

Ground-Water Monitoring in the Area of Operable Unit 4, Hill Air Force Base, Utah, 1995-96, Volume III

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 third 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 are 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. The evaluations indicate 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 concentra-

tions 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 1995-96 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 1996 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 during 1986-96 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 1996 water year (October 1995 to September 1996), 46 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 chloroform were each detected in at least one sample. The concentration of TCE exceeded the Maximum Contaminant Level (MCL) of 5 µg/L in water from 27 wells, and concentrations were less than the MCL in water from the other 19 wells. Temporal changes in TCE concentrations in water from selected wells are shown in figure ES-1. The maximum concentrations of TCE during the 1995 water year were compared to the maximum concentrations of TCE during the 1996 water year for a subset of 24 wells. Concentrations of TCE in water from the nine wells in which the concentrations of TCE had been less than the MCL during the 1995 water year remained below the MCL during the 1996 water year. In water from the subset of wells in which the concentrations of TCE exceeded the MCL during the 1996 water year, the maximum concentrations of TCE increased in eight wells and decreased in seven wells.

Cis-1,2-dichloroethylene (c-1,2-DCE) was detected in water from 8 of the 46 wells sampled (U4-003, U4-021, U4-022, U4-031, U4-047, U4-062, U4-063, U4-064). Trans-1,2-dichloroethylene (t-1,2-DCE) was detected in water from 4 of the 46 wells sampled (U4-003, U4-021, U4-031, and U4-062). Chloroform was detected in water from 3 of the 46 wells sampled (U4-031, U4-062, and U4-064). 1,2-dichloroethane (1,2-DCA) was detected in water from 2 of the 46 wells sampled (U4-022 and U4-023). Acetone was detected in water from well U4-022 at a concentration of 160 µg/L in water year 1994 but was not detected in any wells in water years 1995 or 1996.

Results of chemical analyses indicate no change in areal extent of the TCE plume during 1995-96. Additional wells were sampled in 1996 to better define the boundary of the TCE plume. This additional control resulted in a slight revision of the boundary because TCE was detected in a well along the 1995 plume boundary. Within the plume, considerable change in TCE concentration has occurred since 1995.

Four sets of paired wells were included in the monitoring program to determine if TCE or other contaminants were migrating deeper into the ground-water system. Only one set of the four pairs, U4-007 and U4-008, showed evidence of deeper migration of TCE. In December 1992, the TCE concentration in water from well U4-007, which is screened about 6.3 ft below well U4-008, began increasing and reached a maximum of about 230 µg/L in the sample collected during November 1993. The migration of TCE downward to water in

well U4-007 may have resulted from reversal of the hydraulic gradient during spring 1993. The maximum TCE concentration in water from well U4-007 in the 1996 water year was 150 µg/L. The deeper migration of TCE to water in well U4-007 indicates the importance of maintaining the hydraulic gradient upward to prevent deeper movement of contaminants in ground water at OU 4. The reason for the deeper migration in water from well pair, U4-007 and U4-008; and not in the upgradient well pair, U4-005 (the deeper well) and U4-006 (the shallower well), is not known.

TCE concentrations in water from well U4-034 decreased from 14,000 µg/L to 3,300 µg/L during the 1995 water year and increased from 2,600 µg/L to 3,400 µg/L during the 1996 water year. This decrease and concurrent increase in TCE concentrations in water from well U4-001 indicates that the upper drain set may be affecting the TCE source in Landfill 1.

Water levels in some of the monitoring wells responded to the less-than-average precipitation in 1996. Precipitation during the 1996 water year was about 13 in., or 66 percent of the 1979-96 average.

Water samples were collected and analyzed for selected trace elements in wells where trace elements previously had exceeded MCLs. Water from wells with trace-element concentrations exceeding MCLs during 1989-95 continued to have concentrations above MCLs in the 1996 water year.

Water from 48 wells was sampled and analyzed for sulfate during the 1996 water year. The sulfate plume during 1996 was represented by two areas of concentration above 100 mg/L, instead of one area. Sulfate concentrations decreased below 100 mg/L in water from well U4-022 in 1996.

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 1994-96.

Most of the changes in the areal extent of the sulfate plume are likely 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 were compared for the 1995 water year to maximum concentrations of sulfate for the 1996 water year. Concentrations increased in water from 10 wells and decreased in water from 11 wells.

During April and May 1996, additional field measurements were taken at OU 4, which included redox potential, and concentration of dissolved oxygen

