Executive Summary

Introduction

This document presents the *Monitoring Well Installation and Impact Assessment of South Weber No. 2 Report* for Hill Air Force Base (HAFB) Operable Unit 1 (OU1). South Weber No. 2 is a municipal water supply well operated by the Weber Basin Water Conservancy District, and was recently found to contain petroleum-based compounds from samples within the well casing. The purpose of the monitoring wells installation is to acquire groundwater samples from the water-bearing zones to evaluate the source of the contamination, assess the lithology of the soil materials adjacent to South Weber No. 2, and estimate the potential for OU1 contamination to migrate to the depths of the production zones of South Weber No. 2.

Site Background

South Weber No. 2 supplies water for domestic use to residents of the City of South Weber and surrounding areas. The well is located at the southern end of 850 East in the City of South Weber, Utah. On September 29, 1996, the submersible pump motor in South Weber Well No. 2 failed, and the customers of the City of South Weber drinking water system complained of an oily petroleum hydrocarbon odor in their drinking water. The submersible pump and motor were subsequently removed for repairs, and oil was observed floating on top of the water column in the well. The oil was bailed from the well and the submersible pump and motor were reinstalled in the well. The well was tested for contamination. No contamination was observed and the well was put on line. On August 19, 1997, a "slight odor of oil" was observed emanating from the well, and oil was noted on water produced from the well during flushing. The submersible pump motor subsequently failed, and petroleum based Volatile Organic Compounds (VOCs) were detected in samples collected from water in the discharge piping from the well (Weston, 1997). The well was taken offline pending further investigation.

South Weber No. 2 is located within the aerial extent of the OU1 shallow, off-Base groundwater plume. The source of the groundwater contamination within the shallow, off-Base groundwater plume consists of primarily cis 1,2-Dichloroethene (DCE). The contamination emanates from on-Base source areas.

Field Procedures

Five monitoring wells were installed using a hollowstem auger and rotary wash drilling rig. The shallow monitoring wells were drilled to depths of 69, 114, and 137 feet below the ground surface (bgs). The deep monitoring wells were drilled to depths of 200 and 453 feet bgs. A continuous core and a continuous log to the total depth of the boring was obtained. Geotechnical soil samples were obtained and analyzed for soil type and vertical permeability. A monitoring well was installed in each boring. Two-inch monitoring wells were installed to depths of 66, 109, 132, and 195 feet bgs. A five-inch monitoring well was installed to a depth of 450 feet. The 5-inch monitoring well was installed in the top of the

production zone of South Weber No. 2. A conductor casing was installed in the well to a depth of 140 feet bgs to protect the groundwater aquifer from surface contamination. Dedicated sampling pumps were installed in all of the monitoring wells. The monitoring wells were developed by surging, bailing, and pumping and sampled for VOCs and Semi-Volatile Organic Compounds (SVOCs).

Regional Hydrogeology

A majority of the domestic and municipal water supply used in this the area is obtained from the Delta and Sunset Aquifers. The tops of these principal aquifers occur at depths of between 200 and 400 feet and 500 and 700 feet. The Delta Aquifer is the most productive aquifer in the area and is the aquifer most often tapped by high-discharge wells. The aquifers primarily consists of extensive sequences of coarse-grained sediments interbedded with fine-grained sediments that were deposited by the ancestral Weber River. Fine-grained sediments overlie the aquifers.

Shallow, unconfined water-bearing zones are also present in floodplain deposits along stream channels, in isolated coarse-grained sediments, and regionally in the valley lowlands within a few feet of the ground surface. Recharge to shallow water-bearing zones in the HAFB area is by seepage from the Weber River, canals, and small streams, infiltration of precipitation, and excess irrigation water. Some portions of the shallow, unconfined water-bearing zones at HAFB have been contaminated and are the focus clean-up efforts. The shallow unconfined water-bearing zones tend to have very low yields and are not considered aquifers.

