Well-Construction, Water-Level, and Water-Quality Data for Ground-Water Monitoring Wells for the J4 Hydrogeologic Study, Arnold Air Force Base, Tennessee

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Open-File Report 95-763

Prepared in cooperation with the

UNITED STATES AIR FORCE,
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U.S. DEPARTMENT OF THE INTERIOR
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By CONNOR J. HAUGH

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Nashville, Tennessee
1996

U.S. DEPARTMENT OF THE INTERIOR

BRUCE BABBITT, Secretary

U.S. GEOLOGICAL SURVEY

Gordon P. Eaton, Director

For addtional information write to:

District Chief

U.S. Geological Survey

810 Broadway, Suite 500

Nashville, Tennessee 37203

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CONVERSION FACTORS, VERTICAL DATUM, AND SITE-NUMBERING SYSTEM

Multiple	By	To obtain
inch (in.)	25.4	millimeter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
acre	4,047	square meter
acre	0.4047	hectare
square mile (mi^2)	2.590	square kilometer
gallon per minute (gal/min)	0.06308	liter per second

Temperature in degrees Celsius (°C) can be converted to degrees Fahrenheit (°F) as follows:

$$°F = 1.8 \times °C + 32$$

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)—a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

Site-numbering system: The U.S. Geological Survey assigns each site listed in this report a local Tennessee well number and a station identification number. The local well number is used as a concise label for a site. The station identification number is used as an identifier for site data stored in the national computer data base of the U.S. Geological Survey. These numbering systems are used in addition to the well numbers assigned by Arnold Engineering Development Center.

The local well number in Tennessee consists of three parts: (1) an abbreviation of the name of the county in which the well is located, (2) a letter designating the 7 1/2-minute topographic quadrangle on which the well is plotted, and (3) a number generally indicating the numerical order in which the well was inventoried. The symbol Cf:G-010, for example, indicates that the well is located in Coffee County on the "G" quadrangle and is identified as well 10 in the numerical sequence. Quadrangles are lettered from left to right, beginning in the southwest corner of the county.

The station identification number is a unique number for each site based on a latitude and longitude grid system. The number consists of 15 digits. The first 6 digits denote the degrees, minutes, and seconds of latitude; the next 7 digits denote degrees, minutes, and seconds of longitude; and the last 2 digits (assigned sequentially) identify the wells within a 1-second grid.

Well-Construction, Water-Level, and Water-Quality Data for Ground-Water Monitoring Wells for the J4 Hydrogeologic Study, Arnold Air Force Base, Tennessee

By Connor J. Haugh

EXECUTIVE SUMMARY

Between December 1993 and March 1994, 27 wells were installed at 12 sites near the J4 test cell at Arnold Engineering Development Center (AEDC) in Coffee County, Tennessee. The wells ranged from 28 to 289 feet deep and were installed to provide information on subsurface lithology, aquifer characteristics, ground-water levels, and ground-water quality. This information will be used to help understand the effects of dewatering operations at the J4 test cell on the local ground-water-flow system. The J4 test cell, extending approximately 250 feet below land surface, is used in the testing of rocket motors. Ground water must be pumped continuously from around the test cell to keep it structurally intact. The amount of water discharged from the J4 test cell was monitored to estimate the average rate of ground-water withdrawal at the J4 test cell.

The purpose of this report is to present well-construction details and water-quality sampling results for the J4 hydrogeologic study. Well-construction details for the 27 wells installed by the U.S. Geological Survey are presented. Water-quality analyses are reported for the J4 test cell ground-water discharge, 26 wells drilled for this study, and 9 pre-existing wells. Hydrographs are presented for 14 wells for the period July 1994 through June 1995. Discharge data from the J4 test cell are presented for the period October 1990 through September 1995. Rainfall data are presented for this same period.

Of the 27 wells drilled for this study, 6 of the wells were completed in the shallow aquifer, 11 were completed in the chert gravels of the upper part of the Manchester aquifer, 2 were completed in fractures in the bedrock of the lower part of the Manchester aquifer, 5 were completed in the Fort Payne aquifer, and 3 were completed in the upper Central Basin aquifer system.

Water-quality samples were collected from 26 of the new wells, 9 existing wells, and the ground-water discharge from the J4 test cell. All samples were analyzed for common inorganic ions, trace metals, and volatile organic compounds. The median dissolved-solids concentrations were 52 mg/L in the shallow aquifer, 96 mg/L in the Manchester aquifer, 240 mg/L in the Fort Payne aquifer, and 2,140 mg/L in the upper Central Basin aquifer system. Almost all of the physical properties and inorganic constituents followed a similar trend with the lowest concentrations in the shallow and Manchester aquifers and the highest concentrations in the upper Central Basin aquifer system.

