terms of the evaluation criteria. Of the three alternatives that provide effective overall protection of human health and the environment, this alternative is either cheaper than or comparable to the other alternatives.

Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Practicable. The selected remedy represents the maximum extent practicable to which permanent solutions and treatment technologies can be utilized in a cost-effective manner for the Site 31 groundwater plume. Direct groundwater treatment with GAC provides the best balance of tradeoffs in terms of long-term effectiveness and permanence; reduction in toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost.

Preference for Treatment as a Principal Element. The selected remedy satisfies the statutory preference for remedies that employ treatment as a principal element. By treating the VOC-contaminated groundwater with GAC, the selected remedy addresses the principal threat posed by the Site 31 groundwater plume through the use of a proven treatment technology.

10.2 SOIL

Site 4 - Landfill Closure

Protection of Human Health and the Environment. The selected remedy protects human health and the environment through landfill closure and construction of a cap over the landfill which will reduce infiltration of precipitation and prevent erosion of landfill waters. Additionally, the closure would isolate the storm drainage system from the landfill material through the installation of an impermeable vertical barrier. The selected remedy provides long-term maintenance and water quality monitoring of the closure system, response programs, and establishment of a closure fund to support the required maintenance activities. Capping is a proven technology in controlling migration of soil contaminants.

The selected remedy will ensure the long-term effectiveness in minimizing the migration of soil contaminants to the groundwater. The mobility of soil contaminants will be reduced through the construction of a low permeability cover and a vertical barrier along the surface water drainage channel. Upon completion of the cap, the alternative will have an immediate impact on reduction of potential soil contaminant migration.

Compliance with Applicable or Relevant and Appropriate Requirements. The selected remedy will comply with all applicable or relevant and appropriate chemical-, action-, and location-specific ARARs (refer to Appendix C, Tables C-7).

Cost-Effectiveness. The selected remedy was chosen because it was rated highest in terms of the overall evaluation criteria and is cheaper than other alternatives that offer effective protection of human health and the environment.

Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Practicable. The selected remedy represents the maximum extent practicable to which permanent solutions can be utilized in a cost-effective manner. The selected remedy provides the best balance of tradeoffs in terms of long-term effectiveness and permanence; reduction in toxicity, mobility, or volume; short-term effectiveness; implementability; and cost.

Preference for Treatment as a Principal Element. The selected remedy does not satisfy the statutory preference for remedies that employ treatment as a principal element. Treatment of wastes found at Site 4 is not practicable for two reasons. First, the nature of the wastes (refuse, debris) is not amenable to treatment. Second, even though extensive sampling of the landfill was conducted, no apparent source area for contaminants was observed.

Site 10 - Excavation and Low Temperature Thermal Desorption

Protection of Human Health and the Environment. The selected remedy protects human health and the environment by treating the contaminated soils with low-temperature thermal desorption. Exposure to PAH-contaminated soils is reduced by reducing the PAH levels within the soils. The exposure to workers and the public during excavation and treatment of contaminated soils will be minimized through engineering controls, personal protective equipment, and standard operating procedures. Dust suppression measures and engineering controls will be implemented to reduce exposure to the surrounding community from dust particles and air emissions during the removal and treatment of soils.

Since the contaminated soils will be removed and treated, no long-term operational or monitoring considerations exist at Site 10. Low-temperature thermal treatment should effectively mitigate the risk by eliminating the residual contamination at the site. Periodic inspections and long-term operation and maintenance would not be required for this alternative. Toxicity reduction through low-temperature thermal treatment is dependent on volatilization of the PAHs and effective off-gas treatment. Catalytic oxidation and incineration will effectively destroy the contaminant, eliminating any toxicity concerns. In the event this process fails to meet expected remediation levels, alternative technologies can easily be implemented.

Compliance with Applicable or Relevant and Appropriate Requirements. The selected remedy will comply with all applicable or relevant and appropriate chemical-, action-, and location-specific ARARs (refer to Appendix C, Table C-8).

Cost-Effectiveness. The selected remedy was chosen because of the two similar alternatives that provide for overall protection of human health and the environment and are implementable, it is the only one that offers a permanent solution, and costs are comparable.

Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Practicable. The selected remedy represents the maximum extent practicable to which permanent solutions can be utilized in a cost-effective manner. The selected remedy provides the best balance of tradeoffs in terms of long-term effectiveness and permanence; reduction in toxicity, mobility, or volume; short-term effectiveness; implementability; and cost.

Preference for Treatment as a Principal Element. The selected remedy satisfies the statutory preference of remedies that employ treatment as a principal element. By removing PAHs from the soils and controlling the air emissions to meet air quality ARARs, the selected remedy addresses the principal threat posed by Site 10 soils through the use of proven treatment technologies.

Site 15 - Excavation and Low Temperature Thermal Desorption

Protection of Human Health and the Environment. The selected remedy protects human health and the environment by treating the contaminated soils with low-temperature thermal desorption. Exposure to PAH-contaminated soils is reduced by reducing the PAH levels within the soils. The exposure to workers and the public during excavation and treatment of contaminated soils will be minimized through engineering controls, personal protective equipment, and standard operating procedures. Dust suppression measures and engineering controls will be implemented to reduce exposure to the surrounding community from dust particles and air emissions during the removal and treatment of soils.

Since the contaminated soils will be removed and treated, no long-term operational or monitoring considerations exist at Site 15. Low-temperature thermal treatment should effectively mitigate the risk by eliminating the residual contamination at the site. Periodic inspections and long-term operation and maintenance would not be required for this alternative. Toxicity reduction through low-temperature thermal treatment is dependent on volatilization of the PAHs and effective off-gas treatment. Catalytic oxidation and incineration will effectively destroy the contaminant, eliminating any toxicity concerns. In the event this process fails to meet expected remediation levels, alternative technologies can easily be implemented.

Compliance with Applicable or Relevant and Appropriate Requirements. The selected remedy will comply with all applicable or relevant and appropriate chemical-, action-, and location-specific ARARs (refer to Appendix C, Table C-8).

Cost-Effectiveness. The selected remedy was chosen because of the two similar alternatives that provide for overall protection of human health and the environment and are implementable, it is the only one that offers a permanent solution, and costs are comparable.

Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Practicable. The selected remedy represents the maximum extent practicable to which permanent solutions can be utilized in a cost-effective manner. The selected remedy provides the best balance of tradeoffs in terms of long-term effectiveness and permanence; reduction in toxicity, mobility, or volume; short-term effectiveness; implementability; and cost.

Preference for Treatment as a Principal Element. The selected remedy satisfies the statutory preference of remedies that employ treatment as a principal element. By removing PAHs from the soils and controlling the air emissions to meet air quality ARARs, the selected remedy addresses the principal threat posed by Site 10 soils through the use of proven treatment technologies.

Site 18 - Soil Vapor Extraction with Purus PADRETM System

Protection of Human Health and the Environment. The selected remedy protects human health and the environment by mechanically removing volatile contaminants from unsaturated soils and treating the contaminants at the surface. This remedy will reduce soil contaminant concentrations and thus prevent further degradation of groundwater.

Implementation of the selected remedy will provide long-term effective remediation. However, the effectiveness of the technology is limited by subsurface soil conditions. It is therefore possible that in some areas the contamination may not be effectively treated to the required cleanup standards.

Implementation of the selected remedy should not adversely impact the community, workers, or the environment. Engineering controls will be employed as necessary during the installation of the remedy to mitigate exposure to and offsite migration of contaminants. The use of this technology will result in a contaminated gas stream that will require treatment. However, since the contaminated gas stream will be under a vacuum, the potential of leaks of the contaminated gas stream to the environment is minimized.

Compliance with Applicable or Relevant and Appropriate Requirements. The selected remedy will comply with all applicable or relevant and appropriate chemical-, action-, and location-specific ARARs (refer to Appendix C, Table C-10).

Cost-Effectiveness. Of the three alternatives that provide effective protection of human health and the environment, all were rated equally in terms of the overall selection criteria. The selected remedy is slightly higher in cost, but was chosen because it integrates with the Site 18 groundwater treatment system. The Purus PADRETM system can be used to treat contaminated vapors from both the SVE system and the air stripper, thereby minimizing costs of combined soil/groundwater treatment.

Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Practicable. The selected remedy represents the maximum extent practicable to which permanent solutions and treatment technologies can be utilized in a cost-effective manner for source removal. SVE provides the best balance of tradeoffs in terms of long-term effectiveness and permanence; reduction in toxicity, mobility, or volume; short-term effectiveness; implementability; and cost.

Preference for Treatment as a Principal Element. The selected remedy satisfies the statutory preference of remedies that employ treatment as a principal element. By removing VOC contaminants in subsurface soils and treating the extracted vapor to meet air quality ARARs, the selected remedy addresses the principal threat posed by Site 18 soils through the use of proven treatment technologies.

Site 31 Surface Soils - Excavation and Low Temperature Thermal Desorption

Protection of Human Health and the Environment. The selected remedy protects human health and the environment by treating the contaminated soils with low-temperature desorption. Exposure to PAH-contaminated soils is reduced by reducing the PAH levels within the soils. The exposure to workers and the public during excavation and treatment of contaminated soils will be minimized through engineering controls, personal protective equipment, and standard operating procedures. Dust suppression measures and engineering controls will be implemented to reduce exposure to the surrounding community from dust particles and air emissions during the removal and treatment of soils.

Since the contaminated soils will be removed and treated, no long-term operational or monitoring considerations exist at Site 31. Low-temperature thermal treatment should effectively mitigate the risk by eliminating the residual contamination at the site. Periodic inspections and long-term operation and maintenance would not be required for this alternative. Toxicity reduction through low-temperature thermal treatment is dependent on volatilization of the PAHs and effective off-gas treatment. Catalytic oxidation and incineration will effectively destroy the contaminant, eliminating any toxicity concerns. In the event this process fails to meet expected remediation levels, alternative technologies can easily be implemented.

Compliance with Applicable or Relevant and Appropriate Requirements. The selected remedy will comply with all applicable or relevant and appropriate chemical-, action-, and location-specific ARARs (refer to Appendix C, Table C-11).

Cost-Effectiveness. The selected remedy was chosen because of the two similar alternatives that provide for overall protection of human health and the environment and are implementable, it is the only one that offers a permanent solution, and costs are comparable.

Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Practicable. The selected remedy represents the maximum extent practicable to which permanent solutions can be utilized in a cost-effective manner. The selected remedy provides the best balance of tradeoffs in terms of long-term effectiveness and permanence; reduction in toxicity, mobility, volume; short-term effectiveness; implementability; and cost.

Preference for Treatment as a Principal Element. The selected remedy satisfies the statutory preference for remedies that employ treatment as a principal element. By removing PAHs contaminants from the soils and controlling the air emissions to meet air quality ARARs, the selected remedy addresses the principal threat posed by Site 31 soils through the use of proven treatment technologies.

Site 31 Subsurface Soil - Soil Vapor Extraction with Carbon Adsorption

Protection of Human Health and the Environment. The selected remedy protects human health and the environment by mechanically removing volatile contaminants from unsaturated soils and treating the contaminants at the surface. This remedy will reduce soil contaminant concentrations and thus prevent further degradation of groundwater through contaminant migration.

Implementation of the selected remedy will provide long-term effective remediation. However, the effectiveness of the technology is limited by subsurface soil conditions. It is therefore possible that in some areas the contamination may not be effectively treated.

Implementation of the selected remedy should not adversely impact the community, workers, or the environment. Engineering controls will be employed as necessary during the installation of the remedy to mitigate exposure to and offsite migration of contaminants. The use of this technology will result in a contaminated gas stream that will require treatment. However, since the contaminated gas stream will be under a vacuum, the potential of leaks of the contaminated gas stream to the environment is minimized.

Compliance with Applicable or Relevant and Appropriate Requirements. The selected remedy will comply with all applicable or relevant and appropriate chemical-, action-, and location-specific ARARs (refer to Appendix C, Table C-12).

Cost-Effectiveness. The selected remedy was chosen because of the three similar alternatives that provide for overall protection of human health and the environment, it is the least expensive.

Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Practicable. The selected remedy represents the maximum extent practicable to which permanent solutions and treatment technologies can be utilized in a cost-effective manner for source removal. SVE provides the best balance of tradeoffs in terms of long-term effectiveness and permanence; reduction in toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost.

Preference for Treatment as a Principal Element. The selected remedy satisfies the statutory preference for remedies that employ treatment as a principal element. By removing VOC contaminants in subsurface soils and treating the extracted vapor to meet air quality ARARs, the selected remedy addresses the principal threat posed by Site 18 soils through the use of proven treatment technologies.

Site 34 Surface Soil - Excavation and Low Temperature Thermal Desorption

Protection of Human Health and the Environment. The selected remedy protects human health and the environment by treating the contaminated soils with low-temperature desorption. Exposure to PAH-contaminated soils is reduced by reducing the PAH levels within the soils. The exposure to workers and the public during excavation and treatment of contaminated soils will be minimized through engineering controls, personal protective equipment, and standard operating procedures. Dust suppression measures and engineering controls will be implemented to reduce exposure to the surrounding community from dust particles and air emissions during the removal and treatment of soils.

Since the contaminated soils will be removed and treated, no long-term operational or monitoring considerations exist at Site 34. Low-temperature thermal treatment should effectively mitigate the risk by eliminating the residual contamination at the site. Periodic inspections and long-term operation and maintenance would not be required for this alternative. Toxicity reduction through low-temperature thermal treatment is dependent on volatilization of the PAHs and effective off-gas treatment. Catalytic oxidation and incineration will effectively destroy the contaminant, eliminating any toxicity concerns. In the event this process fails to meet expected remediation levels, alternative technologies can easily be implemented.

Compliance with Applicable or Relevant and Appropriate Requirements. The selected remedy will comply with all applicable or relevant and appropriate chemical-, action-, and location-specific ARARs (refer to Appendix C, Table C-13).

Cost-Effectiveness. The selected remedy was chosen because of the two similar alternatives that provide for overall protection of human health and the environment and are implementable, it is the only one that offers a permanent solution, and costs are comparable.

Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Practicable. The selected remedy represents the maximum extent practicable to which permanent solutions can be utilized in a cost-effective manner. The selected remedy provides the best balance of tradeoffs in terms of long-term effectiveness and permanence; reduction in toxicity, mobility, volume; short-term effectiveness; implementability; and cost.

Preference for Treatment as a Principal Element. The selected remedy satisfies the statutory preference for remedies that employ treatment as a principal element. By removing PAHs contaminants from the soils and controlling the air emissions to meet air quality ARARs, the selected remedy addresses the principal threat posed by Site 34 soils through the use of proven treatment technologies.

Site 34 Subsurface Soil - Bioventing

Protection of Human Health and the Environment. The selected remedy protects human health and the environment through enhancement of the natural microbial biodegradation of hydrocarbons in unsaturated soils. This remedy is completed by providing sufficient air flow in the soil to maintain oxygenated conditions. This remedy will reduce soil contaminant concentrations thereby providing protection to human health by limiting further degradation of the groundwater.

