

# Ground-Water Monitoring in the Area of Operable Unit 4, Hill Air Force Base, Utah, October 1996 through September 1997, Volume IV

## EXECUTIVE SUMMARY

### Introduction

In March 1991, the U.S. Geological Survey (USGS), in cooperation with Hill Air Force Base (AFB), initiated a monitoring program to determine the spatial and temporal changes in concentrations of contaminants detected in the shallow ground water in the area of Operable Unit 4 (OU 4) on the north side of Hill AFB. The need for the monitoring program was recognized during a Remedial Investigation (RI) of contamination in the area of OU 4 during 1988-92 by the USGS. The monitoring program was planned for an indefinite period depending on the behavior of the contaminants during and following remediation. This report is the fourth in a series of annual reports that describe the results of the monitoring program.

Hill AFB is located in northern Utah, about 25 mi north of Salt Lake City and about 5 mi south of Ogden. Hill AFB covers about 6,700 acres and is located on the Weber Delta, a terrace about 300 ft above the valley floor in Weber and Davis Counties. Landfills 1 and 2, the North Gate Dump areas, Munitions Dump, and Spoils area are in OU 4. The study area includes these sites and the area immediately surrounding these sites. Evaluations of data collected during 1988-92, contained in the Remedial Investigation Report for Operable Unit 4 (U.S. Geological Survey, 1992, referred to in this report as the RI report), and the Addendum to the Remedial Investigation Report for Operable Unit 4 (U.S. Geological Survey, 1993, referred to in this report as the Addendum report), indicated that Landfill 1, which covers about 5 acres, was the most probable source area for trichloroethylene (TCE) and other contaminants found at the site.

### Problem

During the RI, 13 volatile organic compounds (VOCs), 2 suspected inorganic contaminants (sulfate and nitrate), and 14 trace elements were detected in shallow ground water at OU 4. TCE was the VOC detected most frequently and in the highest concentrations, as concluded in the Addendum report. Sulfate and nitrate were suspected contaminants because their concentrations were higher in ground water contaminated by TCE than in nearby areas not contaminated by TCE. Plumes of TCE and sulfate were detected in shallow ground water throughout a large part of OU 4. No contamination was detected in the underlying aquifers used for public water supply. OU 4 is adjacent to several residences that use water from aquifers underlying the contaminated shallow ground water.

Remediation was begun in 1993 by installing horizontal drains and treating the outflow to remove the TCE. Determining the effects of remediation on contaminant behavior at OU 4 was complicated by climatic variations and by the relining of the Davis-Weber Canal, both of which affect recharge to the shallow ground-water system. Water-quality monitoring is needed to maintain a current assessment of the nature and extent of contamination and to evaluate the effects of remediation procedures.

## **Purpose and Scope**

This report evaluates and describes the spatial occurrence and temporal behavior during 1996-97 of the chemicals that are discussed in the "Problem" section, including the plumes of TCE and sulfate. Changes in contaminant concentrations are discussed in relation to structural and climatic changes that affected the ground-water hydrology. Selected data collected as part of the monitoring program, as well as previous historical data, are tabulated in appendixes A-E.

## **Ground-Water Quality**

The ground-water-quality data collected during the 1997 water year were examined to determine (1) if previously undetected contaminants were present in water from any of the wells, and (2) the spatial and temporal behavior of contaminants that had been previously identified in the RI and Addendum reports. Water-quality data collected from 1986-97 for the monitoring wells included VOCs, major inorganic ions, selected trace elements, and field measurements and are listed in appendixes B, C, D, and E.

In the 1997 water year (October 1996 to September 1997), 36 wells were sampled and analyzed at least once for VOCs (appendix B). TCE, cis-1,2-dichloroethylene (c-1,2-DCE), trans-1,2-dichloroethylene (t-1,2-DCE), and total-1,2-dichloroethylene were each detected in at least one sample. The concentration of TCE exceeded the Maximum Contaminant Level (MCL) of 5 mg/L in water from 21 wells, and concentrations were less than the MCL in water from the other 15 wells. Temporal changes in TCE concentrations in water from selected wells are shown in figure ES-1.

Water levels in some of the monitoring wells responded to the greater-than-average precipitation in 1997. Precipitation during the 1997 water year was about 26.05 in., or 134 percent of the 1979-97 average.

Water samples were collected and analyzed for selected trace elements in wells where concentrations of trace elements previously exceeded MCLs. Water from wells with trace-element concentrations exceeding MCLs during 1989-1996 continued to have concentrations greater than the MCLs in the 1997 water year.