Water from all of the wells completed below the Chattanooga Shale in the upper Central Basin aquifer system (AEDC-268, -277, -281, and

-175) contained significant amounts of aromatic hydrocarbons such as benzene, toluene, ethylbenzene, and xylenes (BTEX). These compounds occur naturally in association with petroleum deposits (natural gas and crude oil) and shale lithologies, as well as in many refined petroleum products.

Several wells contained water with chlorinated organic compounds such as 1,2-dichloroethane, 1,1-dichloroethylene, and trichloroethylene, which exceeded the maximum contaminant levels (MCL) for public water systems. These wells included AEDC-64, -83, -159, -269, -271, -272, -273, -274, -275, -278; the ground-water discharge from the J4 test cell also exceeded the MCL's for these same compounds. The highest concentrations were detected in well AEDC-274 with 45 μg/L 1,2-dichloroethane, 320 μg/L 1,1-dichloroethylene, and 1,200 μg/L trichloroethylene.

INTRODUCTION

Arnold Air Force Base (AAFB) occupies about 40,000 acres in Coffee and Franklin Counties, Tennessee (fig. 1). The primary mission of AAFB is to support the development of aerospace systems. This is accomplished through test facilities at Arnold Engineering Development Center (AEDC), which occupies about 4,000 acres in the center of AAFB. The J4 test cell is one of the major test facilities located at AEDC.

The J4 test cell was constructed in the early 1960's to support the testing of rocket motors. The cell is approximately 100 feet in diameter, extends approximately 250 feet below land surface, and penetrates several aquifers. Ground water is pumped continuously from around the test cell to keep it structurally intact. Because of its depth, dewatering has depressed the water levels in the aquifers around this site. Additionally, contaminants—predominately volatile organic compounds—are present in the ground-water discharge from the test cell and in ground water at several other sites within the AEDC facility. As part of the United States Air Force Installation Restoration Program (IRP), the U.S. Geological Survey (USGS), in cooperation with the U.S. Air Force and Arnold Air Force Base (AAFB), is conducting an investigation of the effect of dewatering at the J4 test cell on the local hydrology.

Objectives of the investigation are to (1) define the subsurface lithology; (2) describe the aquifer characteristics; (3) determine the shape and extent of the cone of depression that has developed by dewatering at the J4 test cell; (4) determine the potential for introducing contaminants from aquifers overlying the Chattanooga Shale, a regional confining unit, to aquifers underlying that unit; and (5) document current water-quality characteristics.

Sites were identified near the J4 test cell where data were needed. Between December 1993 and March 1994, 27 wells were drilled at 12 sites to provide information on subsurface lithology, aquifer characteristics, water levels, and ground-water quality. Three of the wells were drilled through the Chattanooga Shale to provide information on the deep ground-water system.

Purpose and Scope

The purpose of this report is to present well-construction details and water-quality sampling results for the J4 hydrogeologic study. Well-construction details for the 27 wells installed by the USGS are presented. Water-quality analyses are reported for the J4 test cell ground-water discharge, 26 wells drilled for this study, and 9 pre-existing wells. Hydrographs are presented for 14 wells for the period July 1994 through June 1995. Discharge data from the J4 test cell are presented for the period October 1990 to June 1995. Rainfall data are presented for this same period.

Study Area

The study area encompasses 4 mi^2 of the main testing area at AEDC (fig. 2). The J4 test cell is located on the western side of the AEDC testing facilities. The Duck River-Elk River drainage divide runs through the eastern and southern edges of AEDC testing facilities. Land-surface elevations across the AEDC testing facilities range from about 1,120 feet above sea level at the Duck River-Elk River drainage divide to about 1,030 feet above sea level at the western boundary. Just west of the J4 test cell is a large retention pond. Discharge water from J4 flows through a ditch to the retention pond.