Implementation of the selected remedy will provide long-term effective remediation. However, the effectiveness of the technology is limited by subsurface soil conditions. It is therefore possible that in some areas the contamination may not be effective treated.

Implementation of the selected remedy should not adversely impact the community, workers, or the environment. The injection of ambient air into the subsurface will not result in air discharges that could affect local residents. Monitoring of surface ambient air will confirm potential discharges through the surface soils. The selected remedy has a positive impact on the environment in that natural processes are used to degrade contaminants to non-toxic end products. The time period for treatment is site specific depending upon the rate of degradation attainable with the microorganisms present in the soil and the ability to apply oxygen.

Compliance with Applicable or Relevant and Appropriate Requirements. The selected remedy will comply with all applicable or relevant and appropriate chemical-, action-, and location-specific ARARs (refer to Appendix C, Table C-14).

Cost-Effectiveness. The selected remedy was chosen because it was rated highest in terms of the overall evaluation criteria and is cheaper than other alternatives that provide effective protection of human health and the environment.

Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Practicable. The selected remedy represents the maximum extent practicable to which permanent solutions and treatment technologies can be utilized in a cost-effective manner for source removal. Bioventing provides the best balance of tradeoffs in terms of long-term effectiveness and permanence; reduction in toxicity, mobility, volume through treatment; short-term effectiveness; implementability; and cost.

Preference for Treatment as a Principal Element. The selected remedy satisfies the statutory preference for remedies that employ treatment as a principal element. By enhancement of the natural microbial biodegradation of hydrocarbons in unsaturated zone subsurface soils, the selected remedy addresses the principal threat posed by Site 34 soils through the use of treatment technologies.

11.0 DOCUMENTATION OF SIGNIFICANT CHANGES

No significant changes to the OU1 ROD were required as a result of public comments received by the Air Force.

APPENDIX A

RESPONSIVENESS SUMMARY

A. Overview

Prior to the public comment period March Air Force Base (AFB) had chosen preferred remedial alternatives for each individual site within the Operable Unit 1 (OU1). The March AFB chosen alternatives addressed the soil and/or groundwater problems for each site. The preferred alternative for each site located within OU1 is as follows:

Site Number	Contamination Media	Preferred Alternative(s)
4	Groundwater	Direct treatment with liquid phase granular activated carbon (GAC)
4	Subsurface Soil	Landfill Closure
10	Surface Soil	Excavation and on-site consolidation, or excavation, or low temperature thermal desorption
15	Surface Soil	Excavation and on-site consolidation, or excavation, or low temperature thermal desorption
18	Groundwater	Air stripping with Purus PADRETM system/total fluids recovery
18	Subsurface Soil	Soil vapor extraction with Purus PADRETM system and bioventing
31	Groundwater	Direct treatment with liquid phase GAC adsorption
31	Surface Soil	Excavation and on-site consolidation, or excavation, or low temperature thermal desorption
31	Subsurface Soil	Soil vapor extraction and carbon adsorption
34	Surface Soil	Excavation and on-site consolidation, or excavation, or low temperature thermal desorption
34	Subsurface Soil	Bioventing

The Superfund Amendments and Reauthorization Act (SARA) of 1986 requires federal facilities, like March AFB, to work closely with the Environmental Protection Agency (EPA) and follow their guidelines while conducting hazardous waste site investigations and cleanup. Following a July 1989 proposal for the inclusion of March AFB to the National Priorities List (NPL), March AFB began coordinating with EPA, the California Department of Health and Safety (DHS), and the California Regional Water Quality Control Board (RWQCB) to develop a plan to address the regulatory requirements of these agencies while continuing ongoing efforts to characterize and clean up waste sites. These negotiations were successfully concluded on September 27, 1990, by which time representatives of the three regulatory agencies and the Air Force had signed the

Federal Facilities Agreement (FFA). In September of 1990 the FFA provided a schedule of future Installation Restoration Program (IRP)/Superfund activities at March AFB which was released for public comment.

B. Background on Community Involvement

The Remedial Investigation / Feasibility Study (RI/FS) report and Proposed Plan for OU1 were released to the public on April 28, 1994. These two documents were made available to the public in the Administrative Record, the information repositories at the Moreno Valley and March AFB libraries, and at the Moreno Valley Chamber of Commerce. The notice of availability of these documents was published in the Press-Enterprise on April 27, 1994. A fact sheet, condensed from the Proposed Plan, was sent to everyone on the March AFB mailing list, which includes Restoration Advisory Board (RAB) members. An OU1 RI/FS subcommittee, formed by the RAB, provided oral comments to the RAB at its April 26, 1994 meeting.

C. Summary of Public Comments Received During Public Comment Period and Agency Responses

A public comment period was held from April 28 to May 28, 1994. In addition, a public meeting was held on May 12, 1994 at 7 p.m. at the Best Western Image Suites in Moreno Valley. Representatives of the U.S. Air Force, USEPA, Department of Toxic Substances Control, and California Regional Water Quality Control Board, Santa Ana, attended the public meeting to address any questions about the RI/FS and Proposed Plan.

The major comments expressed during the meeting held on May 12, 1994 are transcribed below:

<u>Remedial Alternative Preferences</u>

1. Question: Why were some more expensive technologies picked over cheaper ones?

March AFB Response: Time: For example: Natural attenuation at Panero would take 200 years. We want to get the base cleaned up fast. Also, we prefer a sure-fire method instead of lesser known methods. The Air Force wants to get the cleanup done as quickly as possible, and to their standards. They will pay extra for this.

2. Question: Why are you not moving sites 10 and 15 to Site 4?

March AFB Response: Air Force policy is to not move the problem somewhere else. To take care of it permanently and not put it in the ground where it might cause us problems somewhere else.

3. Question: For the OU1 plume (Site 4), the air stripping with carbon adsorption was more expensive, but you picked the liquid-phase granular activated carbon. Was that because it is being used in the GETS (Groundwater Extraction and Treatment System)?

March AFB Response: Yes, the GETS is already in place so we are just going to supplement that.

4. Question: What about the innovative technologies? What is happening with that?

March AFB Response: The IT (Innovative Technology) system needs to be relocated because the results of our soil vaporization studies show that the contamination at Site 2 have migrated through the vadose zone and have now gone southerly. We think we know where they have gone, and we are doing some drilling to find out. The system has been temporarily shut off. The UVB is up and running and has been working well, and the program has been extended for another year. Earth Tech will be putting in two soil vapor extraction systems to work on the vadose zone removal of TCEs. We will be putting in three Steamist systems to monitor the progress of those, and they will also monitor the effectiveness of the UVB. Those systems will remain in operation as long as there is a contaminant level that might degrade the groundwater.

5. Question: How much carbon is being used in the GAC systems, and would it be more cost effective to use thermal oxidation?

March AFB Response: The carbon is reused. We have elected to use the Purus system because it recirculates the carbon and you never have to reinstall the carbon for a 20 year period. In the GETS system, we install new carbon once a year, and we put in 20,000 pounds. Also, in these types of systems there is always 10 percent left over that has hazardous material in it that we can not rejuvenate. The Purus system does not do that.

6. Question: The minutes of the March 16 meeting, in describing the presentation on the OU1 Proposed Plan, say that there will be no further action on some sites. Could there be an explanation in the minutes of why those sites will have no further action?

March AFB Response: We could attach a summary to the minutes.

Remedial Alternative Safety Concerns

1. Question: What is the plan for Site 4 dust control, where the cap will be installed over the landfill?

March AFB Response: We will be planting natural plants that do not need much water, that will live with the existing rainfall we have. We do not want to put in a sprinkler system because that just introduces water into the landfill. The cap will be a modified cap under RCRA Title XV, which will have geosynthetic fibers in it, so that even if you penetrate the soil, you can not puncture it. It will have one foot to 18 inches of soil on top. The life of the cap is a minimum of 20 years.

2. Question: Are Earthquake faults a problem if you are going to be burying materials?

March AFB Response: No. We have existing landfills that have been there since 1940. We are not proposing to bury anything more in the ground. We may be moving some contaminated material into existing ones, and we have two alternatives. It is cheaper to move the contaminated material than to oxidize it. We would prefer to dispose of it permanently (by oxidation), but if we do not have the funding at the appropriate time to do that, we need a fallback position, which is to move 2,000 yards of material that are similar to the landfill into the existing landfill and cap it. We are still doing geophysical studies to see if the faults we have found on base have moved structurally any number of inches in the last 10,000 years.

3. Question: Regarding bioventing - is it hard to control the air flow; will it push contaminants in other directions?

March AFB Response: We are only talking about 30 pounds of air pressure, which is nothing. We will have systems installed at Site 34 also, to monitor the amount of vadose cleanup we are getting. We do not expect large amounts of movement of contaminants in the vadose zone, this is an innovative system that has never been used at March AFB. It is a method of permanent monitoring to determine vadose zone cleanup, and monitoring of groundwater cleanup. An advantage of the system is that it monitors at discrete depths, so we can always tell if there is migration to other areas, and if there is, there will be time to put in other methods of controlling it.

Cost/Funding Issues

1. Question: What happens to the long-term monitoring if funds are cut off?

March AFB Response: Our budget is figured until the year 1998, at which time we will be in primarily operation and maintenance (O&M), which will remain constant until the year 2010, at which time the O&M dollars will decrease. The O&M costs are only about $1.2 million per year, for all the 6 to 8 systems on base that will be up running.

EPA Response: The EPA has the continual responsibility to make sure the Air Force does the monitoring.

Public Participation Process

1. Question: How do we get that information (on monitoring) - for example, in 15 years from now?

March AFB Response: The information will always be available (even in 15 years) in the repositories located at the RWQCB, the base library, and the Moreno Valley library. The EPA can also be contacted as to when the last monitoring was conducted.

March AFB General Comment: We would like people to come to the public meeting on the Proposed Plan and ask questions like you are now. The questions and answers will be written up and attached to the Plan, so it will become a matter of permanent record. We will have court stenographer at that meeting taking down the entire proceedings.

Enforcement

1. Question: In regard to the annual reviews, how stringent is EPA in following these annual reviews; how frequently do they monitor?

EPA Response: This is really two questions. The first is how often the monitoring is done, and John (Sabol) is saying that this will be on the order of once a year. Second, under CERCLA/Superfund legislation, the EPA is required to do a 5-year review with the lead agency (in this case the DOD) to see how well the corrective action is working. These reviews are statutory requirements.

Part II - Comprehensive Response to Specific Legal and Technical Questions

Reports by the Engineering Evaluation/Cost Analysis (EE/CA) Review Subcommittee

Site 2

1. Comment by Ms. Helen Grinyer: On page 6, paragraph 3, "munitions" are mentioned.

March AFB Response: The inclusion of the word "munitions" is a mistake. There were no munitions at Site 2 which was a waste oil/paints/solvents site. The munitions are associated with Site 25 A and B.

2. Comment by Ms. Helen Grinyer: There's a mistake in English, too "With on" should be "With only" (paragraph 7). Referring to page 14..when was the last survey done?

March AFB Response: The last survey was done about 4 weeks ago, although this was not mentioned in the EE/CA. There might have been a mis-communication between the contractor who did the report and the contractor who did the survey. The EE/CA will be corrected to include the last survey.

3. Comment by Ms. Helen Grinyer: In Figures 2-4 and 2-5, magnetic surveys, the gas line doesn't show up although it is shown in Figure 2-7.

March AFB Response: If these Figures were the magnetometer surveys, the gas line should have been detected and be included in the Figures. This will be reviewed and corrected.

4. Question: How was the benzene concentration determined?

March AFB Response: There is a series of EPA protocols that are used to determine the contaminants. They should have listed all the EPA protocols and what types of contaminants that they find.

Comment: The figures given don't reflect the maximum amount of benzene allowed as shown on the tables.

March AFB Response: The maximum differs between the state and federal.

5. Question: If you're going to be digging up dirt and moving it from Site 2 to Site 4, how will you keep the contaminants from being airblown during the process?

March AFB Response: The contamination is only 5 parts per billion, which is a low level. If there is a problem, a foam spray is available to spray on the dirt to keep airborne emissions down.

The Air Force will be requiring the contractors to comply with all local, state, and federal regulations to prevent and airborne emissions. The exact methods to be used are left up to the contractors.

Site 17

1. Comment by Mr. Barry McClellan: I've had most of my questions answered in the report and from touring the site previously. In the swimming pool, 90% is backfill and 10% is metallic. The recommended action is to excavate and remove it. Everything seems to be done according to standard protocol. You've tested the soil around the pool, and afterwards you will be coring to test the soil under the pool.

March AFB Response: We'll remove the pool entirely. The concrete will be taken out, the soil at the bottom will be sampled to determine the degree of contamination, and if there is contamination then we will develop a system that will work.

