EXECUTIVE SUMMARY

This report describes the findings of remedial investigations at Operable Unit 1 (OU 1), Hill Air Force Base (Hill AFB), Utah, from 1991 through June 1995. OU 1 is one of eight operable units being investigated at Hill AFB, which was placed on the National Priority List in July 1987. Operable Unit 1 includes the following on-Base disposal sites:

- Chemical Disposal Pits 1 and 2: An industrial liquid waste disposal site in operation from 1952 through 1973
- Landfill 3: An industrial (dump and burn) liquid and solid waste disposal site in operation from 1940 through 1967
- Landfill 4: A sanitary refuse landfill in operation from 1967 through 1973
- Fire Training Area 1: A fire training practice area used by Hill AFB from the mid 1950s through 1973 to extinguish simulated aircraft fires
- Fire Training Area 2: A fire training practice area used by Hill AFB from 1973 until 1995 to extinguish simulated aircraft fires
- Waste Phenol/Oil Pit: A brick-lined pit used periodically to dispose and burn waste oil and phenol from 1954 through 1965
- Waste Oil Storage Tank Site: Site of four 20,000 to 25,000-gallon above-ground storage tanks used to store fuel oil, jet fuel, and hydraulic oil. The tanks were removed in 1985.

In addition, OU 1 includes a portion of the Weber River Valley downgradient of the disposal sites. Organic solvents and fuels have been detected in soil, ground water, and light non-aqueous phase liquid (LNAPL) on Base; and organic solvents (principally DCE) have been detected in ground water in the western portion of the downgradient Weber River Valley.

Hill AFB lies on a terrace south of and approximately 300 feet above the Weber River Valley. The on-Base stratigraphy consists of approximately 40 feet of sand and gravel deposits underlain by approximately 200 feet of silty clay that contains sand stringers. The hydrogeology at OU 1 is influenced strongly by this stratigraphy. The shallow aquifer encompasses the lower few feet of the sand and gravel unit and continues into the silty clay unit. Ground water primarily flows horizontally in the sand and gravel unit, with only a minor component of vertical or horizontal flow in the silty clay unit. Based on ground-water contamination observed in the shallow aquifer in the Weber River Valley, there is an apparent hydraulic connection between the western part of the shallow on-Base aquifer and the shallow off-Base aquifer. Ground water from the shallow aquifer migrates laterally toward the hillside and either discharges as springs and seeps on the hillside or flows through the veneer on the hillside to the Weber River Valley. A small portion of the ground water may flow downward into the deeper portions of the shallow

aquifer, probably along preferential pathways such as interconnected sand stringers, and then laterally into the shallow aquifer in the Weber River Valley.

The principal contaminants detected on Base at OU 1 are chlorinated solvents and fuel hydrocarbons. Hill AFB's primary mission always has been, and continues to be, aircraft maintenance and repair. Based on the detected contaminants, the materials disposed at OU 1 are consistent with this mission: fuels, oils, solvents, degreasers, and lubricants. Extensive record searches have found no indication that weapons-related material (i.e., explosives, chemical warfare agents, or defoliants) were disposed at OU 1, and the results of ground-water analyses support the conclusion that these materials are not present at OU 1. If these materials had been disposed at OU 1, the quantities would have been small and the frequency of disposal would have been low.

The organic contamination at OU 1 is heterogeneous and extremely complex. It consists of highly weathered fuels, partially burned or degraded fuels and solvents, and products of burning and of aerobic and anaerobic degradation of chlorinated and fuel hydrocarbons. Soil contamination on Base includes tetrachloroethene (up to 9,100 micrograms per kilogram [µg/kg]), trichloroethene (up to 40,000 µg/kg), dichloroethene (up to 14,000 µg/kg), and jet fuel (up to 42,100 µg/kg). A light non-aqueous phase liquid (LNAPL) layer extends to the northwest from the chemical disposal pits, Fire Training Area 1, and the eastern part of Landfill 3. The LNAPL, which floats on the ground water, covers approximately 7 acres on Base. Up to 1 foot of LNAPL has been measured in a some on-Base monitoring wells. The LNAPL consists primarily of jet fuel and light lubricating oil, with relatively high concentrations of solubilized chlorinated solvents and other organic contaminants such as polychlorinated biphenyls, pesticides, and dioxins and furans.