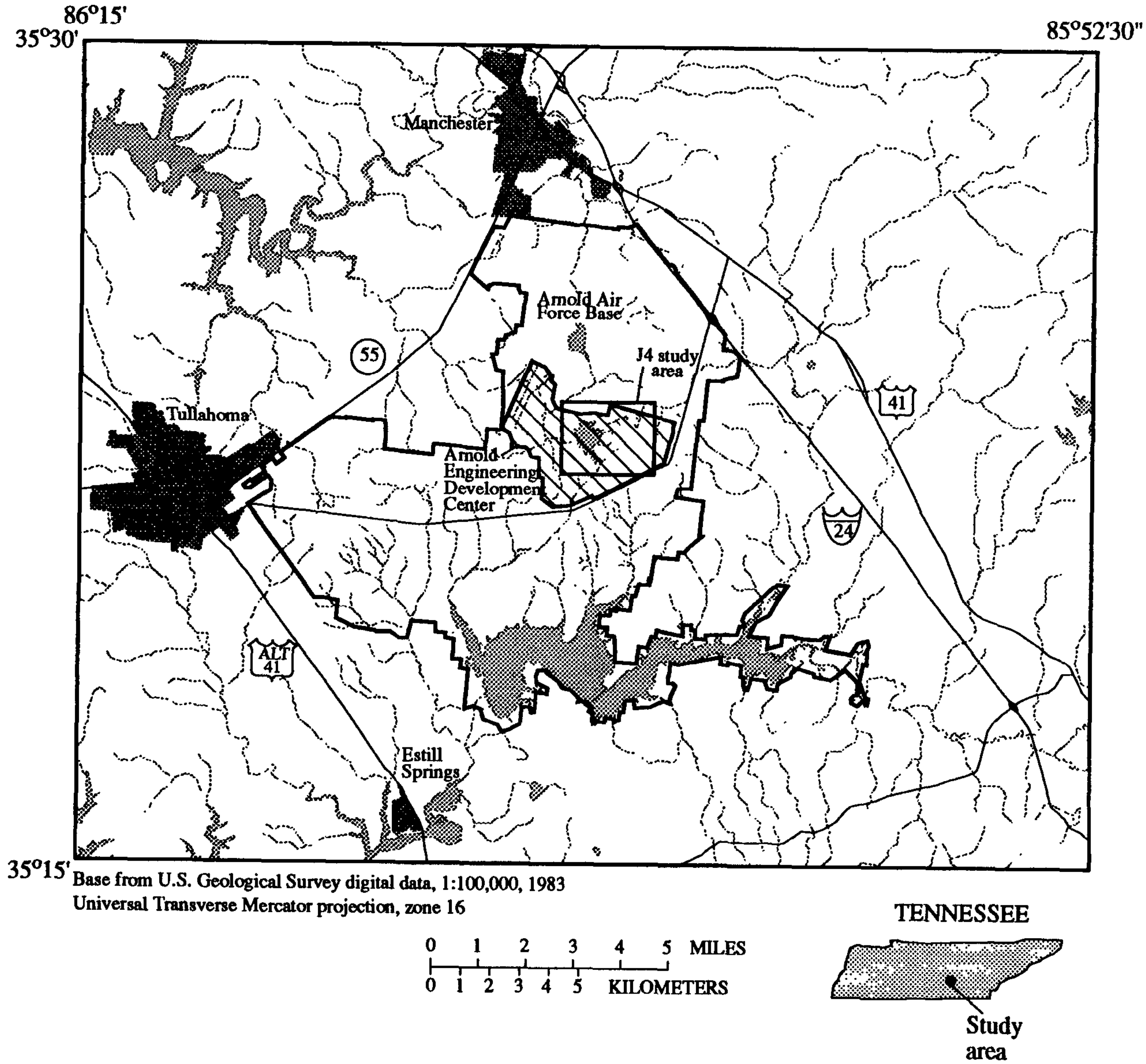
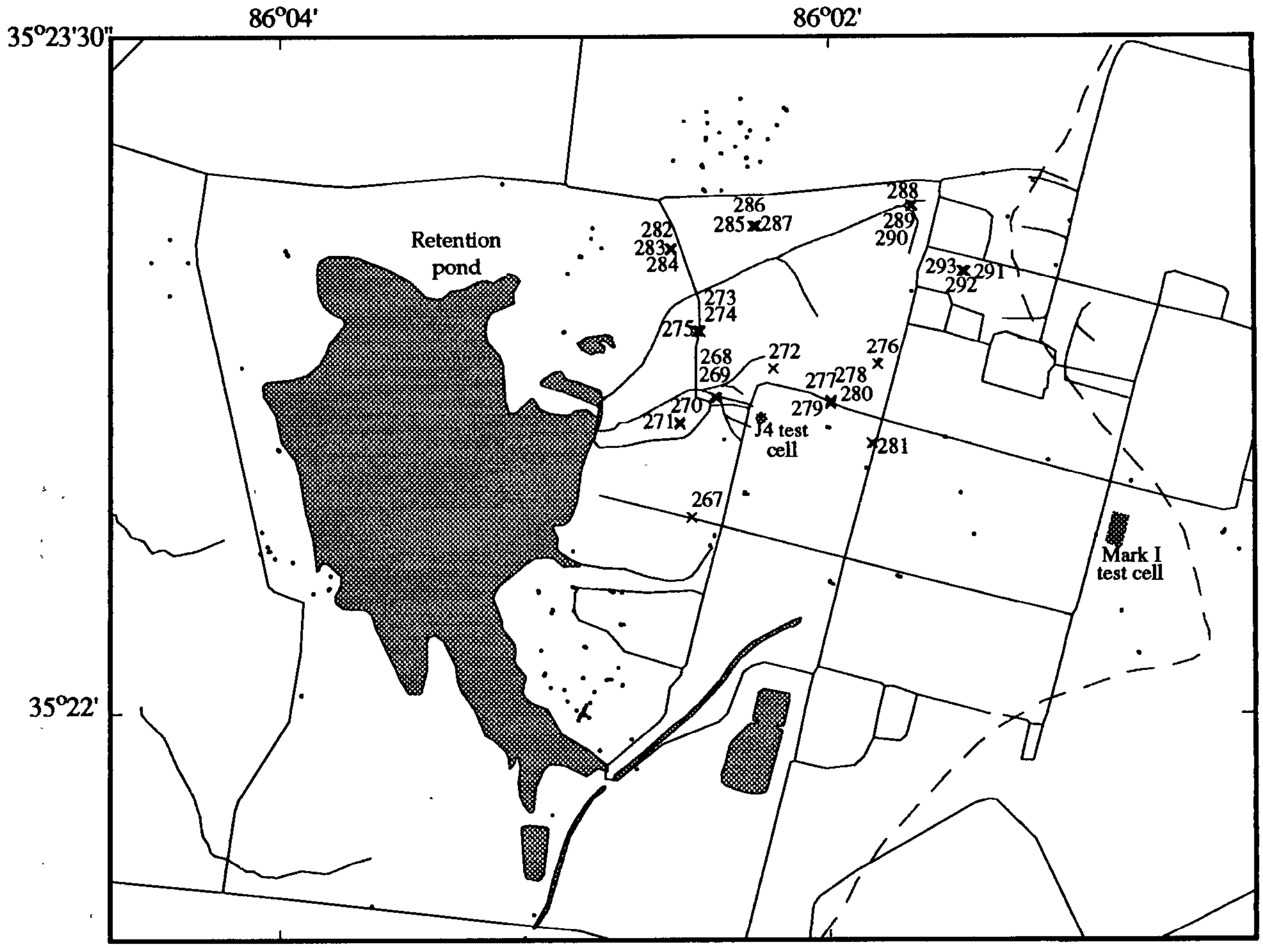