The deep confined aquifer recharge area is confined to an area ½ to 1-mile from the mountain front. Finer-grained sediments are observed ½ to 1-mile from the mountain front and the aquifers become confined. Finer-grained materials begin to predominate toward the center of the valley. Over the region, groundwater generally moves from recharge areas along the front of the Wasatch Range west and southwest to discharge areas in topographically low points near the Great Salt Lake.

South Weber No. 2 Geology

Continuous cores from the borings adjacent to South Weber No. 2 were used to describe geologic and hydrogeologic conditions at the site. Figure ES-1, presents a cross-section of the geologic conditions at South Weber No. 2. The geologic units identified in the general area of South Weber No. 2 include the sand, sand/clay, and basal clay units of the Alpine Formation, silty sands and gravels of an unnamed formation, and sands and gravels of the groundwater aquifer. The Alpine Formation consists of unsaturated, fine-grained materials ranging from clay to silty sand. The Alpine Formation extends from the ground surface to 263 feet bgs. Groundwater is found along thin, fine to medium grained sand layers. Four water-bearing zones were identified in the Alpine Formation. Monitoring wells were installed in each of these water-bearing zones.

Geotechnical testing of the finer-grained materials indicate the vertical permeability to range from 3.3×10^{-7} to 8.7×10^{-9} centimeters per second (cm/sec). Results of these tests indicate that the finer grained materials have very low permeabilities and will act as confining layers to the prevent or limit downward migration of groundwater.

The underlying Unnamed Formation is composed of gravel and boulder materials from 263 to 334 feet bgs. This layer is assumed to be saturated. The boulders and gravels overlie a silty sand material from 334 to 404 feet bgs. The silty sand materials are partially saturated. Vertical permeability testing of the silty sand material was found to be 6.8×10^{-6} cm/sec. The Unnamed Formation overlies the groundwater aquifer. The groundwater aquifer was encountered at a depth of 404 feet bgs and is composed of sand with boulders and gravels. The groundwater aquifer is fully saturated with the static groundwater table rising to 271 feet bgs.

Results of Groundwater and South Weber No. 2 Casing Fluid Analysis

Each of the monitoring wells were sampled for VOCs and SVOCs by EPA Methods SW8260 and SW8270 and water-quality parameters. Table ES-1 summarizes the detected compounds observed in the groundwater samples.

Contamination consisting of 1,1-Dichloroethane, DCE, trans-1,2-Dichloroethene, 1,1,1-Trichloroethane (TCA), and Trichloroethene (TCE) was detected in the samples from Monitoring Well U1-193. Monitoring Well U1-193 was screened from 46 to 66 feet bgs. The DCE and TCE contamination levels exceeded the Maximum Contamination Levels (MCLs) for these compounds. Contamination consisting of DCE and TCE was also observed in Monitoring Well U1-194 screened from 99 to 109 feet bgs. The TCE contamination level is above the MCL for TCE. These contaminants and the concentrations are consistent with other monitoring wells screened in the same water-bearing zone in this area. A trace of DCE was observed in Monitoring Wells U1-198, screened from 122 to 132 feet bgs. The contamination level is well below MCL for DCE.

No contamination was detected in the deeper monitoring wells U1-196, screened from 175 to 195 feet bgs, or monitoring well U1-197, which is screened from 430 to 450 feet bgs and is directly above the first intake point of South Weber No 2. A duplicate sample also confirmed the lack of groundwater contamination.

No sheens or floating oil were observed in any of the monitoring wells adjacent to South Weber No. 2.

Fluids in the South Weber No. 2 well casing were also sampled as part of this investigation to assist in the determination of the source of contamination. Oil floating in the casing was sampled for VOCs and SVOCs. The sample was collected by bailing and it was noted that there was approximately six inches of oil floating on top of water in the well casing. Results of the detected compounds are presented in Table ES-2. Results indicate detection of VOCs typically associated with fuels and lubricants. None of the compounds common to the OU1 plume in this area were detected in the sample from South Weber No. 2.