The LNAPL is the primary source of organic contaminants to the shallow on-Base aquifer in the western portion of OU 1. Chlorinated solvents in the shallow on-Base ground water include trichloroethene (up to 2,300 micrograms per liter [µg/l]), chlorinated benzenes (up to 4,900 µg/l), dichloroethene (up to 42,000 µg/l), and vinyl chloride (up to 2,400 µg/l). Dichloroethene and vinyl chloride are degradation products of tetrachloroethene and trichloroethene. The areal extent of ground water with detectable dichloroethene is approximately 193 acres (101 acres on Base and 92 acres off Base), 34 acres have detectable chlorinated benzenes (all on Base), and 20 acres have detectable vinyl chloride (all on Base except for a small area immediately adjacent to the Base boundary northeast of Landfill 4). Chlorinated solvents are the primary contaminants detected off Base in the shallow ground water of the western Weber River Valley. Contaminants detected in off-Base surface water and ground water northwest of OU 1 include dichloroethene (up to 1,500 µg/l) and trichloroethene (up to 28 µg/l). Except for several springs located immediately north of the Base boundary near Landfill 4, no organic contaminants have been detected downgradient of OU 1 in the eastern part of the Weber River Valley.

Based on the results of these investigations, a detailed conceptual contaminant transport model (illustrated in Figures 1 and 2) was developed to illustrate possible hydraulic interconnections and transport pathways at OU 1. The predominant source areas for most

contaminants are Chemical Disposal Pits 1 and 2, Landfill 3, and Fire Training Area 1. Figure 1 shows the fate and transport of contaminants associated with these major source areas. Much lower concentrations of contaminants are associated with the other disposal areas (Landfill 4, Fire Training Area 2, the Waste Oil/Phenol Pit, and the Waste Oil Storage Tank Site). Figure 2 shows the conceptual fate and transport of contaminants associated with these areas.

The predominant contaminant transport pathway is from the chemical disposal pits, Landfill 3, and Fire Training Area 1 to the unsaturated zone and into the LNAPL. Some constituents then dissolve in the shallow on-Base ground water, and are transported through zones of high permeability on the hillside either to hillside springs and seeps or to the shallow ground water off Base (on the western side of OU 1 only). Although the upper and deeper portions of the shallow on-Base aquifer are hydraulically connected, migration of contaminants to the deeper portion of the on-Base aquifer is considered a minor pathway because very few contaminants have been detected in wells screened in the deeper portion of the aquifer, and because the silty clay layer likely retards the vertical migration of contaminants.

Analysis of the fate and transport of contaminants at OU 1 suggests that two major factors control the movement and persistence of ground-water contaminants migrating from the source areas: reduction-oxidation conditions in the ground water, and sand-and-gravel-filled paleo channels incised into the surface of the silty clay unit. Aerobic degradation of hydrocarbons and construction of a cap and slurry wall (as interim remedial measures) have produced reducing conditions in the ground water and capillary fringe, which has led to anaerobic degradation of chlorinated hydrocarbons to other chlorinated compounds such as DCE, TCE, and vinyl chloride, and to mobilization of metals such as iron, manganese, and arsenic. The paleo channels in the clay surface direct most of the ground-water flow in the shallow aquifer toward the west and east. This flow is in contrast to the overall north-northwestward gradient as defined by the local potentiometric surface of the water table.

Based on the results of these investigations, OU 1 is considered sufficiently characterized to develop a remedial strategy for the various media at the site and to support decisions based on risks to human health and the environment. Field investigations currently are scheduled or underway to address several minor data gaps, and the results will be included in the final version of this report.

The results of the Baseline Risk Assessment for OU 1 are included as an appendix to this document. At this time there are no known completed exposure pathways to potential receptors on or off Base that would result in a significant risk. There could be risks to human health and the environment if land use were to change in the future.