Figure 1. Location of the study area at Arnold Air Force Base, Tennessee



Base from U.S. Geological Survey digital data, 1:100,000, 1983
Universal Transverse Mercator projection, zone 16

0 1,000 2,000 3,000 FEET
0 250 500 750 METERS

EXPLANATION

- – — – DRAINAGE DIVIDE
- × 267 WELL LOCATION AND NUMBER—Well drilled for this study
- • WELL LOCATION—Well existing previous to this study

Figure 2. Study area with locations of wells installed by the U.S. Geological Survey at Arnold Engineering Development Center, Coffee County, Tennessee.

Stratigraphy	Thickness of unit, in feet	Lithology	Hydrogeologic unit	
Regolith derived from in-situ weathering of the St. Louis Limestone, Warsaw Limestone, and Fort Payne Formation	45-100	Clay, silt, and sand with some chert and rock fragments.	Highland Rim aquifer system	Shallow aquifer
		Rock fragments, chert gravel, and rubble with some clay.		Manchester aquifer, upper part
Fort Payne Formation	10-40	Fractured and solutioned, cherty limestone.		Manchester aquifer, lower part
		Dense, cherty limestone, bedded chert, and some limestone. Few fractures.		Fort Payne aquifer
Chattanooga Shale	20-25	Dark, grayish black, carbonaceous shale.	Chattanooga confining unit	
Ordovician formations, undifferentiated	Greater than 300	Limestone, generally pure, with some siltstone and calcareous shale.	Upper Central Basin aquifer system	

Figure 3. Stratigraphy, lithology, and hydrogeologic units near the J4 test cell at Arnold Engineering Development Center, Coffee County, Tennessee.

Hydrogeologic Setting

The AAFB area is covered by regolith derived from the in-situ weathering of Mississippian age carbonates (in descending order): the St. Louis Limestone, the Warsaw Limestone, and the Fort Payne Formation (Wilson, 1976). Regolith in the J4 area is typically 45 to 100 feet thick and consists primarily of clayey chert rubble with some silt and sand. Typically, the regolith grades upward from gravel-size chert rubble at the top of bedrock to clay-size chert particles with silt, sand, and clay at land surface (Burchett, 1977).

Bedrock underlying the regolith consists of the Fort Payne Formation. The Fort Payne Formation is an indurated siliceous limestone containing many chert nodules and platy chert stringers. The bedrock of the Fort Payne Formation in this area is generally 10 to 40 feet thick. The upper part of the bedrock of the Fort Payne Formation contains many fractures and solution openings.

Underlying this bedrock unit is the Chattanooga Shale. The Chattanooga Shale consists of about 22 feet of fissile, black, carbonaceous shale. Dark blue-gray, bioclastic and argillaceous limestones of Late Ordovician age underlie the Chattanooga Shale.

Several different zones or aquifers are present in the study area. The Chattanooga Shale is considered to be the base of the fresh ground-water system in the study area. The ground-water system above the Chattanooga Shale can be divided into three aquifers: the shallow aquifer, the Manchester aquifer, and the Fort Payne aquifer (fig. 3).