D. Remaining Concerns

None

APPENDIX B

ADMINISTRATIVE RECORD INDEX

ADMINISTRATIVE RECORD INDEX

KRR	OU	TITLE	DATE	TYPE	AUTHOR	RECIPIENT
AR0174	1	ADDITIONAL SITE CHARACTERIZATION, WORK PLAN ADDENDUM OPERABLE UNIT 1	11/01/93	WORK PLAN	EARTH TECH CORP	AFCEE/ESR
AR0176	1	ADDL SITE CHARACTERIZATION WORKPLAN ADDENDUM, OU#1	12/03/93	DOCUMENT REVIEW	RICHARD RUSSELL	JOHN SABOL
AR0001	2	AIR FORCE CORDONS OFF POSSIBLY TOXIC MATERIALS	01/17/92	NEWSPAPER ARTICLE	UNKNOWN	
AR0002	B	AIR FORCE ENVIRONMENTAL PROGRAM CLEANS UP HAZARDOUS WASTE SITES	08/30/91	NEWSPAPER ARTICLE	WENDY WILLIAMS, 22 ARW/PA	BEACON
AR0003	2	AIR FORCE VILLAGE WEST LAND CONVEYANCE ENV ASSESSMENT	10/01/87	REPORT	WIKHAUS & ASSOCIATES	SAC
AR0004	B	AREA 5, PANERO. SITE 11, STATEMENT OF WORK DRILLING AND WELL INSTALLATION	02/26/91	REPORT	INEL	
AR0005	1	BASE EXTRACTS, CLEANS CONTAMINATED WATER	05/22/92	PRESS RELEASE	KIM RANSFORD, 22 ARW/PA	BEACON
AR0006	2	BASE WASTE DUMP FOUND IN GRAVEL PIT	01/18/92	NEWSPAPER ARTICLE	GARY POLAKOVIC	
AR0007	1	BASE WELLS SET TO CLEAR POLLUTION	05/15/92	NEWSPAPER ARTICLE	GARY POLAKOVIC, PRESS ENTERPRISE	
AR0172	B	BASEWIDE GROUNDWATER MONITORING PROGRAM - SUMMER QTR 1993	10/01/93	ANALYTICAL DATA	TETRA TECH	HQ AMC

KRR	OU	TITLE	DATE	TYPE	AUTHOR	RECIPIENT
AR0173	B	BASEWIDE GROUNDWATER MONITORING PROGRAM - SPRING QTR 1993	10/101/93	ANALYTICAL DATA	TETRA TECH	HQ AMC
AR0135	2	BUDGET AND SCHEDULE CONFIRMATION, APPENDIX A	01/06/92	WORK PLAN	RADIAN CORP	US CORP OF ENGINEERS
AR0129	2	CALTRANS SAMPLING RESULTS	02/25/92	CORRESPONDENCE	JOHN KEMMERER, US EPA	LAWRENCE WATS 22 CES/DEV
AR0008	B	CERCLA OF 1980	12/12/86	FEDERAL DOCUMENT	US CONGRESS: WASHINGTON	USEPA: NAFB:
AR0170	B	CHILD DEVELOPMENT CENTER EXPANSION FINAL PRELIM ENDANGERMENT ASSESS	01/07/93	REPORT	TETRA TECH	HQ AMC/CEVR
AR0100	B	CITY OF MORENO VALLEY COMMENTS ON MAFB FFA	01/02/91	DOCUMENT REVIEW	MURRAY L. WARDEN,	22 AREFW/PA
AR0009	B	COMMUNITY RELATIONS PLAN FOR MARCH AFB, FINAL	05/01/91	COMMUNITY RELATIONS	ALBERT B.: EBASCO:	EG&G: INEL: MAFB/DEV/PAR:
AR0010	B	COMPILING ADMINISTRATIVE RECORDS IN REGION 9, DRAFT	01/17/91	PROGRAM GUIDANCE	USEPA/R9:	MEIDLEIM C, MFB/PAE
AR0011	B	COMPREHENSIVE SITE MANAGEMENT PLAN	12/01/90	PLAN		
AR0012	1	DESIGN DESCRIPTION, SPECIFICATIONS DRAWINGS AREA 5	05/30/91	WORK SPECIFICATION	INEL	DOD/DEV
AR0013	1	DISPLAY AD FOR GETS PUBLIC MEETING	05/19/92	PUBLIC NOTICE	KIM RANSFORD, 22 SPTG/DEV	PRESS-ENTERPR
AR0014	B	DISPLAY AD FOR TECHNICAL REVIEW COMMITTEE	02/22/92	PUBLIC NOTICE	KIM RANSFORD, 22 ARW/PA	PRESS-ENTERPR
AR0015	B	DISPLAY AD, TRC MEETING 14 MAY 92	05/08/92	PUBLIC NOTICE	KIM RANSFORD	PRESS ENTERPR

KRR	OU	TITLE	DATE	TYPE	AUTHOR	RECIPIENT
AR0111	B	DOD AND STATE MEMORANDUM OF AGREEMENT (DSMOA)	11/08/90	INTER-AGENCY AGREEMENT	DOD/STATE	22 CSG/DEV
AR0130	2	DRAFT FINAL RI/FS WORKPLAN AND SAP DEADLINE	07/24/92	CORRESPONDENCE	RICHARD RUSSELL	JOHN SABOL
AR0143	B	DRAFT INVESTIGATION-DERIVED WASTE MANAGEMENT PLAN	08/26/92	DOCUMENT REVIEW	JOHN BRODERICK, CRWQCB	JOHN SABOL
AR0180	3	EE/CA REPORT, OU #3 REMOVAL ACTION - DRAFT FINAL	12/01/93	REPORT	INEL	MARCH AFB
AR0154	2	ENERGY DISSIPATORS, SITE 40 WORK PLAN	09/01/92	WORK PLAN	KLEIKFELDER	MARCH AFB
AR0016	1	ENG EVAL/COST ANALYSIS AREA 5 AND SITE 5 REMOVAL ACTIONS GETS	01/01/91	REPORT	INEL	MAFB
AR0017	B	ENVIRONMENTAL PROGRAM DEVELOPS CLEANUP PLAN	06/22/90	NEWSPAPER ARTICLE	SGT RENEE WRITE	
AR0168	B	EXPANDED SOURCE INVEST/RCRA APPENDIX B: VISUAL SITE INSP NOTES - VOL 1	10/01/92	REPORT	EARTH TECH	HQ AMC
AR0169	B	EXPANDED SOURCE INVEST/RCRA APPENDIX B: VISUAL SITE INSP NOTES - VOL 2	10/01/92	REPORT	EARTH TECH	HQ AMC
AR0167	B	EXPANDES OURCE INVESTIGATION/RCRA APPENDIX A: - PHOTO LOG	10/1/92	REPORT	EARTH TECH	HQ AMC
AR0166	B	EXPANDEDSOURCE INVESTIGATION/RCRA FACILITY ASSESSMENT	06/01/93	REPORT	EARTH TECH	HQ AMC
AR0018	B	FEDERAL FACILITIES AGREEMENT, MARCH AIR FORCE BASE, CALIF.	09/27/90	INTER-AGENCY AGREEMENT	USEPA: MAFB: CDBS: SARWQCB:	USEPA: MAFB: CDHS: SARWQC
AR0156	B	FFA DRAFT PRIMARY DOCUMENT DEADLINES	01/23/91	CORRESPONDENCE	JAMES E. FREDERICK	EPA & STATE REGULATORS
AR0158	B	FFA DRAFT PRIMARY DOCUMENT DEADLINES	01/08/91	DOCUMENT REVIEW	RICHARD RUSSELL	J. POLAND
AR0157	B	FFA DRAFT PRIMARY DOCUMENTS AND SUBMITTAL DEADLINES	02/07/91	CORRESPONDENCE	RICHARD RUSSELL	J. POLAND

KRR	OU	TITLE	DATE	TYPE	AUTHOR	RECIPIENT
AR0155	B	FFA REVISED DRAFT PRIMARY DOCUMENT DEADLINES	02/06/91	CORRESPONDENCE	J. POLAND	EPA & STATE REGULATORS
AR0019	3	FREE PRODUCT RECOVERY, PANERO	03/01/90	REPORT	HYDRO-FLUENT, INC.	INEL
AR0120	1	GETS STARTUP DATE	12/20/91	COMMENTS	RICHARD RUSSELL, US EPA	JOAN POLAND
AR0121	1	GETS STARTUP DATE	01/14/92	COMMENTS	LTC THOMAS GROSS, 22 SPTG/DE	RICHARD RUSSE US EPA
AR0122	1	GETS STARTUP DATE	02/05/92	COMMENTS	RICHARD RUSSELL, US EPA	LTC GROSS, 22 SPTG/DE
AR0126	1	GROUNDWATER CLEANUP AT EAST MARCH AFB	05/20/92	FACT SHEET	KIM RANSFORD	
AR0139	2	GROUNDWATER SAMPLING AND ANALYSIS PLAN ADDENDUM, SITE II	01/12/91	PLAN	INEL	HQ SAC
AR0134	2	HEALTH & SAFETY PLAN CALTRANS T.O. NUMBER 08-227502-03	01/07/92	WORK PLAN	GEO/RESOURCE CONSULTANTS, INC.	CALTRANS
AR0020	3	HEALTH & SAFETY PLAN, PANERO DRAFT	04/01/90	PLAN	HYDRO-FLUENT, INC.	INEL
AR0109	B	INTER-AGENCY AGREEMENT BETWEEN USAF AND ATSDR	01/18/91	INTER-AGENCY AGREEMENT	RICHARD RUSSELL	JOAN POLAND
AR0148	B	INVESTIGATION-DERIVED WASTE MANAGEMENT PLAN - DRAFT	10/01/92	DOCUMENT REVIEW	RICHARD RUSSELL	JOHN SABOL
AR0170	1	IRP SAMPLING & ANALYSIS PLAN ADDENDUM	10/01/93	PLAN	EARTH TECH	AFCEE/22, CES
AR0162	B	LETTER OF CONCERN	04/05/90	CORRESPONDENCE	FRED H. WECK, COL	RAYMOND T. SWENSON, LTC
AR0106	B	MAFB REMEDIAL PROJECT MANAGER	03/06/92	INTER-AGENCY AGREEMENT	ALBERT A. ARELLANO, CAL-EPA	JOAN POLAND
AR0179	B	MANAGEMENT ACTION PLAN	12/31/93	PLAN	RADIAN	HQ AMC

KRR	OU	TITLE	DATE	TYPE	AUTHOR	RECIPIENT
AR0171	B	MANAGEMENT ACTION PLAN APPENDIX A - DRAFT	10/22/93	PLAN	RADIAN	HQ AMC, 22 CES/CEVR
AR0132	B	MANAGEMENT ACTION PLAN DRAFT	10/22/93	PLAN	RADIAN CORP	22 CES/CEVR
AR0178	B	MANAGEMENT ACTION PLAN, APPENDIX A, ATCH A AND B	12/31/93	PLAN	RADIAN	HQ AMC
AR0114	B	MARCH ADDED TO SUPERFUND LIST	11/14/89	NEWSPAPER ARTICLE	GARY POLAKOVIC	
AR0126	2	MARCH AFB ADDITIONAL INFO REGARDING THE PRELIM	02/14/92	REPORT	JOAN POLAND	US & STATE REGULATORS
AR0117	B	MARCH AFB CLEANING UP PRACTICES OF THE PAST	07/11/90	PRESS RELEASE	SGT RENEE WRIGHT	MORENO VALLEY
AR0118	B	MARCH AFB CLEANUP PROGRAM	05/21/92	FACT SHEET	KIM RANSFORD	
AR0164	B	MARCH AFB FEDERAL FACILITY AGREEMENT ISSUES	03/28/91	CORRESPONDENCE	MARK E. SMALLWOOD, CAPT	J. POLAND
AR0022	B	MARCH AFB MAY JOIN LIST OF WORST WASTE SITES	07/14/89	NEWSPAPER ARTICLE	GARY POLAKOVIC	
AR0023	B	MARCH AFB NEWS RELEASE "PUBLIC INVITED TO TRC MEETING"	05/21/92	PUBLIC NOTICE	KIM RANSFORD, 22 ARW/PA	
AR0161	B	MARCH AIR FORCE BASE SIGNATURE PAGE TRANSMITTAL	09/19/90	CORRESPONDENCE	ALBERT A. ARELLANO	J. POLAND
AR0024	1	MARCH DELAYS CLEANUP OF TOXIC POLLUTION	01/28/92	NEWSPAPER ARTICLE	GARY POLAKOVIC	
AR0176	B	MARCH FIELD, 75 YEARS OF SERVICE 1813-1993	10/01/93	REPORT	TSGT RANDOLPH J. SAUNDERS	
AR0025	B	MARCH INVITES PUBLIC TO DISCUSS CLEANUP	05/13/92	NEWSPAPER ARTICLE	HEMET NEWS	
AR0026	1	MARCH RELEASES NEW GETS SCHEDULE	01/23/92	NEWS RELEASE	KIM RANSFORD, 22 ARW/PA	

KRR	OU	TITLE	DATE	TYPE	AUTHOR	RECIPIENT
AR0027	B	MARCH STEPS FORWARD WITH CLEAN UP PROGRAMS	03/06/92	NEWSPAPER ARTICLE	COL WILLIAM COBB, 22 ARRFW/CC	
AR0028	1	MARCH WASTE CLEANUP FALLS BEHIND SCHEDULE	05/19/90	NEWSPAPER ARTICLE	GARY POLAKOVIC	
AR0116	B	MARCH, NORTON MAY GET FUNDS TO CLEAN WASTES	06/28/90	NEWSPAPER ARTICLE	PRESS-ENTERPRISE	
AR0144	B	MINUTES OF MAFB RPM MEETING - 25 AUG 92	08/25/92	MEETING MINUTES	EARTH TECH	JOHN SABOL
AR0123	B	MORE CLEANUP FUNDS FOR MARCH	08/16/90	NEWSPAPER ARTICLE	GARY POLAKOVIC	
AR0029	B	MORE POLLUTION SITES DISCOVERED AT MARCH	/ /	NEWSPAPER ARTICLE	GARY POLAKOVIC	
AR0163	B	NATIONAL PRIORITY LIST SUPERFUND SITE	02/07/90	CORRESPONDENCE	JERRY CLIFFORD	COL R. RIZZO
AR0030	B	NOTICE OF THE MEETING (14 MAY 92) & GETS PUBLIC MEETING (21 MAY 92)	05/07/92	PUBLIC NOTICE	KIM RANSFORD/22 ARW/PA	
AR0031	B	PHASE II CONFIRMATION/QUANTIFICATION, STAGE 2, FINAL REPORT	06/01/88	DATA VERIFICATION	E-8	USEPA: MAFB: CDHS: SARWQC
AR0032	B	PHASE II STAGE 1 RI/FS CONFIRMATION/QUANTIFICATION	03/01/87	REPORT	ENGINEERING SCIENCE	HQ SAC/AFCEE
AR0033	B	PHASE II STAGE 2, TECHNICAL OPERATIONS PLAN	04/01/87	PLAN	E-S	OEHL/TS: HQ SAC/SQPB: MA
AR0034	3	PHOTOS OF TANK REMOVAL	09/18/91	NEWSPAPER ARTICLE	PRESS-ENTERPRISE	
AR0035	2	POTENTIALLY HAZARDOUS MATERIALS DISCOVERED AT MARCH AFB	01/16/92	NEWS RELEASE	KIM RANSFORD, 22 ARW/PA	BEACON
AR0036	2	PRELIMINARY ASSESSMENT/SITE INSPECTION HQ 15 AF/DRMO	02/14/92	DOCUMENT REVIEW	RICHARD RUSSELL, TETRA TECH	JOAN POLAND, AFCEE
AR0125	2	PRELIMINARY CHARACTERIZATION OF HQ15AF SITE 40	02/06/92	CORRESPONDENCE	ROBERT HERRINGTON, TETRA TECH	CAPT SMALLWOO AFCEE

