EXECUTIVE SUMMARY

A treatability study was conducted at Operable Unit 4 (OU 4), Hill Air Force Base, Utah to evaluate the feasibility of using horizontal drains to extract ground water contaminated with trichloroethene (TCE) from the subsurface. Nine horizontal drains were installed in August 1993. The drains were operated periodically from August to November 1993 and have been operating continuously from April 1994 to the present.

Approximately 3 million gallons of contaminated ground water were extracted using the pilot scale horizontal drains from August 1993 to December 1994. Flow rates from the horizontal drains were initially 10 to 20 gpm per drain but dropped off very rapidly by approximately one order of magnitude as the drains continued to operate. The high initial flow rates are believed to be due to rapid draining of sand layers. Steady state ground-water flow rates appear to be limited by the rate of flow through the sandy clay comprising the shallow aquifer. Flow rates from the horizontal drains vary seasonally according to the amount of recharge entering the shallow ground water. Steady state flow rates in the spring are approximately 1 gpm per drain, and flow rates in the late summer and fall are approximately 0.5 gpm per drain.

Evaluation of ground-water elevations in vertical monitoring wells surrounding the horizontal drains determined that the horizontal drains do affect the water levels in the immediate vicinity of the drains. The overall ground-water flow pattern at the site is not significantly affected because ground-water flow at the site is controlled very strongly by the steeply sloping surface topography. The radius of influence of one horizontal drain is believed to be approximately 40 feet.

Approximately 24 pounds (2 gallons) of TCE was removed by the horizontal drains between August 1993 and December 1994. The mass of TCE removed represents less than one percent of the total mass of TCE estimated at the site (There is approximately 8,800 pounds of TCE in the ground water and soil at OU 4). Therefore, the technology is not very efficient for contaminant removal, as would be expected for a conventional ground-water extraction remedy. The horizontal drains appear to have had minimal impact on the contaminant levels in vertical monitoring wells surrounding the drains. Contaminant concentrations in the ground water extracted from the drains also appear to have remained fairly constant during the period of operation. It is likely that the contaminant levels have remained constant because the extracted ground water is being replaced by contaminated ground water from upgradient.

Results of the horizontal drain performance evaluation indicate that horizontal drain performance is limited by vertical flow of ground water into the drains. Therefore, contaminant capture efficiency can be maximized by installing the drains with their screened intervals intersecting the most highly contaminated ground water, which is in the upper 20 feet of the saturated zone. Drain efficiency may be increased in situations where there are large distances between contaminated ground water and the drains by enhancing vertical flow of contaminated ground water. Horizontal drain efficiency also can be maximized by installing the drains so that their screened intervals are entirely

submerged below the water table to minimize outflow from the drains into the surrounding soils. Operation and maintenance requirements can be minimized by designing the drains to minimize plugging with fines or biological growth.

A preliminary slope stability evaluation was conducted because OU 4 is included in an area mapped as part of the South Weber Landslide Complex. The slope stability evaluation included surface and subsurface observations, geotechnical sampling, and monitoring of slope inclinometers. There was no evidence of large-scale historical landslides in soil borings drilled to depths of 80 feet, below the anticipated depth of potential landslide planes. Conditions representative of landslide debris were not observed. Slope inclinometer monitoring has revealed no evidence of slope movement during the monitoring period. Because the South Weber Landslide Complex does not appear to have a significant affect on contaminant migration at OU 4, additional slope stability analyses are not recommended at this time.

An updated interpretation of the hydrogeology at OU 4 was prepared based upon historical and recently-obtained field data. The evaluation indicates that contaminated ground water at OU 4 flows primarily along the upper 20 feet of saturated sediments in an erosional veneer along the upper portion of the escarpment that extends off Base. Although there is a driving force for downward vertical migration of contaminants from the upper to the lower portion of the shallow aquifer along the escarpment, contaminant migration appears to be limited by the low vertical hydraulic conductivity of the sandy clay comprising the aquifer. There has been no evidence of downward vertical migration of TCE during ground-water sampling conducted from 1989 to 1994. The TCE plume does not appear to have expanded areally over the past 5 years, and TCE concentrations in the ground water appear to have remained fairly constant. Reasons the plume has not expanded may include low ground-water velocities, evapotranspiration of contaminants when ground-water surfaces as seeps, attenuation due to dispersion and/or degradation, and stratigraphic or hydraulic barriers to flow of contaminated ground water.