The shallow aquifer is described as alluvial, residual silt, clay and sand deposits, and clay-size chert particles of the upper part of the regolith. It is not continuous throughout the study area and is perched at some locations. The Manchester aquifer, the most productive of the zones, consists of chert rubble at the base of the regolith and solution openings in the upper part of the bedrock (Burchett and Hollyday, 1974). The Fort Payne aquifer corresponds to the lower part of the Fort Payne Formation bedrock where solution openings are less developed. The base of the Fort Payne aquifer is the Chattanooga Shale.

The Ordovician limestones below the Chattanooga Shale compose the upper Central Basin aquifer system. The Chattanooga Shale isolates this deeper aquifer from the aquifers above it.

WELL CONSTRUCTION

Twenty-seven wells were installed at 12 sites in the study area using standard air-rotary techniques (fig. 2). Six of the wells were completed in the shallow aquifer, 11 were completed in the chert gravels of the upper part of the Manchester aquifer, 2 were completed in fractures in the bedrock of the lower part of the Manchester aquifer, 5 were completed in the Fort Payne aquifer, and 3 were completed in the upper Central Basin aquifer system. Standard air-rotary techniques were used for drilling all wells. For wells completed in the regolith, an 8-inch-diameter borehole was drilled to the desired depth. For wells completed in bedrock, a 14-inch-diameter borehole was drilled through the regolith to a minimum of 2 feet into rock. Nominal 10-inch-diameter steel surface casing was set into rock and the base sealed with bentonite clay. The annular space was backfilled to land surface with neat cement grout. For wells completed in the bedrock of the Fort Payne Formation, the borehole was advanced with an 8-inch air hammer bit to the desired depth. For wells completed in the Ordovician limestones below the Chattanooga Shale, a 10-inch-diameter hole was drilled in bedrock with an air hammer bit to a minimum of 2 feet into the Chattanooga Shale. Nominal 8-inch-diameter steel casing was set into the Chattanooga Shale and the base sealed with bentonite clay. The annular space was backfilled to land surface with neat cement grout. The borehole was then advanced in the Ordovician limestones with an 8-inch-diameter air hammer bit to the desired depth.

Well-construction techniques used in this study followed guidelines outlined by the U.S. Environmental Protection Agency (1986) for Resource Conservation and Recovery Act (RCRA) ground-water monitoring wells. All wells were completed with 4-inch-diameter, schedule 40, threaded polyvinylchloride casing and screen. A sand pack was installed from the bottom of the borehole to a minimum of 2 feet above the top of the screen. A 2-foot thick bentonite seal was placed above the sand pack. The annulus was then grouted from the top of the seal to land surface with a neat cement grout (fig. 4). Screen lengths for the regolith wells were 10 feet. Screen lengths for bedrock wells were either 5, 10, or 20 feet. Slot sizes on all screens were 0.020 inch.

Well elevations were established from existing vertical control points by USGS personnel using standard surveying techniques. Well locations were obtained by field locating the wells on a 1:4,800 scale base map then digitizing the positions. Well-construction data are summarized in table 1. Lithologic information is summarized in table 2.

GROUND-WATER LEVELS

Depths to ground water and water-level fluctuations near the J4 test cell were determined by collection of monthly and continuous ground-water levels. Ground-water levels were measured continuously at 14 wells from July 1994 to June 1995. These wells were selected to provide water-level data from wells aerially distributed around the J4 test cell and completed in each of the aquifers. A summary of monthly values is presented in table 3. Continuous hydrographs are shown in figures 5 through 12. The data indicate that annual water-level fluctuations for wells completed above the Chattanooga Shale range from greater than 10 feet in well AEDC-275 to less than 2 feet in well AEDC-154.

Table 1. Well-construction data for wells for the J4 hydrogeologic study at Arnold Engineering Development Center, Coffee County, Tennessee

[AEDC, Arnold Engineering Development Center; USGS, U.S. Geological Survey; --, no data; SH, shallow aquifer; MN, Manchester aquifer; FP, Fort Payne aquifer; UCB, upper Central Basin aquifer system]