The type of compounds and concentrations in South Weber No. 2 were also compared with the results from the source area for OU1. As shown on Table ES-2, the results from South Weber No. 2 contain very high levels of compounds indicating a free-product phase. Free product beneath the source area, as shown on Table ES-2, contains three of the same compounds as detected in South Weber No. 2. The OU1 source is mainly composed of chlorinated solvents and fuel-type products. Additional comparison shows that South Weber No. 2 contains several other VOCs that were not detected in the source area. The free product in South Weber No. 2 appears to be light oil and lacks chlorinated solvents.

Given distance from the OU1 source area, differences in comparisons of the free product found in the source area to that of South Weber No. 2, differences in the compounds found in the OU1 plume and those found in South Weber No. 2 and finally the lack of contamination found in the deeper adjacent monitoring wells, it is unlikely that the compounds found in South Weber No. 2 are related to the OU1 source or groundwater plume.

Contamination Transport Modeling

To evaluate the potential for contaminates to migrate vertically from the plume to the production zones of South Weber No. 2 a modeling study was performed to simulate the transport of DCE. The model incorporated data collected from the continuous cores and the results of the geotechnical testing. The model simulated vertical migration for 200 years into the future using the maximum detected chemical concentrations observed in the adjacent shallow monitoring wells. Model results indicated that the contaminants would not migrate to the production zones within the 200-year period. The model showed that it would take 133 years for DCE to migrate approximately 330 feet and the concentration at that time and depth would be approximately 0.007 parts per billion. The MCL for DCE is 70 ppb. The model result is four orders of magnitude below the MCL and at such a low concentration that it would not be detectable by most current analytical methods.

Chemical waste disposal at OU1 was believed to started around the 1950's, this would allow a maximum of approximately 50 years for contaminate migration. Data collected from the monitoring wells adjacent to South Weber No. 2 shows that contamination has not migrated beyond approximately 175 feet deep. Given the field data, the results of the modeling effort and the depth to the production zone it is unlikely that contaminants have migrated vertically and caused the contamination in the South Weber No. 2 well casing.

Conclusions

Based on the results of this investigation, the following conclusions are made:

- Based on the results of coring and geotechnical testing significant layers of fine-grained materials with very low vertical permeabilities overlies the groundwater aquifer.
- Due to the significant fine-grained layers that exist at this location, the groundwater aquifer is considered confined and these low permeability layers likely prevent or limit to vertical migration of groundwater or contamination. As a result of these fine-grained layers this area is not a recharge zone to the drinking water aquifer.
- Results of the sampling of monitoring wells directly adjacent to South Weber No. 2 indicate that contamination has not migrated beyond a depth of 175 feet.
- The comparison of types and concentrations of compounds in South Weber No. 2 to the adjacent monitoring wells indicate that South Weber No. 2 is composed of distinctly different compounds and significantly higher concentrations. Comparisons of the compounds in the South Weber No. 2 and those in the source area for OU1 were also made and indicate that the contamination in South Weber No. 2 is comprised of compounds not found in the source area. Results also indicate the fluids found in the

well casing are likely free phase light oil. Given these results it is unlikely that the compounds that the fluids found in the well casing in South Weber No. 2 are related to the OU1 source area or groundwater plume.

- The compounds found in the oil in the well casing of South Weber No. 2 is similar to the compounds detected in samples collected from the submersible pump after failure. Interviews and results supplied by the pump manufacturer indicate that the initial oil in the pump was "food grade" and did not contain any of the compounds found in the samples collected by the Weber Basin Water Conservancy District. Differences between the two samples are likely the results of pump failure and subsequent intake of the oil floating in the well casing through the pump equalization tubes. Differences could also be attributed to sampling technique and the possible contamination of the pump oil by pulling the pump through the floating oil layer in the casing.

- A fate and transport model was used to evaluate the potential for contaminates to migrate vertically from the plume to the production zones of South Weber No. 2. Results of the modeling effort indicate that contaminants would not migrate into the production zone within the simulated 200-year period.