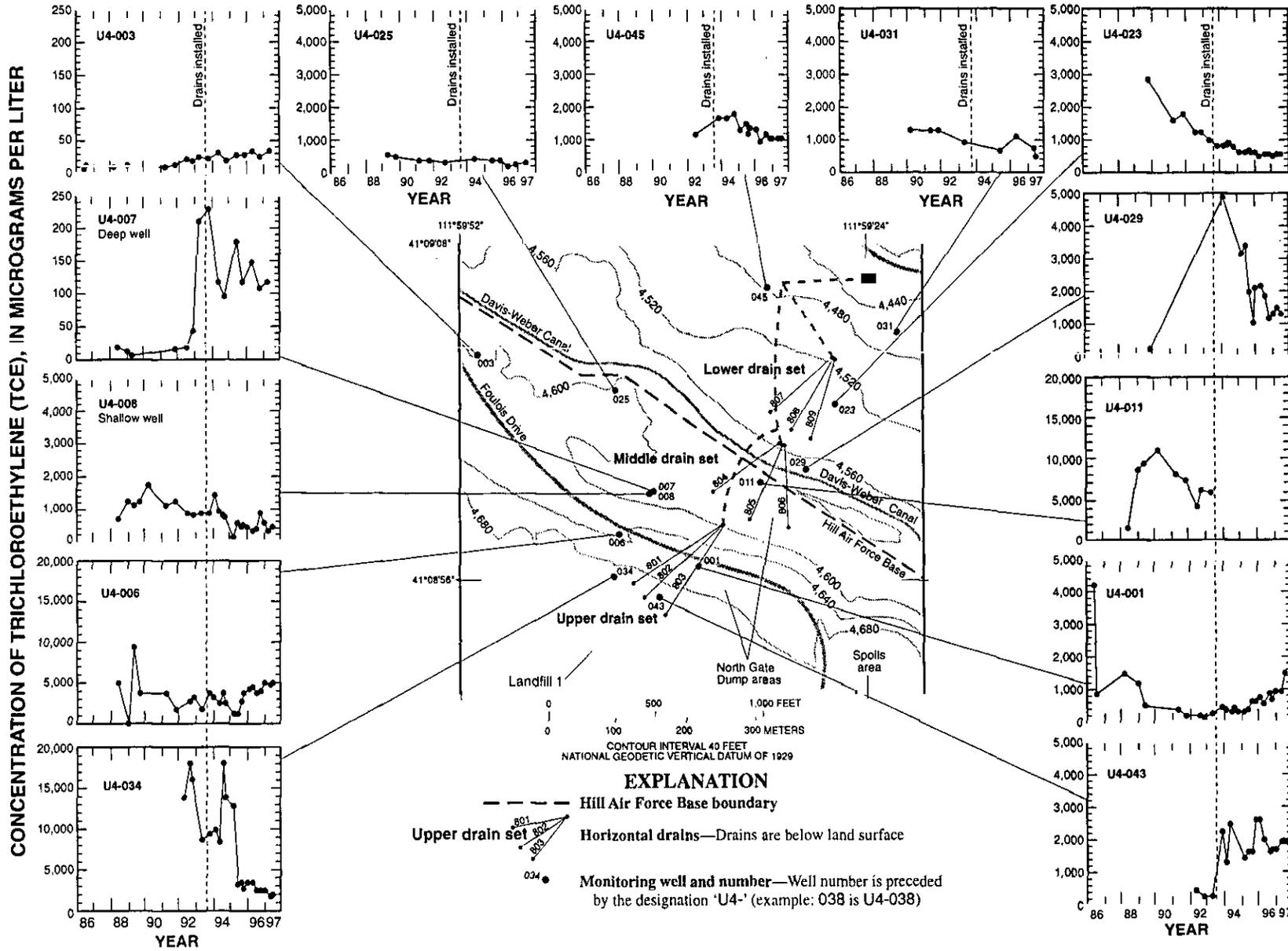


Figure ES-1. Location of selected wells and horizontal drains and concentrations of trichloroethylene in water from selected wells in the area of Operable Unit 4, Hill Air Force Base, Utah, January 1986 to September 1997.

Water from 34 wells was sampled and analyzed for sulfate during the 1997 water year. The sulfate plume during 1997 was represented by concentrations greater than 100 mg/L, except the area surrounding wells U4-021 and U4-022, which had maximum sulfate concentrations of 75.6 mg/L and 78.3 mg/L, respectively.