KRR	OU	TITLE	DATE	TYPE	AUTHOR	RECIPIENT
AR0037	3	PRELIMINARY SITE CHARACTERIZATION, PANERO	04/01/91	REPORT	EARTH TECH	AFCEE
AR0038	1	PROJECT MANAGEMENT PLAN FOR AREA #5 GROUNDWATER REMEDIATION	01/01/90	PLAN	INEL	HQ SAC
AR0039	3	PROJECT MANAGEMENT PLAN, PANERO	04/01/90	PLAN	INEL	HQ SAC
AR0115	B	PUBLIC INVITED TO TRC MEETING, 14 MAY 92	05/02/91	PRESS RELEASE	22 ARW/PA	
AR0040	B	PUBLIC NOTICE OF FEDERAL FACILITY AGREEMENT	11/10/90	PUBLIC NOTICE	22 ARW/FA	PRESS-ENTERPR
AR0041	B	PUBLIC NOTICE OF FEDERAL FACILITY AGREEMENT	11/19/90	PUBLIC NOTICE	22 ARW/PA	HEMET NEWS
AR0043	B	PUBLIC NOTICE OF FEDERAL FACILITY AGREEMENT	11/24/90	PUBLIC NOTICE	22 ARW/PA	HEMET NEWS
AR0042	B	PUBLIC NOTICE OF FEDERAL FACILITY AGREEMENT	11/24/90	PUBLIC NOTICE	22 ARW/PA	PRESS-ENTERPR
AR0112	B	PUBLIC NOTICE OF TRC MEETING, 23 JAN 92	01/22/92	PUBLIC NOTICE	KIM RANSFORD	PRESS-ENTERPR
AR0044	1	PUMPING TEST FOR EIGHT WELLS AREA 5 DRAFT	08/01/91	INFORMAL REPORT	INEL	MAFB
AR0045	3	PUMPING TEST, PANERO	07/01/91	REPORT	INEL	DOE
AR0046	B	QUALITY ASSURANCE PROJECT PLAN UNDERGROUND STORAGE PLAN INVESTIGATE	05/01/90	PLAN		
AR0153	2	RACK/GASOLINE PUMP ISLAND WORK PLAN	09/21/92	DOCUMENT REVIEW	JOHN BRODERICK	JOHN SABOL
AR0047	B	RECORDS SEARCH REPORT	04/01/84	REPORT/STUDY	HILL CH2M	USEPA: MAFB/DEV:
AR0128	2	REFERENCE MATERIAL FOR OPERABLE UNIT 2 SITES	05/04/92	CORRESPONDENCE	ROBERT HERRINGTON, TETRA TECH	JOHN SABOL, 2
AR0141	3	REMOVAL OF HYDRANT SYSTEM	01/05/90	REPORT	INEL	HQ SAC

KRR	OU	TITLE	DATE	TYPE	AUTHOR	RECIPIENT
AR0160	B	REQUIREMENTS OF THE FEDERAL FACILITIES AGREEMENT	11/15/90	CORRESPONDENCE	JOHN KEMMERER	
AR0107	B	RESPONSE TO CITY OF MORENO VALLEY COMMENTS ON MAFB FFA	04/03/91	DOCUMENT REVIEW	COL. WILLIAM COBB, 22 AREPW/CC	NORMAN R. KIN
AR0159	B	RESPONSE TO PROPOSED TIMELINES IRP OPERABLE UNITS	01/07/91	DOCUMENT REVIEW	KENNETH R. WILLIAMS	J. POLAND
AR0108	B	RESPONSES SUMMARY ON PUBLIC COMMENTS ON MAFB FFA	02/28/91	DOCUMENT REVIEW	RICHARD RUSSELL, US EPA	JOAN POLAND
AR0048	B	REVIEW OF STAGE 4 SITE CHARACTERIZATION SUMMARY	06/26/91	DOCUMENT REVIEW	KENNETH R. WILLIAMS	JOAN POLAND
AR0147	2	RI REPORT/RISK ASSESSMENT	09/30/92	DOCUMENT REVIEW	RICHARD RUSSELL	JOHN SABOL
AR0147	2	RI/FS APPENDIX AND WORK PLAN FOR AIR FORCE VILLAGE WEST	08/10/92	DOCUMENT REVIEW	RICHARD RUSSELL	JOHN SABOL
AR0103	B	RI/FS BASEWIDE WORK PLAN/ANALYSIS AND SAMPLING PLAN-DRAFT	09/27/91	DOCUMENT REVIEW	RICHARD RUSSELL, US EPA	JOAN POLAND
AR0105	B	RI/FS BASEWIDE WORK PLAN/SAMPLING AND ANALYSIS PLAN-DRAFT	12/02/91	DOCUMENT REVIEW	KENNETH WILLIAMS, RWQCB	JOAN POLAND
AR0101	B	RI/FS BASEWIDE WORK PLAN/SAMPLING AND ANALYSIS PLAN -	12/19/91	DOCUMENT REVIEW	RICHARD RUSSELL, US EPA	JOAN POLAND
AR0049	B	RI/FS FINAL BASEWIDE SAMPLING AND ANALYSIS PLAN	01/01/92	REPORT/STUDY	EARTH TECHNOLOGY	HQ SAC/DE:
AR0050	B	RI/FS FINAL BASEWIDE WORK PLAN	01/01/92	WORK PLAN	EARTH TECHNOLOGY CORP	
AR0051	1	RI/FS FINAL SAMPLING AND ANALYSIS PLAN ADDENDUM	01/01/92	REPORT STUDY	EARTH TECHNOLOGY CORP	HQ SAC/DE: AFCEE: MAFB
AR0052	1	RI/FS FINAL WORK PLAN ADDENDUM FOR OPERABLE UNIT 1	01/01/92	WORK PLAN	EARTH TECHNOLOGY CORP	HQ SAC/DE: AFCEE: MAFB
AR0053	3	RI/FS OPERABLE UNIT 3 (PANERO SITE) WORK PLAN	06/01/91	REPORT	INEL	MAFB

KRR	OU	TITLE	DATE	TYPE	AUTHOR	RECIPIENT
AR0054	3	RI/FS SAMPLING AND ANALYSIS PLAN ADDENDUM (PANERO) FINAL	02/01/92	WORK PLAN ADDENDUM	INEL	HQ SAC: DOE
AR0055	B	RI/FS WORK PLAN DRAFT	02/01/88	WORK PLAN	E-S	HQ SAC/DE: OKHL/TS: MAF
AR0056	3	RI/FS WORK PLAN ADDENDUM OPERABLE UNIT 3 (PANERO SITE) FINAL	02/01/92	WORK PLAN ADDENDUM	INEL	HQ SAC: DOE
AR0104	1	RI/FS WORK PLAN ADDENDUM OU1/SAMPLING AND ANALYSIS PLAN - DRAFT	09/27/92	DOCUMENT REVIEW	RICHARD RUSSELL, US EPA	JOAN POLAND
AR0102	1	RI/FS WORK PLAN ADDENDUM/SAMPLING AND ANALYSIS PLAN OU1 - DRAFT FINAL	12/19/91	DOCUMENT REVIEW	RICHARD RUSSELL, US EPA	JOAN POLAND
AR0137	3	RI/FS WORK PLAN ADDENDUM/SAP ADDENDUM, OU 3	12/26/91	DOCUMENT REVIEW	RICHARD RUSSELL	JOAN POLAND
AR0099	B	RI/FS WORK PLAN AND SAMPLING ANALYSIS PLAN	09/30/91	DOCUMENT REVIEW	EMAD E. YEMUT, CAL-EPA	JOAN POLAND
AR0127	2	RI/FS WORK PLAN AND SAMPLING AND ANALYSIS PLAN	03/18/92	DOCUMENT REVIEW	RIZGAR GHAZI, CAL-EPA	JOAN POLAND
AR0021	B	RI/FS WORK PLAN AND SAMPLING AND ANALYSIS PLAN - DRAFT	12/20/91	DOCUMENT REVIEW	ALBERT ARELLANO, CAL-EPA	JOAN POLAND
AR0098	1	RI/FS WORK PLAN AND SAMPLING AND ANALYSIS PLAN - DRAFT	12/20/91	DOCUMENT REVIEW	ALBERT A. ARELLANO, CAL-EPA	JOAN POLAND
AR0136	3	RI/FS WORK PLAN AND SAP, OU 3 DOCUMENT REVIEW	12/30/91	DOCUMENT REVIEW	ALBERT ARELLANO	JOAN POLAND
AR0119	1	RI/FS WORK PLAN/SAMPLING AND ANALYSIS PLAN ADDENDUMS (OU1) - DRAFT	10/02/91	DOCUMENT REVIEW	KENNETH WILLIAMS CRWQCB	JOAN POLAND
AR0149	B	RPM MEETING MINUTES W/AGENDA	10/21/92	MEETING MINUTES	EARTH TECH	DISTRIBUTION

KRR	OU	TITLE	DATE	TYPE	AUTHOR	RECIPIENT
AR0131	B	RPM MEETING MINUTES, 20 JUL 92	07/27/92	MEETING MINUTES	EARTH TECH	REGULATORS
AR0152	2	SAMPLING & ANALYSIS PLAN ADDENDUM, OU 2	09/21/92	DOCUMENT REVIEW	JOHN BRODERICK	JOHN SABOL
AR0057	1	SEEING IS BELIEVING	02/02/92	NEWSPAPER ARTICLE		
AR0058	2	SITE 11 YIELD SAMPLING PLAN DRAFT	03/01/90	SAMPLING PLAN	INEL	SAC
AR0059	2	SITE 11 PROJECT MANAGEMENT PLAN	02/01/90	PLAN	INEL	SAC
AR0060	2	SITE 11 PROJECT MANAGEMENT PLAN ADDENDUM DRAFT	12/01/91	SAP PLAN	INEL	SAC/DOE
AR0061	2	SITE 11 SOIL GAS SAMPLING AND ANALYSIS	04/01/91	REPORT	GOLDER ASSOCIATES	INEL
AR0062	2	SITE 11 SOIL GAS SURVEY DRAFT	04/01/91	REPORT	INEL	SAC/DOE
AR0063	2	SITE 40 HAZARD	01/16/92	PUBLIC NOTICE	KIM RANSFORD, 22 ARE/PA	ORANGECREST/A OLD HEIGHTS
AR0146	2	SITE CHARACTERIZATION STUDY, BLDG 3404	01/09/92	REPORT	EARTH TECH	AFCEE/DEV
AR0150	2	SITE CHARACTERIZATION STUDY, BLDG 3404	10/05/92	DOCUMENT REVIEW	TETRA TECH	JOHN SABOL
AR0064	3	SOIL GAS SURVEY FOR PANERO LIQUID FUEL SYS	12/01/89	SURVEY	TARGET ENVIRONMENTAL SERVICES	EG&G
AR0065	3	SOIL MANAGEMENT PLAN FOR PANERO ACPT FUELING SYS PROJECT	05/01/90	PLAN	INEL	MAFB
AR0066	3	SOIL STORAGE AND TREATMENT FOR PANERO ACPT FUELING SYS	06/01/90	SPECIFICATION	E-S	EG&G
AR0067	3	SOIL TREATMENT WORK PLAN, PANERO	06/12/90	WORK PLAN		
AR0069	B	STAGE 3 QUALITY ASSURANCE PROGRAM PLAN (QAPP) DRAFT	03/01/88	QAPP	E-S	EA SAC/DE:AFCEE:

KRR	OU	TITLE	DATE	TYPE	AUTHOR	RECIPIENT
AR0070	B	STAGE 3 RI/PRELIMINARY FS, AREA #5, FINAL REPORT	09/01/89	REPORT STUDY	E-S	USEPA: MAFB: CDHS: SARWQC
AR0068	B	STAGE 3 WORK PLAN	05/01/88	WORK PLAN	E-S	HQ SAC/DE: O MAFB
AR0071	1	STAGE 4 ANALYTICAL DATA, INFORMAL TECHNICAL INFORMATION REPORT	03/01/91	REPORT	EARTH TECH	HQ SAC/DE: H HSD/YAQ
AR0072	B	STAGE 4 HEALTH AND SAFETY PLAN	01/01/89	PLAN	EARTH TECH	SAC/AFCEE
AR0073	B	STAGE 4 QUALITY ASSURANCE PROJECT PLAN ADDENDUM	09/01/90	PLAN	EARTH TECH	HA SAC/AFCEE
AR0075	B	STAGE 4 RI/FS WORK PLAN, DRAFT REPORT	01/01/89	WORK PLAN	EARTH TECH CORP	USEPA: MAFB: CDHS: SARWQC
AR0076	B	STAGE 4 RI/FS, QAPP, FINAL REPORT	05/01/90	REPORT/STUDY	EARTH TECH CORP	HQ SAC/DE: M HSDYAQ
AR0077	B	STAGE 4 SITE CHARACTERIZATION SUMMARY	06/27/91	DOCUMENT REVIEW	RICHARD RUSSELL, USEPA	JOAN POLAND
AR0165	B	STAGE 4 SITE CHARACTERIZATION SUMMARY	04/01/91	REPORT	EARTH TECH	HQ SAC
AR0074	B	STAGE 4 SITE CHARACTERIZATION SUMMARY, APPENDICES A THRU G	04/01/91	REPORT	EARTH TECH	HQ SAC/DE: H
AR0078	2	STAGE 5 DRMO AND HQ 15AF STATEMENT OF WORK	06/01/91	PLAN		
AR0079	2	STAGE 5 DRMO SITE CHARACTERIZATION SUMMARY INFORMAL TECH INFO	01/31/92	REPORT	TETRA TECH	HQ SAC/DE: AFCEE/ESR
AR0085	B	STAGE 5 HEALTH AND SAFETY PLAN DRAFT	06/01/91	PLAN	EARTH TECH	HQ SAC/AFCEE
AR0080	2	STAGE 5 HQ 15AF AREA SITES DRAFT SITE CHARACTERIZATION SUMMARY	01/31/92	REPORT	TT	HQ SAC/DE: AFCEE/ESR

KRR	OU	TITLE	DATE	TYPE	AUTHOR	RECIPIENT
AR0081	2	STAGE 5 SAMPLING AND ANALYSIS PLAN ADDENDUM DRMO & HQ 15 DRAFT	08/16/91	PLAN	TETRA TECH	HQ SAC/DE: HSD/YAQ
AR0082	2	STAGE 5 SAMPLING AND ANALYSIS PLAN ADDENDUM FOR OU2	08/27/92	PLAN	TETRA TECH	HQ SAC/DE: A
AR0086	B	STAGE 5 STATEMENT OF WORK	01/01/90	STATEMENT OF WORK		
AR0084	2	STAGE 5 WORK PLAN ADDENDUM FOR DRMO & 15 AP SITES DRAFT	08/16/91	WORK PLAN	TT	HQ SAC/DE: HSD/YAQ
AR0083	2	STAGE 5 WORK PLAN ADDENDUM, OU 2	08/27/92	WORK PLAN	TETRA TECH	SAC/AFCEE
AR0087	1	STATEMENT OF WORK, AREA 5, SITE 4 GETS	09/01/90	WORK PLAN		
AR0130	2	STATEMENT OF WORK, REHABILITATION OF CREEK CHANNEL, SITE 40	07/29/92	WORK PLAN	JOHN R. SABOL	22 ARW/LGC
AR0088	3	SUBSURFACE INVESTIGATION/SOIL SAMPLING RPT - PANERO	08/29/91	REPORT	DEOMATRIX	COE
AR0089	B	TALK MUTED ABOUT MARCH POLLUTION	06/28/91	NEWSPAPER ARTICLE	GARY POLAKOVIC	
AR0090	B	TASK #9 PROJECT MANAGEMENT PLAN	06/01/89	INFORMAL PLAN	INEL	SAC
AR0091	B	TRC AGENDA 14 MAY 92 MEETING	05/14/92	MEETING AGENDA	JOHN SABOL, 22 SPTG/DEV	TRC MEMBERS
AR0092	B	TRC CHARTER	03/19/91	INTER-AGENCY AGREEMENT	JOAN POLAND	TRC MEMBERS
AR0093	B	TRC MINUTES	09/10/91	MEETING MINUTES	JOAN POLAND	TRC MEMBERS
AR0094	B	TRC MINUTES	06/18/91	MEETING MINUTES	JOAN POLAND	TRC MEMBERS
AR0095	B	TRC TRANSCRIPT	03/21/92	MEETING TRANSCRIPTS	JOAN POLAND, 22 CES/DEV	TRC MEMBERS