AEDC well number	Local well number	USGS site identification	Easting (feet)	Northing (feet)	Land surface elevation (feet)	Measuring point height (feet)	Steel casing depth (feet)	Depth to bottom of seal (feet)	Screened interval (feet)	Depth to bottom of borehole[1] (feet)	Hydro-geo-logic unit	Date of construction
AEDC-267	Cf:G-069	352247086031501	1,983,860	359,600	1084.74	2.20	--	49	51 - 61	61	MN	02-03-94
AEDC-268	Cf:G-070	352258086031201	1,984,080	360,670	1080.59	1.57	81	160	260 - 280	289	UCB	12-08-93
AEDC-269	Cf:G-071	352258086031202	1,984,060	360,680	1081.06	2.50	--	42	44 - 54	54	MN	12-08-93
AEDC-270	Cf:G-072	352256086031601	1,983,740	360,450	1089.95	1.29	55	62	78 - 88	88	FP	12-06-93
AEDC-271	Cf:G-073	352256086031602	1,983,750	360,430	1089.95	1.30	--	36	39 - 49	49	MN	12-06-93
AEDC-272	Cf:G-074	352301086030601	1,984,600	360,930	1084.46	2.20	--	53	56 - 66	66	MN	02-03-94
AEDC-273	Cf:G-075	352304086031401	1,983,920	361,270	1083.67	1.68	74	80	83 - 93	93	FP	01-05-94
AEDC-274	Cf:G-076	352304086031402	1,983,940	361,270	1083.25	1.60	--	58	60 - 70	73	MN	01-06-94
AEDC-275	Cf:G-077	352304086031403	1,983,910	361,280	1083.78	1.70	--	22	24 - 34	34	SH	03-08-94
AEDC-276	Cf:G-078	352301086025501	1,985,540	360,970	1089.38	2.30	--	64	67 - 77	78	MN	03-14-94
AEDC-277	Cf:G-079	352258086030001	1,985,120	360,650	1088.72	1.20	96	156	260 - 280	289	UCB	12-13-93
AEDC-278	Cf:G-080	352258086030002	1,985,120	360,630	1088.30	1.08	82	82	84 - 94	94	MN	12-20-93
AEDC-279	Cf:G-081	352258086030003	1,985,120	360,620	1088.71	1.70	--	66	69 - 79	81	MN	12-20-93
AEDC-280	Cf:G-082	352258086030004	1,985,110	360,610	1088.85	1.90	--	30	32 - 42	42	SH	03-08-94
AEDC-281	Cf:G-083	352254086025504	1,985,490	360,260	1096.23	0.72	101	160	260 - 280	289	UCB	01-04-94
AEDC-282	Cf:G-084	352311086031701	1,983,670	362,010	1087.77	0.87	75	82	86 - 96	96	FP	02-01-94
AEDC-283	Cf:G-085	352311086031702	1,983,660	362,010	1087.17	2.10	--	61	63 - 73	76	MN	02-02-94
AEDC-284	Cf:G-086	352311086031703	1,983,670	362,000	1087.60	3.10	--	25	28 - 38	38	SH	03-08-94
AEDC-285	Cf:G-087	352313086030801	1,984,410	362,210	1082.96	1.83	81	83	88 - 98	103	MN	01-10-94
AEDC-286	Cf:G-088	352313086030802	1,984,430	362,210	1086.55	1.36	--	65	69 - 79	80	MN	01-10-94
AEDC-287	Cf:G-089	352313086030803	1,984,440	362,210	1083.25	2.50	--	16	18 - 28	28	SH	03-08-94
AEDC-288	Cf:G-090	352315086025101	1,985,850	362,400	1079.80	1.06	99	100	102 - 112	112	FP	01-12-94
AEDC-289	Cf:G-091	352315086025102	1,985,850	362,390	1079.71	2.80	--	80	82 - 92	95	MN	01-24-94
AEDC-290	Cf:G-092	352315086025103	1,985,860	362,400	1079.97	1.80	--	16	18 - 28	29	SH	03-10-94
AEDC-291	Cf:G-093	352309086024501	1,986,310	361,810	1081.26	1.06	97	98	100 - 105	105	FP	01-26-94
AEDC-292	Cf:G-094	352309086024502	1,986,320	361,810	1081.22	2.20	--	78	82 - 92	95	MN	01-27-94
AEDC-293	Cf:G-095	352309086024503	1,986,330	361,810	1080.96	2.10	--	16	18 - 28	28	SH	03-10-94

[1] Depth to bottom of borehole listed here is at time of well completion. Some wells were backfilled with grout to a desired depth before well completion.