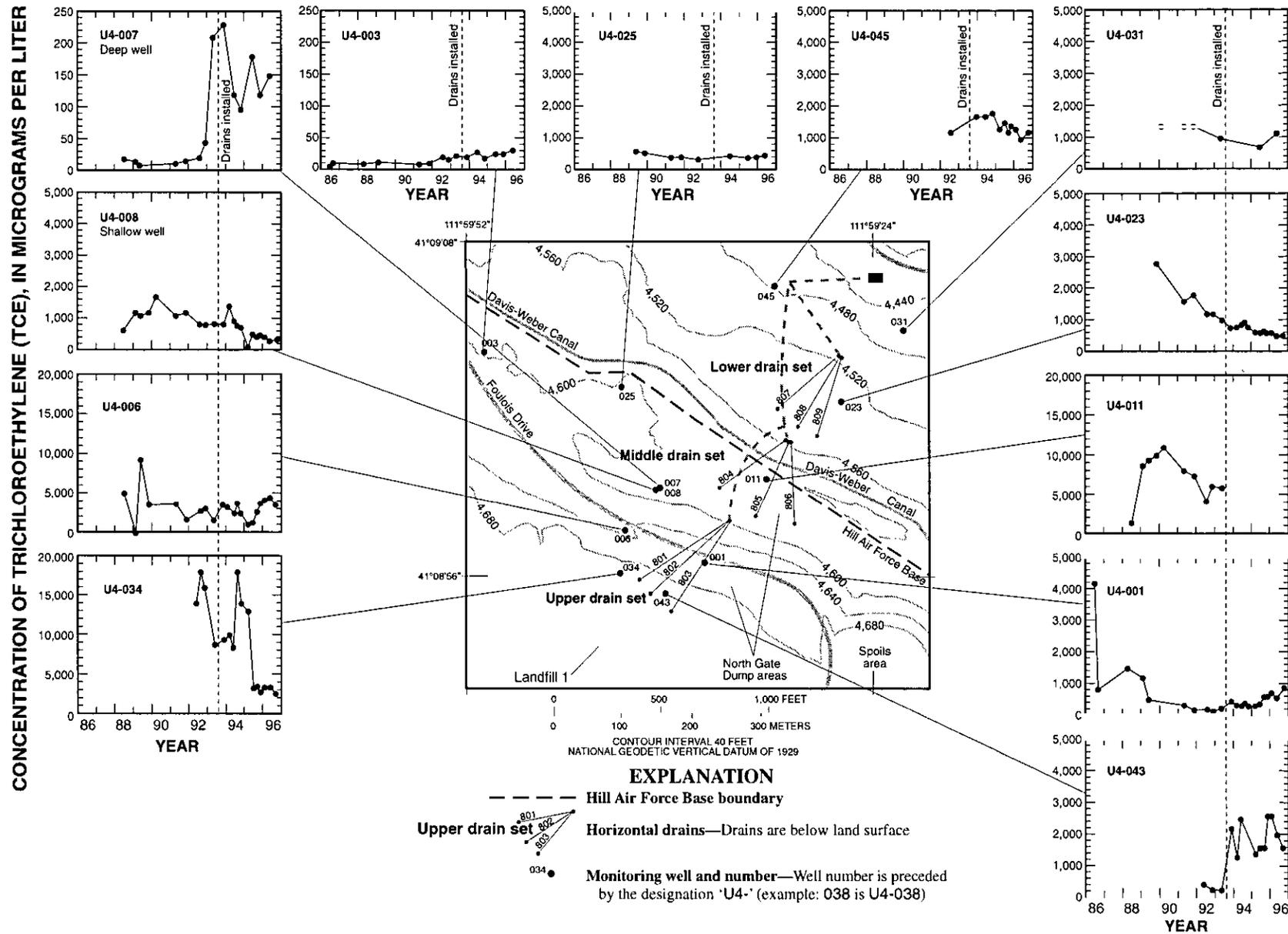


Figure ES-1. Location of selected wells and horizontal drains and concentrations of trichloroethylene in water from selected wells in the area of Operable Unit 4, Hill Air Force Base, Utah, January 1986 to September 1996.

and ferrous iron. Redox potentials generally are higher in recharge areas such as Landfill 1 and lower in discharge areas such as the flood plain.

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 1995-96 include addition of wells U4-037 and U4-039 to the monitoring list. These wells need to be sampled annually for VOCs to ensure that the southwestern part of the TCE plume has remained stable. Semiannual monitoring of 10 new wells drilled by Montgomery Watson, Consulting Engineers, Incorporated in the fall of 1996 is currently being done. Future monitoring of these wells will depend on the results obtained during the 1997 water year. Water levels from all monitoring wells need to be measured quarterly.

Table ES-1. Wells suggested for continued monitoring of water quality at quarterly, semiannual, or annual intervals and water levels measured 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 SiO₂, 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)
Upgradient from Davis-Weber Canal		
U4-001	U4-003	U4-017
U4-006	U4-005	U4-018
U4-008	U4-007	¹ U4-037
² U4-011	³ U4-025	¹ U4-039
⁴ U4-034	U4-033	
⁴ U4-043	^{5,6} U4-035	
	U4-036	
Downgradient from Davis-Weber Canal		
U4-023	⁷ U4-015	U4-013
U4-029	U4-016	U4-014
U4-045	U4-022	
U4-031	U4-021	
	U4-203	
Weber River flood plain		
	U4-012	
	⁵ U4-041	
	⁵ U4-042	

¹ Sample for VOCs only.

² Currently (1996) not enough water in well to collect a sample.

³ Add selenium (SW7740).

⁴ Add lead (SW7421).

⁵ Add arsenic (SW7060).

⁶ Sample for selected inorganic constituents (SW6010) only.

⁷ Currently (1996) not able to collect sample.