KRR	OU	TITLE	DATE	TYPE	AUTHOR	RECIPIENT
AR0140	3	TREATMENT TECH ASSESS FOR CORR ACTION OF JP-4 FUEL RELEASE	02/28/90	REPORT INEL	HQ SAC	
AR0096	B	TREATMENT TECHNOLOGY ASSESSMENT DRAFT	02/01/90	REPORT	INEL	HQ SAC
AR0097	B	WELL CLOSURE METHODS AND PROCEDURES PLAN	05/01/90	REPORT	INEL	DOE
AR0123	2	WIPE SAMPLING FOR PCBs IN BOILER ROOM OF BLDG 3404	03/26/90	CORRESPONDENCE	MAJ FORREST R. SPRESTER	22CSG/DEV
AR0151	2	WORK PLAN ADDENDUM AND SAP	09/18/92	DOCUMENT REVIEW	ALBERT A. ARELLANO	JOHN SABOL
AR0145	2	WORKPLAN ADDENDUM & SAP, OU2, STAGE 5-DRAFT FINAL	08/27/92	DOCUMENT REVIEW	RICHARD RUSSELL	JOHN SABOL
AR0133	2	WORKPLAN DEPT OF TRANS T.O. NUMBER 08-227502-03 (SITE 43)	01/07/92	WORK PLAN	GEO/RESOURCE	CALTRANS

APPENDIX C
ARAR TABLES

TABLE C-1

SITE 4/OU1 GROUNDWATER PLUME

COMPARATIVE ANALYSIS OF COMPLIANCE WITH CHEMICAL-SPECIFIC ARARS

Contaminant of Concern in Groundwater	Source	Applicable, Relevant and Appropriate, or To-be-considered (TBC)	Alternative 2G Limited Action	Alternative 3G Direct Treatment with Liquid Phase GAC	Alternative 4G UV and Chemical Oxidation	Alternative 6G Air Stripping with Carbon Adsorption
Bis(2-ethylhexyl)phthalate	(1)	Relevant and Appropriate	4 µg/L California Cleanup Standard will not be achieved	4 µg/L California Cleanup Standard will be achieved	4 µg/L California Cleanup Standard will be achieved	4 µg/L California Cleanup Standard will be achieved
Benzene	(1)	Relevant and Appropriate	1 µg/L California Cleanup Standard will not be achieved	1 µg/L California Cleanup Standard will be achieved	1 µg/L California Cleanup Standard will be achieved	1 µg/L California Cleanup Standard will be achieved
Carbon Tetrachloride	(1)	Relevant and Appropriate	0.5 µg/L California Cleanup Standard will not be achieved	0.5 µg/L California Cleanup Standard will be achieved	0.5 µg/L California Cleanup Standard will be achieved	0.5 µg/L California Cleanup Standard will be achieved
Vinyl Chloride	(1)	Relevant and Appropriate	0.5 µg/L California Cleanup Standard will not be achieved	0.5 µg/L California Cleanup Standard will be achieved	0.5 µg/L California Cleanup Standard will be achieved	0.5 µg/L California Cleanup Standard will be achieved
Trichloroethene (TCE)	(1), (2)	Relevant and Appropriate	5 µg/L California and Federal Cleanup Standard will not be achieved	5 µg/L California and Federal Cleanup Standard will be achieved	5 µg/L California and Federal Cleanup Standard will be achieved	5 µg/L California and Federal Cleanup Standard will be achieved
1,1-Dichloroethene	(1)	Relevant and Appropriate	6 µg/L California Cleanup Standard will not be achieved	6 µg/L California Cleanup Standard will be achieved	6 µg/L California Cleanup Standard will be achieved	6 µg/L California Cleanup Standard will be achieved
cis-1,2-Dichloroethene	(1)	Relevant and Appropriate	6 µg/L California Cleanup Standard will not be achieved	6 µg/L California Cleanup Standard will be achieved	6 µg/L California Cleanup Standard will be achieved	6 µg/L California Cleanup Standard will be achieved
Tetrachloroethene (PCE)	(1), (2)	Relevant and Appropriate	5 µg/L California and Federal Cleanup Standard will not be achieved	5 µg/L California and Federal Cleanup Standard will be achieved	5 µg/L California and Federal Cleanup Standard will be achieved	5 µg/L California and Federal Cleanup Standard will be achieved
1,2-Dichloroethane Cleanup	(1)	Relevant and Appropriate	0.5 µg/L California Cleanup Standard will not be achieved	0.5 µg/L California Cleanup Standard will be achieved	0.5 µg/L California Cleanup Standard will be achieved	0.5 µg/L California Standard will be achieved

TABLE C-1

SITE 4/OU1 GROUNDWATER PLUME

COMPARATIVE ANALYSIS OF COMPLIANCE WITH CHEMICAL-SPECIFIC ARARS

Contaminant of Concern in Groundwater	Source	Applicable, Relevant and Appropriate, or To-be-considered (TBC)	Alternative 2G Limited Action	Alternative 3G Direct Treatment with Liquid Phase GAC	Alternative 4G UV and Chemical Oxidation	Alternative 6G Air Stripping with Carbon Adsorption
Methylene Chloride	(2)	Relevant and Appropriate	5 µg/L Federal Cleanup Standard will not be achieved	5 µg/L Federal Cleanup Standard will be achieved	5 µg/L Federal Cleanup Standard will be achieved	5 µg/L Federal Cleanup Standard will be achieved

Key:
- µg/L = Microgram per liter
- UV = Ultraviolet
- GAC = Granular Activated Carbon
- ARAR = Applicable or Relevant and Appropriate Requirement

(1) Title 22, California Code of Regulations (CCR), Division 4, Chapter 15, Article 5.5, Section 64444.5, Maximum Contaminant Levels for Organic Chemicals.
(2) 40 Code of Federal Regulations (CFR) 141.61, Maximum Contaminant Levels for Organic Chemicals.
(3) 40 Code of Federal Regulations (CFR) 141.11, Maximum Contaminant Levels for Inorganic Chemicals.

TABLE C-2

SITE 4/OU1 GROUNDWATER PLUME

COMPARATIVE ANALYSIS OF COMPLIANCE WITH LOCATION-SPECIFIC AND ACTION-SPECIFIC ARARS

Requirement	Source	Applicable, Relevant and Appropriate, or To-be-considered (TBC)	Alternative 2G Limited Action	Alternative 3G Direct Treatment with Liquid Phase GAC	Alternative 4G UV and Chemical Oxidation	Alternative 6G Air Stripping with Carbon Adsorption
LOCATION-SPECIFIC						
Clean Water Act Section 404(b)(1)	40 CFR Section 230.10	Applicable	NA; no discharge will occur	Will meet ARAR, because no discharge to wetlands is expected.	See Alternative 3G.	See Alternative 3G.
Protection of Wetlands	Executive Order 11990 40 CFR 6, Appendix A	Applicable	NA; no discharge will occur.	Will meet ARAR, because no discharge to wetlands is expected.	See Alternative 3G.	See Alternative 3G.
RCRA Location Standards	Title 22 CCR, Chapter 14, Section 66264.18	Applicable	NA	ARAR will be met. Facility will not be constructed within 20 feet of an earthquake fault or within a 100-year floodplain.	See Alternative 3G.	See Alternative 3G.
ACTION-SPECIFIC						
California Hazardous Waste Rules: ! Standards Applicable to Generators of Hazardous Waste	Title 22 CCR, Division 4.5, Chapter 4.5, 66262 et seq.	Applicable	NA; no wastes are generated	ARAR will be met; spent carbon, cuttings, and other residues will be handled and disposed of as hazardous wastes if they meet California classification criteria. Accumulation and storage requirements will be met.	NA; no wastes are generated.	See Alternative 3G.

TABLE C-2

SITE 4/OU1 GROUNDWATER PLUME

COMPARATIVE ANALYSIS OF COMPLIANCE WITH LOCATION-SPECIFIC AND ACTION-SPECIFIC ARARS
Continued

Requirement	Source	Applicable, Relevant and Appropriate, or To-be-considered (TBC)	Alternative 2G Limited Action	Alternative 3G Direct Treatment with Liquid Phase GAC	Alternative 4G UV and Chemical Oxidation	Alternative 6G Air Stripping with Carbon Adsorption
ACTION-SPECIFIC (Continued)						
California Hazardous Waste Rule:						
! Standards for Operators of Hazardous Waste Transfer, Treatment & Disposal Facilities:	Title 22 CCR, Division 4.5, Chpt 14, Section 6624.190 - Section 6624.199	Relevant and Appropriate	NA; no wastes generated.	Will meet ARAR; relevant and appropriate substantive requirements be incorporated into construction and design of tanks used to store groundwater.	Same as Alternative 3G.	Same as Alternative 3G.
Tanks						
Miscellaneous Units	Title 22 CCR, Division 4.5, Chpt 14, Sections 66264.600-66264.603	Relevant and Appropriate	NA; no wastes generated.	NA; carbon units and associated tanks are regulated under RCRA tank regulations.	NA; associated tanks are regulated under RCRA tank regulations.	The unit will be located, designed, constructed, operated, maintained, and closed in a manner that ensures protection of human health and the environment (e.g., prevention of releases) and will thereby comply with the relevant and appropriate requirements for miscellaneous treatment units.
Waste Classification and Management	Title 23, Division 3, Chapter 15, Article 2 Section 2522	Applicable	NA; no wastes are generated	ARAR will be met; spent carbon, cuttings, and other residue, if not hazardous waste, will be disposed of as designated waste	NA; no wastes are generated	See Alternative 3G.

TABLE C-2

SITE 4/OU1 GROUNDWATER PLUME

COMPARATIVE ANALYSIS OF COMPLIANCE WITH LOCATION-SPECIFIC AND ACTION-SPECIFIC ARARS
Continued

Requirement	Source	Applicable, Relevant and Appropriate, or To-be-considered (TBC)	Alternative 2G Limited Action	Alternative 3G Direct Treatment with Liquid Phase GAC	Alternative 4G UV and Chemical Oxidation Adsorption	Alternative 4G UV and Chemical Oxidation
ACTION-SPECIFIC (Continued)						
South Coast Air Quality Management District Rules & Regulations - New Source Review of Carcinogenic Air Contaminants	Prohibitory Rules - Rule 1401	Applicable	NA; no emissions.	Will meet ARAR; additional controls will not be necessary because risk from emissions will be below 1 x 10-6 risk level stated in the rule.	See Alternative 3G.	See Alternative 3G.
New Source Review of Air Contaminants	Regulation XIII, Rule 1303	Applicable	NA; no emissions.	Will meet ARAR. Due to low concentrations of VOCs in groundwater air emissions without controls will be below the 1 pound/day limit above which BACT is required to limit emissions increases (SCAQMD considers an emissions increase to be at least 1 pound/day). Nonetheless, BACT will be used for all alternatives.	See Alternative 3G.	See Alternative 3G.
Statement of Policy with Respect to Maintaining High Quality of Waters in California	SWCB Resolution Number 68-16	Applicable	NA; no discharge will occur.	Treated groundwater will be discharged to the base wastewater treatment plant, to the ground surface or reinjected to the aquifer. Discharge tot he ground surface will no degrade water quality (see NPDES requirements below).	See Alternative 3G.	See Alternative 3G.

TABLE C-2

SITE 4/OU1 GROUNDWATER PLUME

COMPARATIVE ANALYSIS OF COMPLIANCE WITH LOCATION-SPECIFIC AND ACTION-SPECIFIC ARARS

Continued

Requirement	Source	Applicable, Relevant and Appropriate, or To-be-considered (TBC)	Alternative 2G Limited Action	Alternative 3G Direct Treatment with Liquid Phase GAC	Alternative 4G UV and Chemical Oxidation	Alternative 6G Air Stripping with Carbon Adsorption
ACTION-SPECIFIC (Continued)						
National Pollutant Discharge Elimination System (NPDES) Program	40 CFR Parts 122-125; NPDES Permit No. CAG918001 for March AFT Groundwater Cleanup Project (March 1995)	Applicable	NA; no discharge will occur.	Will meet substantive requirements of regulation through compliance with discharge limits for inorganics and total dissolved solids found in permit. Maximum Daily Limits for regulated constituents are in µg/L are: Total Petroleum Hydrocarbons 100; benzene 1.0; toluene 10; xylenes 10; ethylbenzene 10; chloroform 5; methyl ethyl ketone 10; tetrachloroethene (PCE) 5; methyl isobutyl ketone 10; 1,1-dichloroethylene 6; trichloroethylene (TCE) 5; dichlorobromomethane 5; 1,1,1-trichloroethane (TCA) 5; 1,2-dichloroethylene 10; 1,1-dichloroethane 5; carbon tetrachloride 0.5; naphthalene 10; Maximum Daily Limits for regulated constituents are in mg/l: chromium 0.05²; total lead 0.05; total residual chlorine3 0.1; suspended solids 75; sulfides 0.4; cadmium 0.01; zinc 5	See Alternative 3G.	See Alternative 3G.

Key:

GAC	=	Granular Activated Carbon	SCAQMD	=	South Coast Air Quality Management District
RCRA	=	Resource Conservation and Recovery Act	MCL	=	Maximum Contaminant Level
UIC	=	Underground Injection Control	OSWER	=	Office of Solid Waste and Emergency Response
ARAR	=	Applicable or Relevant and Appropriate Requirement	BACT	=	Best Available Control Technology
NA	=	Not an Applicable or Relevant and Appropriate Requirement	VOC	=	Volatile Organic Compound
µg/L	=	Micrograms per liter	SWCB	=	State Water Control Board
			NA	=	Not applicable

TABLE C-3

SITE 18 GROUNDWATER PLUME
COMPARATIVE ANALYSIS OF COMPLIANCE WITH CHEMICAL-SPECIFIC ARARS

Contaminant of Concern in Groundwater	Source	Applicable, Relevant and Appropriate, or To-be considered (TBC)	Alternative 2G Limited Action	Alternatives 3G/5G Direct Treatment with Liquid Phase GAC/Total Fluids Recovery	Alternatives 7G/5G Air Stripping with Catalytic Oxidation/Total Fluids Recovery	Alternatives 8G/5G Air Stripping with Purus PADRETM System/Total Fluids Recovery
Methylene Chloride	(2)	Relevant and Appropriate	5 µg/L Federal Cleanup Standard will not be achieved	5 µg/L Federal Cleanup Standard will be achieved	5 µg/L Federal Clean Standard will be achieved	5 µg/L Federal Cleanup Standard will be achieved
Benzene	(1)	Relevant and Appropriate	1 µg/L California Cleanup Standard will not be achieved	1 µg/L California Cleanup Standard will be achieved	1 µg/L California Cleanup Standard will be achieved	1 µg/L California Cleanup Standard will be achieved
Toluene	(2)	Relevant and Appropriate	150 µg/L California Cleanup Standard will not be achieved	150 µg/L California Cleanup Standard will be achieved	150 µg/L California Cleanup Standard will be achieved	150 µg/L California Cleanup Standard will be achieved
Ethylbenzene	(1)	Relevant and Appropriate	680 µg/L California Cleanup Standard will not be achieved	680 µg/L California Cleanup Standard will be achieved	680 µg/L California Cleanup Standard will be achieved	680 µg/L California Cleanup Standard will be achieved
Xylenes, Total	(1)	Relevant and Appropriate	1750 µg/L California Cleanup Standard will not be achieved	1750 µg/L California Cleanup Standard will be achieved	1750 µg/L California Cleanup Standard will be achieved	1750 µg/L California Cleanup Standard will be achieved

Key:
ARAR = Applicable or Relevant and Appropriate Requirement
GAC = Granular Activated Carbon
µg/L = Micrograms per liter

(1) Title 22, California Code of Regulations (CCR), Division 4, Chapter 15, Article 5.5, Section 64444.5, Maximum Contaminant Levels for Organic Chemicals.
(2) 40 Code of Federal Regulations (CFR) 141.61, Maximum Contaminant Levels for Organic Chemicals.