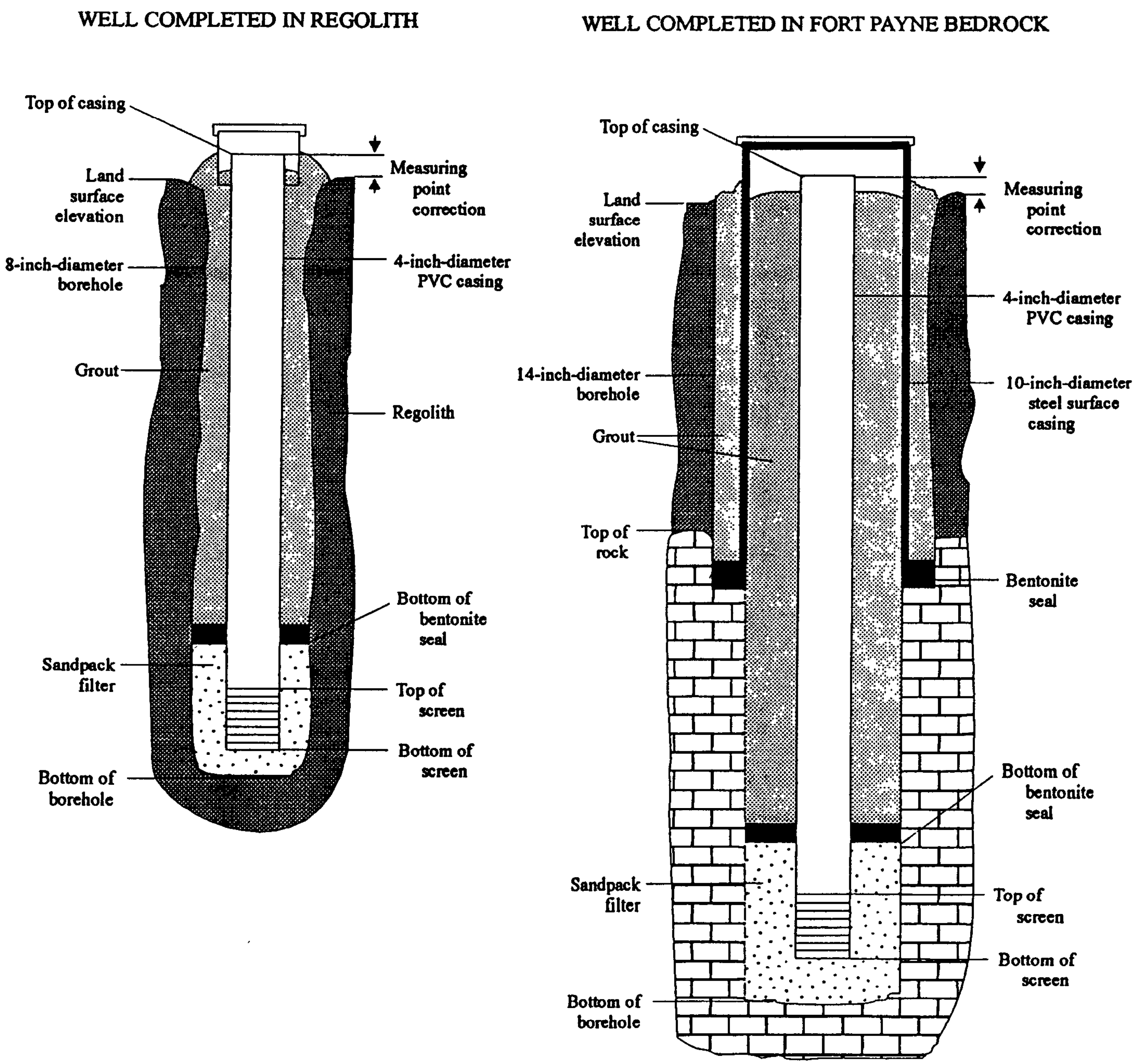


Figure 4. Well-construction diagrams.