Only one of the four sets of clustered wells selected for monitoring showed evidence of increased sulfate concentration in water from the deeper well. Well U4-033 is screened about 18 ft below the bottom of the screen of the shallower well, U4-043. In 1993, after the drains were installed, the sulfate concentrations in water from both of these wells increased. Sulfate concentrations in water from both wells remained relatively constant during 1994-97.

Most of the changes in the areal extent of the sulfate plume likely are caused by the drains that were installed during July and August 1993 as part of remediation and to a lesser extent by variations in precipitation. The maximum concentrations of sulfate in water from selected wells for the 1996 water year were compared to the maximum concentrations of sulfate for the 1997 water year. This comparison shows that sulfate concentrations increased in water from 8 wells, decreased in water from 13 wells, and remained the same in water from 1 well.

### **Suggestions for Monitoring**

The wells suggested for monitoring of water quality and water levels at OU 4 are listed in table ES-1. After each round of sampling, the data need to be reviewed to determine if changes have occurred that might necessitate revision of the monitoring program. Suggestions for revision of the monitoring program in 1997-98 include the addition of well U4-028 to the monitoring list. It is suggested that this well be sampled semiannually to further define the TCE concentration within the plume and to help define the area where the sulfate concentration exceeds 100 mg/L in that part of the study area. Of the nine new wells drilled by Montgomery Watson, Consulting Engineers, Incorporated (MW) in the fall of 1996, it is suggested that three wells be sampled annually for VOCs only (wells U4-066, U4-068, and U4-070). It is suggested that the remaining six wells (U4-067, U4-069, U4-070, U4-072, U4-073, and U4-074) be sampled semiannually for the entire list of constituents. In addition, it is suggested that arsenic be analyzed in samples from wells U4-067 and U4-074. It is also suggested that water levels from wells where water-quality samples are currently collected be measured quarterly and water levels from all other wells at OU4 be measured in July.

**Table ES-1. Wells suggested for continued monitoring of water quality at quarterly, semiannual, or annual intervals and continued monitoring of water levels at quarterly intervals in the area of Operable Unit 4, Hill Air Force Base, Utah**

[Unless otherwise noted, each sample analysis will include the following schedules: volatile organic compounds (SW8240), selected anions (A429 includes chloride, fluoride, sulfate, nitrate, and orthophosphate), total alkalinity (A403), nitrate + nitrite (E353.2), and selected inorganic constituents (SW6010 includes calcium, magnesium, potassium, silica as SiO<sub>2</sub>, sodium, boron, and others as requested); Quarterly sampling: summer and winter sampling of these wells should include only analyses of volatile organic compounds]

Quarterly sampling (spring, summer, fall, winter)	Semiannual sampling (spring, fall)	Annual sampling (spring)
<b>Upgradient from Davis-Weber Canal</b>		
U4-001	U4-003	U4-017
U4-006	U4-005	U4-018
U4-008	U4-007	<sup>1</sup> U4-037
<sup>2</sup> U4-011	<sup>3</sup> U4-025	<sup>1</sup> U4-039
<sup>4</sup> U4-034	U4-033	<sup>1</sup> U4-070
<sup>4</sup> U4-043	<sup>5,6</sup> U4-035	
	U4-036	
	U4-070	
	U4-072	
	U4-073	
	<sup>5</sup> U4-074	
<b>Downgradient from Davis-Weber Canal</b>		
U4-023	<sup>7</sup> U4-015	U4-013
U4-029	U4-016	U4-014
U4-045	U4-021	<sup>1</sup> U4-066
<sup>8</sup> U4-031	U4-022	<sup>1</sup> U4-068
	U4-028	
	<sup>5</sup> U4-067	
	U4-069	
	U4-203	
<b>Weber River flood plain</b>		
	U4-012	
	<sup>5</sup> U4-041	
	<sup>5</sup> U4-042	

<sup>1</sup> Sample for VOCs only.

<sup>2</sup> Currently (1997) not enough water in well to collect a sample.

<sup>3</sup> Add selenium (SW7740).

<sup>4</sup> Add lead (SW7421).

<sup>5</sup> Add arsenic (SW7060).

<sup>6</sup> Sample for selected inorganic constituents (SW6010) only.

<sup>7</sup> Currently (1997) not able to collect sample.

<sup>8</sup> Usually only enough water in well to sample once or twice a year.