TABLE C-4
SITE 18 GROUNDWATER PLUME
COMPARATIVE ANALYSIS OF COMPLIANCE WITH LOCATION-SPECIFIC AND ACTION-SPECIFIC ARARS

Requirement	Source	Applicable, Relevant and Appropriate, or To-be-considered (TBC)	Alternative 2G Limited Action	Alternative 3G/5G Liquid Phase GAC Adsorption/Total Fluids Recovery	Alternatives 7G/5G Air Stripping with Catalytic Oxidation/Total Fluids Recovery	Alternatives 8G/5G Air Stripping with Purus PADRETM System/Total Fluids Recovery
LOCATION-SPECIFIC						
TSDF Location Standards	Title 22 CCR, Chapter 14, Section 66264.18	Applicable	NA	Facility will not be constructed with 200 feet of an earthquake fault and, if sited within the 100-year floodplain, will be designed, constructed, operated, and maintained to prevent washout of waste.	See Alternative 3G/5G.	See Alternative 3G/5G.
ACTION-SPECIFIC						
California Hazardous Waste Rules:						
! Standards Applicable to Generators of Hazardous Waste	Title 22 CCR, Division 4.5, Chapter 12, Section 66262 et seq.	Applicable	NA; no wastes.	Spent carbon and residues will be handled and disposed of as hazardous wastes if they meet classification criteria.	Residues will be handled and disposed of as hazardous wastes if they meet classification criteria.	See Alternative 7G/5G.
! Standards for Operators of Hazardous Waste Transfer, Treatment & Disposal Facilities:						
Tanks	Title 22 CCR, Division 4.5, Chapter 14, Section 6624.190 - Section 6624.199	Relevant and Appropriate	NA; no wastes.	Relevant and appropriate substantive requirements will be incorporated into construction and design of tanks.	See Alternative 3G/5G.	See Alternative 3G/5G.
Miscellaneous Units	Title 22 CCR, Division 4.5, Chap 14, Sections 66264.600 - 66264.603	Relevant and Appropriate	NA; no units.	The unit will be located, designed, constructed, operated, maintained, and closed in a manner that ensures protection of human health and the environment (e.g., prevention of releases) and will thereby comply with relevant and appropriate requirements for miscellaneous units.	The unit will be located, designed, constructed, operated, maintained, and closed in a manner that ensures protection of human health and the environment (e.g., prevention of releases) and will thereby comply with relevant and appropriate requirements for miscellaneous units.	See Alternative 7G/5G.

TABLE C-4
SITE 18 GROUNDWATER PLUME
COMPARATIVE ANALYSIS OF COMPLIANCE WITH LOCATION-SPECIFIC AND ACTION-SPECIFIC ARARS
Continued

Requirement	Source	Applicable, Relevant and Appropriate, or To-be considered (TBC)	Alternative 2G Limited Action	Alternative 3G/5G Liquid Phase GAC Adsorption/Total Fluids Recovery	Alternatives 7G/5G Air Stripping with Catalytic Oxidation/Total Fluids Recovery	Alternatives 8G/5G Air Stripping with Purus PADRETM System/Total Fluids Recovery
Action-Specific (Continued)						
Waste Classification and Management	Title 23, Division 3, Chapter 15, Article 2, Section 2252	Applicable	NA; No waste	Spent carbon and residues, if non-hazardous waste, will be disposed of as designated waste	Residues will be handled and disposed of as designated waste, if non-hazardous waste	See 7G/5G
South Coast Air Quality Management District Rules Regulations New Source Review of Carcinogenic Air Contaminants	Prohibitory Rules - Rule 1401	Applicable	NA; no emissions.	NA; no emissions.	Controls will not be necessary because risk from emissions will be below 1 x 10-6 risk level stated in the rule.	See Alternative 7G/5G.
New Source Review of Air Contaminants	Regulation XIII, Rule 1303	Applicable	NA; no emissions.	NA; no emissions.	Due to low concentrations of VOCs in groundwater, air emissions without controls will be below the 1 pound/day limit above which BACT is required to limit emissions increases (SCAQMD considers an emission increase to be at least 1 pound/day Nonetheless, BACT will be used for all alternatives.	See Alternative 7G/5G.
Statement of Policy with Respect to Maintaining High Quality of Waters in California	SWCB Resolution Number 68-16	Applicable	NA; no discharge will occur.	Treated groundwater will be discharged to the base wastewater treatment plant, to the ground surface, or reinjected to the aquifer. Discharge to the ground surface will not degrade water quality (See NPDES requirements below)	See Alternative 3G/5G.	See Alternative 3G/5G.

TABLE C-4
SITE 18 GROUNDWATER PLUME
COMPARATIVE ANALYSIS OF COMPLIANCE WITH LOCATION-SPECIFIC AND ACTION-SPECIFIC ARARS

Continued

Requirement	Source	Applicable, Relevant and Appropriate, or To-be-considered (TBC)	Alternative 2G Limited Action	Alternative 3G/5G Liquid Phase GAC Adsorption/Total Fluids Recovery	Alternatives 7G/5G Air Stripping with Catalytic Oxidation/Total Fluids Recovery	Alternatives 8G/5G Air Stripping with Purus PADRETM System/Total Fluids Recovery
Action-Specific (Continued)						
National Pollutant Discharge Elimination System (NPDES) Program	40 CFR Parts 122-125; NPDES Permit No. CAG918001 for March AFB Groundwater Cleanup Project (March 1995)	Applicable	NA; no discharge will occur.	Will meet substantive requirements of regulation through compliance with discharge limits for inorganics and total dissolved solids. Limits for regulated constituents in mg/L are: Total Petroleum Hydrocarbons 100, benzene 1.0; toluene 10; xylenes 10; ethylbenzene 10; chloroform 5; methyl ethyl ketone 10; tetrachloroethene (PCE) 5; methyl isobutyl ketone 10; 1,1-dichloroethylene 6; trichloroethylene (TCE) 5; dichlorobromomethane 5; 1,1,1-trichloroethane (TCA) 5; 1,2-dichloroethylene 10; 1,1-dichloroethane 5; carbon tetrachloride 0.5; naphthalene 10; Maximum Daily Limits for regulated constituents are in mg/l: chromium 0.05[2]; total lead 0.05; total residual chlorine3 0.1; suspended solids 75; sulfides 0.4; cadmium 0.01; zinc 5	See Alternative 3G/5G.	See Alternative 3G/5G.

Key

GAC	= Granular Activated Carbon	SCAQMD	= South Coast Air Quality Management District
RCRA	= Resource Conservation and Recovery Act	MCL	= Maximum Contaminant Level
TBC	= To Be Considered	UIC	= Underground Injection Control
OSWER	= Office of Solid Waste and Emergency Response	ARAR	= Applicable or Relevant and Appropriate Requirement
BACT	= Best Available Control Technology	NA	= Not an Applicable or Relevant and Appropriate Requirement
VOC	= Volatile Organic Compound	µg/L	= Micrograms per liter
		SWCB	= State Water Control Board

TABLE C-5
SITE 31 GROUNDWATER PLUME
COMPARATIVE ANALYSIS OF COMPLIANCE WITH CHEMICAL-SPECIFIC ARARS

Contaminant of Concern in Groundwater	Source	Applicable, Relevant, and Appropriate, or To-be-considered (TBC)	Alternative 2G Limited Action	Alternative 3G Direct Treatment with Liquid Phase GAC	Alternative 4G UV and Chemical Oxidation	Alternative 6G Air Stripping with Carbon Adsorption
Bis(2-ethylhexyl)phthalate	(1)	Relevant and Appropriate	4 µg/L California Cleanup Standard will not be achieved	4 µg/L California Cleanup Standard will be achieved	4 µg/L California Cleanup Standard will be achieved	4 µg/L California Cleanup Standard will be achieved
Trichloroethene (TCE)	(1), (2)	Relevant and Appropriate	5 µg/L California and Federal Cleanup Standard will not be achieved	5 µg/L California and Federal Cleanup Standard will be achieved	5 µg/L California and Federal Cleanup Standard will be achieved	5 µg/L California and Federal Cleanup Standard will be achieved
1,1-Dichloroethene	(1)	Relevant and Appropriate	6 µg/L California Cleanup Standard will not be achieved	6 µg/L California Cleanup Standard will be achieved	6 µg/L California Cleanup Standard will be achieved	6 µg/L California Cleanup Standard will be achieved

Key:
ARAR = Applicable or Relevant and Appropriate Requirement
GAC = Granular Activated Carbon
µg/L = Micrograms per liter

(1) Title 22, California Code of Regulations (CCR), Division 4, Chapter 15, Article 5.5, Section 64444.5, Maximum Contaminant Levels for Organic Chemicals.
(2) 40 Code of Federal Regulations (CFR) 141.61, Maximum Contaminant Levels for Organic Chemicals.

TABLE C-6

SITE 31 GROUNDWATER PLUME
COMPARATIVE ANALYSIS OF COMPLIANCE WITH LOCATION-SPECIFIC AND ACTION-SPECIFIC ARARS

Requirement	Source	Applicable, Relevant and Appropriate, or To-be-considered (TBC)	Alternative 2G Limited Action	Alternative 3G Direct Treatment with Liquid Phase GAC	Alternative 4G UV and Chemical Oxidation	Alternative 6G Air Stripping with Carbon Adsorption
LOCATION-SPECIFIC						
Clean Water Act Section 404(b)(1)	40 CFR Section 230.10	Applicable	NA; no discharge will occur.	Will meet ARAR, because no discharge to wetlands is expected.	See Alternative 3G.	See Alternative 3G.
Protection of Wetlands	Executive Order 11990 40 CFR 6, Appendix A	Applicable	NA; no discharge will occur	Will meet ARAR, because no discharge to wetlands is expected.	See Alternative 3G.	See Alternative 3G.
ACTION-SPECIFIC						
California Hazardous Waste Rules						
! Standards Applicable to Generators of Hazardous Waste	Title 22 CCR, Division 4.5, Chapter 12, Section 66262 et seq.	Applicable	NA; no wastes are generated	ARAR will be met; spent carbon, cuttings, and other residues will be handled and disposed of as hazardous wastes if they meet California classification criteria. Accumulation and storage requirements will be met.	NA; no wastes are generated.	See Alternative 3G.

TABLE C-6
SITE 31 GROUNDWATER PLUME
COMPARATIVE ANALYSIS OF COMPLIANCE WITH LOCATION-SPECIFIC AND ACTION-SPECIFIC ARARS
Continued

Requirement	Source	Applicable, Relevant and Appropriate, or To-be-considered (TBC)	Alternative 2G Limited Action	Alternative 3G Direct Treatment with Liquid Phase GAC	Alternative 4G UV and Chemical Oxidation	Alternative 6G Air Stripping with Carbon Adsorption
! Standards for Operators of Hazardous Waste Transfer, Treatment & Disposal Facilities:						
Tanks	Title 22 CCR Division 4.5, Chp 14, Section 6624.190 - Section 6624.199	Relevant and Appropriate	NA	Will meet ARAR; relevant and appropriate substantive requirements will be incorporated into construction and design of tanks used to store groundwater.	Same as Alternative 3G.	Same as Alternative 3G.
Miscellaneous Units	Title 22 CCR Division 4.5, Chp 14, Sections 66264.600-66264.603	Relevant and Appropriate	NA	The unit will be located, designed, constructed, operated, maintained, and closed in a manner that ensures protection of human health and the environment (e.g., prevention of releases) and will thereby comply with the relevant and appropriate requirements for miscellaneous treatment units.	The Unit will be located designed, constructed, operated, maintained, and closed in a manner that ensures protection of human health and the environment (e.g., prevention of releases) and will thereby comply with the relevant and appropriate requirements for miscellaneous treatment units.	The unit will be located, designed, constructed, operated, maintained, and closed in a manner that ensures protection of human health and the environment (e.g., prevention of releases) and will thereby comply with the relevant and appropriate requirements for miscellaneous treatment units.
Waste Classification and Management	Title 23, Division 3, Chapter 15, Article 2 Section 2522	Applicable	NA; no wastes are	ARAR will be met; spent carbon, cuttings, and other residue, if not hazardous waste, will be disposed of as designated waste.	NA; no wastes are generated	See Alternative 3G.

TABLE C-6
SITE 31 GROUNDWATER PLUME
COMPARATIVE ANALYSIS OF COMPLIANCE WITH LOCATION-SPECIFIC AND ACTION-SPECIFIC ARARS
Continued

Requirement	Source	Applicable, Relevant and Appropriate, or To-be-considered (TBC)	Alternative 2G Limited Action	Alternative 3G Direct Treatment with Liquid Phase GAC	Alternative 4G UV and Chemical Oxidation	Alternative 6G Air Stripping with Carbon Adsorption
ACTION-SPECIFIC (Continued)						
South Coast Air Quality Management District Rules & Regulations - New Source Review of Carcinogenic Air Contaminants	Prohibitory Rules - Rule 1401	Applicable	NA; no emissions.	Will meet ARAR; additional controls will not be necessary because risk from emissions will be below 1 x 100-6 risk level stated in the rule.	See Alternative 3G.	See Alternative 3G.
New Source Review of Air Contaminants	Regulation XIII, Rule 1303	Applicable	NA; no emissions.	Will meet ARAR. Due to low concentrations of VOCs in groundwater, air emissions without controls will be below the 1 pound/day limit above which BACT is required to limit emissions increases (SCAQMD considers an emissions increase to be at least 1 pound/day). Nonetheless, BACT will be used for all alternatives.	See Alternative 3G.	See Alternative 3G.
Statement of Policy with Respect to Maintaining High Quality of Waters in California	SWCB Resolution	Applicable	NA; no discharge will	Treated groundwater will be discharged to the base wastewater treatment plant, to the ground surface or reinjected to the aquifer. Discharge to the ground surface will not degrade water quality (see NPDES requirements below).	See Alternative 3G.	See Alternative 3G.

TABLE C-6
SITE 31 GROUNDWATER PLUME
COMPARATIVE ANALYSIS OF COMPLIANCE WITH LOCATION-SPECIFIC AND ACTION-SPECIFIC ARARS
Continued

Requirement	Source	Applicable, Relevant and Appropriate, or To-be-considered (TBC)	Alternative 2G Limited Action	Alternative 3G Direct Treatment with Liquid Phase GAC	Alternative 4G UV and Chemical Oxidation	Alternative 6G Air Stripping with Carbon Adsorption
ACTION-SPECIFIC (Continued)						
National Pollutant Discharge Elimination System NPDES) Program	40 CFR Parts 122-125; NPDES Permit Ab. CAG 918001 for March AFB Groundwater Cleanup Project (March 1995)	Applicable	NA; no discharge will occur.	Will meet substantive requirements of regulation through compliance with discharge limits for inorganics and total dissolved solids. Limits for regulated constituents in µg/L are: Total Petroleum Hydrocarbons 100; benzene 1.0; toluene 10; xylenes 10; ethylbenzene 10; chloroform 5; methyl ethyl ketone 10; tetrachloroethene (PCE) 5; methyl isobutyl ketone 10; 1,1-dichloroethylene 6; trichloroethylene carbon tetrachloride 0.5; naphthalene 10; Maximum Daily Limits for regulated constituents are in mg/l: chromium 0.05²; total lead 0.05; total residual chlorine3 0.1; suspended solids 75; sulfides 0.4; cadmium 0.01; zinc 5	See Alternative 3G.	See Alternative 3G.

Key:

GAC	=	Granular Activated Carbon	SCAQMD	=	South Coast Air Quality Management District
RCRA	=	Resource Conservation and Recovery Act	MCL	=	Maximum Contaminant Level
TBC	=	To Be Considered	UIC	=	Underground Injection Control
OSWER	=	Office of Solid Waste and Emergency Response	ARAR	=	Applicable or Relevant and Appropriate Requirement
BACT	=	Best Available Control Technology	NA	=	Not an Applicable or Relevant and Appropriate Requirement
VOC	=	Volatile Organic Compound	µg/L	=	Micrograms per liter

TABLE C-7
SITE 4 SOIL
COMPARATIVE ANALYSIS OF COMPLIANCE WITH LOCATION-SPECIFIC AND ACTION-SPECIFIC ARARS

Requirement	Source	Applicable, Relevant and Appropriate, or To-be-considered (TBC)	Alternative 2S Limited Action	Alternative 3S RCRA Capping	Alternative 4S Landfill Closure	Alternative 9S Excavation and Off-site Disposal
LOCATION-SPECIFIC						
Protection of Wetlands	Clean Water Act Section 404(b)(1) and Executive Order 11990	Applicable	ARAR will not be met; erosion of landfill and deposition of contaminants into Heacock Storm Drain will not be prevented.	ARAR will be met; closure will prevent erosion of landfill and deposition of contaminants into Heacock Storm Drain and will not adversely impact wetlands. Measures will be taken during construction to prevent adverse impacts on wetlands.	ARAR will be met; closure will prevent erosion of landfill and deposition of contaminants into Heacock Storm Drain and will not adversely impact wetlands. Measures will be taken during construction to prevent adverse impacts on wetlands.	ARAR will be met; potential source of contamination will be eliminated. Measures will be taken during construction to prevent adverse impacts on wetlands.
ACTION-SPECIFIC						
Discharges of Wastes to Land (Landfill Closure and Post-Closure)	Title 23 CCR, Division 3, Chapter 15, Article 8 Section 2581	Applicable	ARAR will not be met; no waiver is justified.	Isolation of landfill materials will be accomplished. A RCRA cap will be constructed and the adjacent Heacock Storm Drain will be lined with an impermeable barrier. ARAR will be met; closure and post-closure requirements include construction of a cover, isolation of landfill materials from surface water drainage, water quality monitoring and response programs, closure maintenance activities, and post-closure maintenance activities.	ARAR will be met; closure and post-closure requirements include construction of a cover, isolation of landfill materials from surface water drainage, water quality monitoring and response programs, closure maintenance activities, and post-closure maintenance activities.	Will meet ARAR; landfill materials will be eliminated, covered and other requirements will be complied with.

TABLE C-7
SITE 4 SOIL
COMPARATIVE ANALYSIS OF COMPLIANCE WITH LOCATION-SPECIFIC AND ACTION-SPECIFIC ARARS
Continued

Requirement	Source	Applicable, Relevant and Appropriate, or To-be-considered (TBC)	Alternative 2S Limited Action	Alternative 3S RCRA Capping	Alternative 4S Landfill Closure	Alternative 9S Excavation and Off-site Disposal
ACTION-SPECIFIC (Continued)						
South Coast Air Quality District Rules and Regulations:						
! Fugitive Dust	Rule 403	Applicable	NA; no excavation of soil will occur.	ARAR will be met; construction activities will comply with regulations; particulate matter will not exceed 50 µg/m3.	ARAR will be met; construction activities will comply with regulations; particulate matter will not exceed 50 µg/m3.	ARAR will be met; construction activities will comply with regulations particulate matter will not exceed 50 µg/m3.
! Gaseous Emissions from Inactive Landfills	Regulation IX, Rule 1150.2	Applicable	NA; no excavation of soil will occur.	May be applicable to construction of cap; ARAR will be complied with. Landfill gases will be collected, if necessary.	May be applicable to construction of landfill cover; ARAR will be complied with.	ARAR will be complied with.
California Hazardous Waste Rules: ! Standards for Operators of Hazardous Waste Transfer Treatment and Disposal Facilities: Landfills	Title 22, Division 4.5, Section 66264.300-66264.318	Relevant and Appropriate	Will not meet ARAR; no waiver is justified.	ARAR will be met; including placement of a final cover, grading, revegetation, and installation of environmental monitoring central systems.	ARAR will be met; including placement of a final cover, grading, revegetation, and installation of environmental monitoring central systems.	ARAR will be met; including placement of a final cover, grading, revegetation, and installation of environmental monitoring central systems.

Key:
- ARAR = Applicable or Relevant and Appropriate Requirement
- RCRA = Resource Conservation and Recovery Act
- µg/m3 = Micrograms per cubic meter
- SCAQMD = South Coast Air Quality Management District
- NA = Not an Applicable or Relevant and Appropriate Requirement

TABLE C-8
SITE 10 SURFACE SOIL
COMPARATIVE ANALYSIS OF COMPLIANCE WITH LOCATION-SPECIFIC AND ACTION-SPECIFIC ARARS

Requirement	Source	Applicable, Relevant and Appropriate, or To-be-considered (TBC)	Alternative 2S Limited Action	Alternative 5S Excavation and Low Temperature Thermal Desorption	Alternative 7S Excavation and Offsite Treatment	Alternative 8S* Excavation and Onsite Consolidation	Alternative 11S Ex-Situ Bioremediation
ACTION-SPECIFIC							
California Hazardous Waste Rules:							
! Standards Applicable to Generators of Hazardous Waste	Title 22, Division 4.5, Chapter 12, Section 66262 et seq.	Applicable	NA; no wastes generated.	See Alternative 8S.	Will meet ARAR; will comply with characterization, and onsite container and storage requirements if soils or residuals are determined to be hazardous waste. Will meet ARAR; only soils without hazardous waste characteristics will be consolidated onsite.	Will meet ARAR; will comply with characterization, and onsite container and storage requirements if soils or residuals are determined to be hazardous waste. Will meet ARAR; only soils without hazardous waste characteristics will be consolidated onsite.	See Alternative 7S.
! Standards for Operators of Hazardous Waste Transfer, Treatment and Disposal Facilities:							
Landfills	Title 22, Division 4.5, Section 66264.300-66264.318	Applicable	NA; no wastes generated.	NA; no wastes generated.	NA; wastes will not be placed in onsite landfills.	Will meet ARAR; only non-hazardous wastes will be placed onsite landfills.	NA; no wastes generated.
Waste Piles	Title 22, Division 4.5, Section 66264.250 - 66264.259	Applicable	NA; no waste piles.	See Alternative 7S.	Will meet ARAR by complying with regulations. Relevant only if temporary storage of RCRA waste in piles occurs.	See Alternative 7S.	See Alternative 7S.

TABLE C-8
SITE 10 SURFACE SOIL
COMPARATIVE ANALYSIS OF COMPLIANCE WITH LOCATION-SPECIFIC AND ACTION-SPECIFIC ARARS

Requirement	Source	Applicable, Relevant and Appropriate, or To-be-considered (TBC)	Alternative 2S Limited Action	Alternative 5S Excavation and Low Temperature Thermal Desorption	Alternative 7S Excavation and Offsite Treatment	Alternative 8S* Excavation and Onsite Consolidation	Alternative 11S Ex-Situ Bioremediation
ACTION-SPECIFIC							
Waste Classification and Management	Title 23, Division 3, Chapter 15, Article 2, Section 2522	Applicable	NA; no waste generated	NA; no waste generated	ARAR will be met; non-hazardous waste will be disposed of as designated waste.	ARAR will be met; non-hazardous waste will be disposed of as designated waste.	See Alternative 7S.
Discharges of Waste to Land (Soil Disposal)	Title 23, Division 3, Chapter 15	Relevant and Appropriate	NA; no discharges will occur.	NA; no discharge of waste will occur.	NA; no onsite discharges will occur.	ARAR will be met; only non-hazardous soils will be discharged, and a cap will prevent leaching of any contaminants to groundwater.	NA; no discharge of waste will occur.
South Coast Air Quality Management District Rules and Regulations							
! Fugitive Dust	Prohibitory Rules, Rule 4403	Applicable	NA; no emissions.	See Alternative 7S.	ARAR will be met; excavation activities will comply with regulations, particulate matter will not exceed 50 µg/m3.	See Alternative 7S.	See Alternative 7S.
! New Source Review of Carcinogenic Air Contaminants	Rule 1401	Applicable	NA; no emissions.	Will meet ARAR; emissions of PAHs will be below 1 x 10-6 risk level stated in the rule; controls will not be required.	No applicable to this alternative.	N/A	See Alternative 5S.

Key:
ARAR = Applicable or Relevant and Appropriate Requirement
RCRA = Resource Conservation and Recovery Act
PAH = Polynuclear Aromatic Hydrocarbon
NA = Not an Applicable or Relevant and Appropriate Requirement
µg/m3 = Micrograms per cubic meter
* Alternative 8S is no longer a viable alternative

TABLE C-9
SITE 15 SURFACE SOIL
COMPARATIVE ANALYSIS OF COMPLIANCE WITH LOCATION-SPECIFIC AND ACTION-SPECIFIC ARARS

Requirement	Source	Applicable, Relevant and Appropriate, or To-be-considered (TBC)	Alternative 2S Limited Action	Alternative 5S Excavation and Low Temperature Thermal Desorption	Alternative 7S Excavation and Offsite Treatment	Alternative 8S* Excavation and Onsite Consolidation	Alternative 11S Ex-Situ Bioremediation
ACTION-SPECIFIC							
California Hazardous Waste Rules							
! Standards Applicable to Generators of Hazardous Waste	Title 22, Division 4.5, Chapter 12, Section 66262 et seq.	Applicable	NA; no wastes generated.	See Alternative 8S.	Will meet ARAR; will comply with characterization, and onsite container and storage requirements if soils or residuals are determined to be hazardous waste.	Will meet ARAR; only soils without hazardous waste characteristics will be consolidated onsite.	See Alternative 7S.
! Standards for Operators of Hazardous Waste Transfer, Treatment and Disposal Facilities:							
Landfills	Title 22, Division 4.5, Section 66264.300 - 66264.318	Applicable	NA; no wastes generated.	NA; no wastes.	NA; wastes will not be placed in onsite landfills.	Will meet ARAR; only non-hazardous wastes will be placed in onsite landfills.	NA, no wastes.
Waste Piles	Title 22, Division 4.5, Section 66264.250 - 66264.259	Applicable	NA; no waste piles.	See Alternative 7S.	Will meet ARAR by complying with regulations. Relevant only if temporary storage of RCRA waste in piles occurs.	See Alternative 7S.	See Alternative 7S
Waste Classification and Management	Title 23, Div. 3, Chapter 15, Article 2, Section 2522	Applicable	NA: no waste generated	NA: no waste generated	ARAR will be met; non hazardous waste will be disposed of as designated waste	ARAR will be met; non hazardous waste will be disposed of as designated waste	See Alternative 7S.

TABLE C-9
SITE 15 SURFACE SOIL
COMPARATIVE ANALYSIS OF COMPLIANCE WITH LOCATION-SPECIFIC AND ACTION-SPECIFIC ARARS

Requirement	Source	Applicable, Relevant and Appropriate, or To-be-considered (TBC)	Alternative 2S Limited Action	Alternative 5S Excavation and Low Temperature Thermal Desorption	Alternative 7S Excavation and Offsite Treatment	Alternative 8S* Excavation and Onsite Consolidation	Alternative 11S Ex-Situ Bioremediation
Discharges of Waste to Land (Soil Disposal)	Title 23, Division 3, Chapter 15	Relevant and Appropriate	NA; no discharges will occur.	NA; no discharge of waste will occur.	NA; no onsite discharges will occur.	ARAR will be met; non-hazardous soils will be covered by a cap to prevent leading.	NA; no discharge of waste will occur.
South Coast Air Quality Management District Rules and Regulations							
! Fugitive Dust	Prohibitory Rules, Rule 403	Applicable	NA; no excavation will occur.	See Alternative 7S.	Compliance will occur by controlling fugitive dust to levels of <50 µg/m3	See Alternative 7S.	See Alternative 7.
! New Source Review of Carcinogenic Air Contaminants	Rule 1401	Applicable	NA; no emissions	Will meet ARAR; emissions of PAHs will be below 1 x 10-6 risk level stated in the rule; controls will not be required.	Not applicable.	Not applicable.	See Alternative 5S.

Key:
ARAR = Applicable or Relevant and Appropriate Requirement
RCRA = Resource Conservation and Recovery Act
PAH = Polynuclear Aromatic Hydrocarbon
NA = Not an Applicable or Relevant and Appropriate Requirement
µg/m3 = Micrograms per cubic meter
* Alternative 8S is no longer a viable alternative

TABLE C-10
SITE 18 SUBSURFACE SOIL
COMPARATIVE ANALYSIS OF COMPLIANCE WITH LOCATION-SPECIFIC AND ACTION-SPECIFIC ARARS

Requirement	Source	Applicable, Relevant and Appropriate, or To-be-considered (TBC)	Alternative 2S Limited Action	Alternative 10S Bioventing	Alternative 12S Soil Vapor Extraction with Catalytic Oxidation	Alternative 13S Soil Vapor Extraction with Purus PADRETM System
ACTION-SPECIFIC						
California Hazardous Waste Rules.						
! Standards Applicable to Generators of Hazardous Waste	Title 22, Division 4.5, Chapter 12, Section 66262 et seq.	Applicable	NA; no wastes.	NA; no wastes.	NA; no wastes are generated.	Will meet ARAR. Residue will be handled and disposed of as hazardous waste if it meets classification criteria.
! Standards for Operators of Hazardous Waste Transfer, Treatment & Disposal Facilities:						
Tanks	Title 22, Division 4.5, Section 6624.190 - Section 6624.199	Relevant and Appropriate	NA; no tanks are used.	NA; no tanks are used.	NA; no tanks are used.	Will meet ARAR. Relevant and appropriate requirements will be incorporated into the design and construction of Purus tanks.
Waste Classification and Management	Title 23, Division 3, Chapter 15, Article 2, Section 2522	Applicable	NA; no wastes	NA; no wastes	NA; no wastes	Residue will be handled and disposed of as designated waste, if it is non hazardous
South Coast Air Quality Management District Rules Regulations - New Source Review of Carcinogenic Air Contaminants	Prohibitory Rules - Rule 1401	Applicable	NA; no emissions.	NA; de minimus emissions.	Will meet ARAR, emissions of BTEX will be below 1 x 10-6 risk level stated in the rule; additional controls will not be required.	See Alternative 12S.
New Source Review of Air Contaminants	Rule 1303	Applicable	NA; no emissions.	NA; de minimus emissions.	Will meet ARAR; emissions will be below the 1 pound/day threshold.	See Alternative 12S.

Key:
ARAR = Applicable or Relevant and Appropriate Requirement
BTEX = Benzene, Toluene, Ethylbenzene, and Xylene
RCRA = Resource Conservation and Recovery Act
NA = Not an Applicable or Relevant and Appropriate Requirement

TABLE C-11
SITE 31 SURFACE SOIL
COMPARATIVE ANALYSIS OF COMPLIANCE WITH LOCATION-SPECIFIC AND ACTION-SPECIFIC ARARS

Requirement	Source	Applicable, Relevant and Appropriate, or To-be-considered (TBC)	Alternative 2S Limited Action	Alternative 5S Excavation and Low Temperature Thermal Desorption	Alternative 7S Excavation and Offsite Treatment	Alternative 8S Excavation and Onsite Consolidation	Alternative 11S Ex-Situ Bioremediation
ACTION-SPECIFIC							
California Hazardous Waste Rules							
! Standards Applicable to Generators of Hazardous Waste	Title 22, Division 4.5, Chapter 12, Section 66262 et seq.	Applicable	NA; no wastes generated.	See Alternative 8S.	Will meet ARAR; will comply with characterization, and onsite container and storage requirements if soils or residuals are determined to be hazardous waste.	Will meet ARAR; only soils without hazardous waste characteristics will be consolidated onsite.	See Alternative 7S.
! Standards for Operators of Hazardous Waste Transfer, Treatment and Disposal Facilities:							
Landfills	Title 22, Division 4.5, Section 66264.300 - 66264.318	Applicable	NA; no wastes generated.	NA; no wastes.	NA; wastes will not be placed in onsite landfills.	Will meet ARAR; only non-hazardous wastes will be placed in onsite landfills.	NA; no wastes.
Waste Piles	Title 22, Division 4.5, Section 66264.250 - 66264.259	Applicable	NA; no waste piles.	See Alternative 7S.	Will meet ARAR by complying with regulations. Relevant only if temporary storage of RCRA waste in piles occurs.	See Alternative 7S.	See Alternative 7S.

TABLE C-11
SITE 31 SURFACE SOIL
COMPARATIVE ANALYSIS OF COMPLIANCE WITH LOCATION-SPECIFIC AND ACTION-SPECIFIC ARARS

Requirement	Source	Applicable, Relevant and Appropriate, or To-be-considered (TBC)	Alternative 2S Limited Action	Alternative 5S Excavation and Low Temperature Thermal Desorption	Alternative 7S Excavation and Offsite Treatment	Alternative 8S* Excavation and Onsite Consolidation	Alternative 11S Ex-Situ Bioremediation
ACTION-SPECIFIC							
Waste Classification and Management	Title 23, Division 3, Chapter 15, Article 2, Section 2522	Applicable	NA; no waste generated	NA; no waste generated	ARAR will be met; non-hazardous waste will be disposed of as designated waste	ARAR will be met; non-Hazardous waste will be disposed of as designated waste	See Alternative 7S
Discharges of Waste to Land (Soil Disposal)	Title 23, Division 3, Chapter 15	Relevant and Appropriate	NA; no discharges will occur.	NA; no discharge of waste will occur	NA; no onsite discharges will occur.	ARAR will be met; non-hazardous soil will be covered by a cap.	NA; no discharge of waste will occur. See Alternative 7S
South Coast Air Quality Management District Rules and Regulations							
! Fugitive Dust	Prohibitory Rules, Rule 403	Applicable	NA; no excavation will occur.	See Alternative 7S.	Compliance will occur. by controlling fugitive dust to levels of <50 µg/m3	See Alternative 7S.	See Alternative 7S.
! New Source Review of Carcinogenic Air Contaminants	Rule 1401	Applicable	NA; no emissions.	Will meet ARAR; emissions of PAHs will be below 1 x 10-6 risk level stated in the rule; controls will not be required.	Not applicable.	See Alternative 5S.	See Alternative 7S.

Key:

ARAR	=	Applicable or Relevant and Appropriate Requirement
RCRA	=	Resource Conservation and Recovery Act
PAH	=	Polynuclear Aromatic Hydrocarbon
NA	=	Not an Applicable or Relevant and Appropriate Requirement
µg/m3	=	Micrograms per cubic meter

* Alternative 8S is no longer a viable alternative

TABLE C-12
SITE 31 SUBSURFACE SOIL
COMPARATIVE ANALYSIS OF COMPLIANCE WITH LOCATION-SPECIFIC AND ACTION-SPECIFIC ARARS

Requirement	Source	Applicable, Relevant and and Appropriate, or To-be-considered (TBC)	Alternative 2S Limited Action	Alternative 12S Soil Vapor Extraction with Catalytic Oxidation	Alternative 13S Soil Vapor Extraction with Purus PADRETM System	Alternative 14S Soil Vapor Extraction with Carbon Adsorption
ACTION-SPECIFIC						
California Hazardous Waste Rules						
! Standards Applicable to Generators of Hazardous Waste	Title 22 CCR, Division 4.5, Chapter 12, Section 66262 et seq.	Applicable	NA; no waste generated.	See Alternative 2S.	ARAR will be met; spent carbon, cuttings, and other residues will be handled and disposed of as hazardous wastes if they meet California classification criteria. Accumulation and storage requirements will be met.	See Alternative 13S.
! Standards for Operators of Hazardous Waste Transfer, Treatment & Disposal Facilities:						
Tanks	Title 22 CCR, Division 4.5, Section 6624.190 - Section 6624.199	Relevant and Appropriate	NA; no wastes.	Relevant and appropriate substantive requirements will be incorporated into construction and design of tanks.	See Alternative 12S.	See Alternative 12S.
Waste Classification and Management	Title 23, Division 3, Chapter 15, Article 2, Section 2522	Applicable	NA; no wastes	NA; no wastes	NA; no wastes	Residue will be handled and disposed of as designated waste, if it is non hazardous
South Coast Air Quality Management District Rules/Regulations						
! New Source Review of Carcinogenic Air Contaminants	Rule 1401	Applicable	NA; no emissions	Will meet ARAR; emissions will be below 3 x 10-6 risk level stated in rule.	See Alternative 12S.	See Alternative 12S.

TABLE C-12
SITE 31 SUBSURFACE SOIL
COMPARATIVE ANALYSIS OF COMPLIANCE WITH LOCATION-SPECIFIC AND ACTION-SPECIFIC ARARS

Continued

Requirement	Source	Applicable, Relevant and and Appropriate, or To-be-considered (TBC)	Alternative 2S Limited Action	Alternative 12S Soil Vapor Extraction with Catalytic Oxidation	Alternative 13S Soil Vapor Extraction with Purus PADRETM System	Alternative 14S Soil Vapor Extraction with Carbon Adsorption
ACTION-SPECIFIC (Continued)						
South Coast Air Quality Management District Rules/Regulations (Continued)						
! New Source Review of Air-Contaminants	Rule 1303	Applicable	NA; no emissions.	Due to low concentrations of VOCs in groundwater, air emissions will be below the 1 pound/day limit above which BACT is required to limit emissions increases (SCAQMD considers an emissions increase to be at least 1 pound/day. Nonetheless, BACT will be used for all alternatives.	See Alternative 12S.	See Alternative 12S.

Key:
- RCRA = Resource Conservation and Recovery Act
- ARAR = Applicable or Relevant and Appropriate Requirement
- NA = Not an Applicable or Relevant and Appropriate Requirement
- VOC = Volatile Organic Compound
- BACT = Best Available Control Technology

TABLE C-13
SITE 34 SURFACE SOIL
COMPARATIVE ANALYSIS OF COMPLIANCE WITH LOCATION-SPECIFIC AND ACTION-SPECIFIC ARARS

Requirement	Source	Applicable, Relevant and Appropriate, or To-be-considered (TBC)	Alternative 2S Limited Action	Alternative 5S Excavation and Low Temperature Thermal Desorption	Alternative 7S Excavation and Offsite Treatment	Alternative 8S Excavation and Onsite Consolidation	Alternative 11S Ex-Situ Bioremediation
ACTION-SPECIFIC							
California Hazardous Waste Rules:							
! Standards Applicable to Generators of Hazardous Waste	Title 22, Division 4.5, Chapter 12, Section 66262 et seq.	Applicable	NA; no wastes generated.	See Alternative 8S.	Will meet ARAR; will comply with characterization, and onsite container and storage requirements if soils are determined to be hazardous waste.	Will meet ARAR; only soils without hazardous waste characteristics will be consolidated onsite.	See Alternative 7S.
! Standards for Operators of Hazardous Waste Transfer, Treatment and Disposal Facilities:							
Landfills	Title 22, Division 4.5, Section 66264.300 - 66264.318	Applicable	NA; no wastes generated.	NA; no wastes.	NA; wastes will not be placed in onsite landfills.	Will meet ARAR; only non-hazardous wastes will be placed onsite landfills.	NA; no wastes.
Waste Piles	Title 22, Division 4.5, Section 66264.250 - 66264.259	Applicable	NA; no wastes piles.	See Alternative 7S.	Will meet AAR by comply with regulations. Relevant only if temporary storage of RCRA waste in piles occurs.	See Alternative 7S.	See Alternative 7S.
Waste Classification and Management	Title 23, Division 3, Chapter 15, Article 2, Section 2522	Applicable	NA; no wastes generated	NA; no wastes generated disposed of as designated waste	ARAR will be met; non hazardous waste will be	See Alternative 7S	See Alternative 7S.

TABLE C-13
SITE 34 SURFACE SOIL
COMPARATIVE ANALYSIS OF COMPLIANCE WITH LOCATION-SPECIFIC AND ACTION-SPECIFIC ARARS

Continued

Requirement	Source	Applicable, Relevant and Appropriate, or To-be-considered (TBC)	Alternative 2S Limited Action	Alternative 5S Excavation and Low Temperature Thermal Desorption	Alternative 7S Excavation and Offsite Treatment	Alternative 8S* Excavation and Onsite Consolidation	Alternative 11S Ex-Situ Bioremediation
ACTION-SPECIFIC (Continued)							
Discharges of Waste to Land (Soil Disposal)	Title 23, Division 3, Chapter 15	Relevant and Appropriate	NA; no discharges will occur.	NA; no discharge of waste will occur.	NA; no onsite discharges will occur.	ARAR will be met; non-hazardous soils will be covered by a cap.	NA; no discharge of waste will occur.
South Coast Air Quality Management District Rules and Regulations							
! Fugitive Dust	Prohibitory Rules, Rule 403	Applicable	NA; no excavation will	See Alternative 7S.	Compliance will occur by controlling fugitive dust to levels of <50 µg/m3	See Alternative 7S.	See Alternative 7S.
! New Source Review of Carcinogenic Air Contaminants	Rule 1401	Applicable	NA; no emissions	Will meet ARAR; emissions of PAHs will be below 1 x 10-6 risk level stated in the rule; controls will not be required.	Not Applicable.	Not Applicable.	See Alternative 5S.

Key:

ARAR	=	Applicable or Relevant and Appropriate Requirement
RCRA	=	Resource Conservation and Recovery Act
PAH	=	Polynuclear Aromatic Hydrocarbon
NA	=	Not an Applicable or Relevant and Appropriate Requirement
µg/m3	=	Micrograms per cubic meter

* Alternative 8S is no longer a viable alternative

TABLE C-14
SITE 34 SUBSURFACE SOIL
COMPARATIVE ANALYSIS OF COMPLIANCE WITH LOCATION-SPECIFIC AND ACTION-SPECIFIC ARARS

Requirement	Source	Applicable, Relevant and Appropriate, or To-be-considered (TBC)	Alternative 2S Limited Action	Alternative 10S Bioventing	Alternative 12S Soil Vapor Extraction with Catalytic Oxidation	Alternative 13S Soil Vapor Extraction with Purus PADRETM System
ACTION-SPECIFIC						
California Hazardous Waste Rules						
! Standards Applicable to Generators of Hazardous Waste	Title 22, Division 4.5, Chapter 12, Section 66262 et seq.	Applicable	NA; no waste generated.	NA; no waste generated.	NA; no waste generated.	Will meet ARAR. Residue will be handled and disposed of as hazardous waste if it meets classification criteria.
Waste Classification and Management	Title 23, Division 3, Chapter 15, Article 2 Section 2522	Applicable	NA; no wastes	NA; no wastes	NA; no wastes	Residue will be handled and disposed of as designated waste, if it is non hazardous
South Coast Air Quality Management District Rules Regulations:						
! New Source Review of Carcinogenic Air Contaminants	Prohibitory Rules - Rule 1401	Applicable	NA; no emissions.	NA; no significant emissions.	Will meet ARAR; rise from emissions of BTEX will be below 1 x 10-6 risk level stated in rule; additional controls will not be required.	See Alternative 12S.
! New Source Review of Air Contaminants	Regulation XIII; Rule 1303	Applicable	NA; no emissions.	NA; no significant emissions.	Will meet ARAR, air emissions with controls will be below the 1 pound/day threshold	See Alternative 12S.

Key:
- ARAR = Applicable or Relevant and Appropriate Requirement
- RCRA = Resource Conservation and Recovery Act
- BTEX = Benzene, Toluene, Ethylbenzene, and Xylenes
- NA = Not an Applicable or Relevant and Appropriate Requirement