WELL COMPLETED IN ORDOVICIAN LIMESTONES

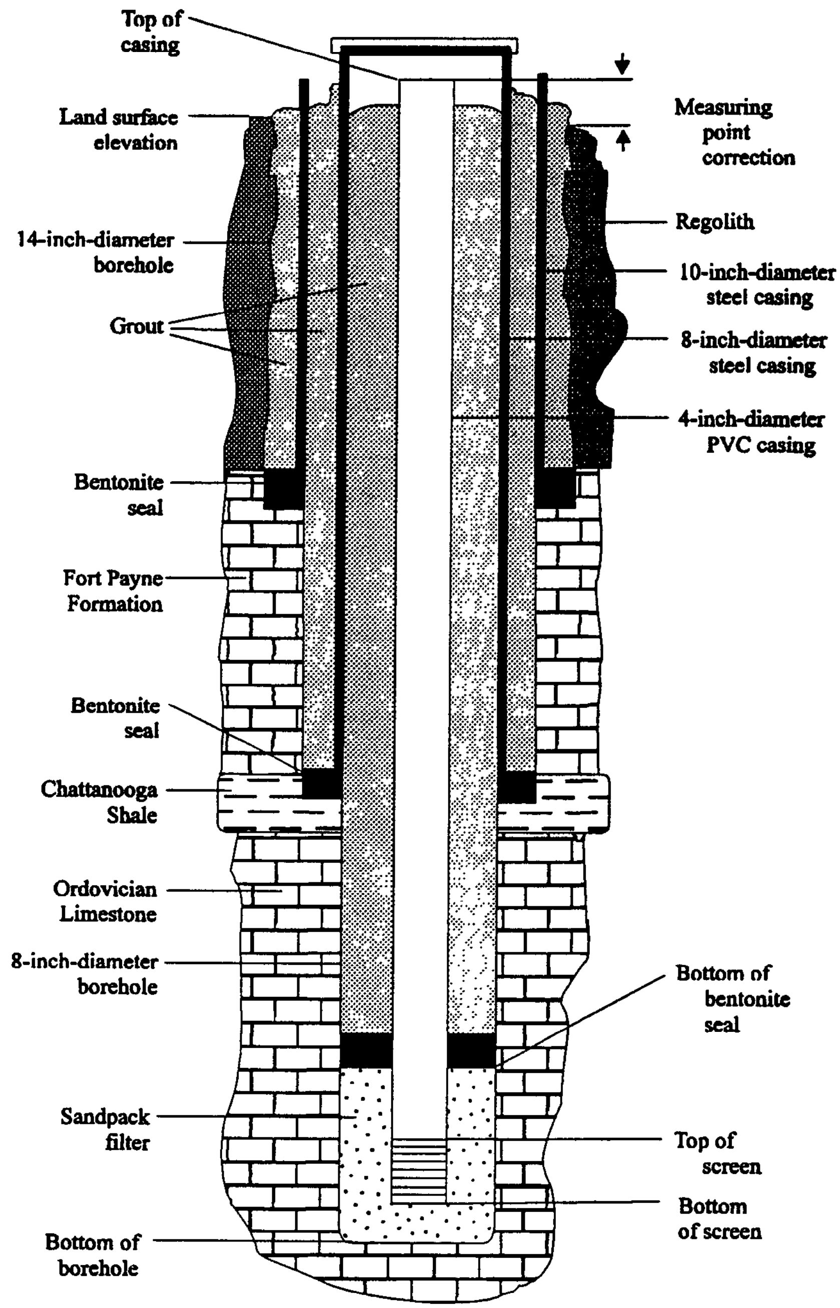


Figure 4. Well-construction diagrams--continued

Table 2. Lithologic information for screened intervals of wells for the J4 hydrogeologic study at Arnold Engineering Development Center, Coffee County, Tennessee

[AEDC, Arnold Engineering Development Center; gal/min, gallons per minute; --, no data; <, less than; SH, shallow aquifer; MN, Manchester aquifer; FP, Fort Payne aquifer; UCB, upper Central Basin aquifer system]

AEDC well number	Hydro-geo-logic unit	Depth to top of bedrock (feet)	Depth to top of Chattanooga Shale (feet)	Depth to bottom of Chattanooga Shale (feet)	Approximate well yield (gal/min)	Lithology of screened interval of well
AEDC-267	MN	64	--	--	20	Clayey gravel with abundant chert gravels
AEDC-268	UCB	58	77	100	<1	Limestone, unfractured
AEDC-269	MN	57	--	--	10	Sandy clay with chert, rock, and crinoid fragments
AEDC-270	FP	53	90	--	<1	Limestone, unfractured
AEDC-271	MN	48	--	--	1	Sandy clay with some chert and rock fragments
AEDC-272	MN	70	--	--	40	Sandy clay with chert gravels
AEDC-273	FP	72	94	--	<1	Limestone, unfractured
AEDC-274	MN	73	--	--	50	Clayey gravel with chert gravels and crinoid stems
AEDC-275	SH	--	--	--	<1	Sandy clay with some chert fragments
AEDC-276	MN	78	--	--	8	Sandy clay with chert gravels
AEDC-277	UCB	81	93	118	<1	Limestone, unfractured
AEDC-278	MN	80	93	--	30	Limestone, fracture at 86 feet
AEDC-279	MN	81	--	--	12	Sandy clay with chert gravels
AEDC-280	SH	--	--	--	<1	Sandy clay with minor amounts of chert fragments
AEDC-281	UCB	80	99	118	<1	Limestone, unfractured
AEDC-282	FP	73	98	--	<1	Limestone, unfractured
AEDC-283	MN	76	--	--	6	Sandy clay with chert gravels
AEDC-284	SH	--	--	--	<1	Sandy clay with minor amounts of chert fragments
AEDC-285	MN	79	105	--	250	Limestone, fracture at 86 feet
AEDC-286	MN	80	--	--	75	Clayey gravel with chert gravels and crinoid stems
AEDC-287	SH	--	--	--	<1	Sandy, silty clay
AEDC-288	FP	97	114	--	5	Limestone, small fractures
AEDC-289	MN	95	--	--	80	Clayey gravel with abundant chert gravels
AEDC-290	SH	--	--	--	<1	Sandy, silty clay
AEDC-291	FP	95	107	--	<1	Limestone, unfractured
AEDC-292	MN	95	--	--	60	Clayey gravel with abundant chert gravels
AEDC-293	SH	--	--	--	<1	Sandy, silty clay

Table 3. Monthly water-level data for wells at Arnold Engineering Development Center, Coffee County, Tennessee

[AEDC, Arnold Engineering Development Center; SH, shallow aquifer; MN, Manchester aquifer; FP, Fort Payne aquifer; UCB, upper Central Basin aquifer system; --, no data]

AEDC well number	Aquifer	Water level, in feet below land surface											
		6-21-94 to 6-30-94	7-27-94 to 7-29-94	8-10-94	9-13-94 to 9-20-94	10-13-94	11-17-94	12-5-94	1-12-95	3-3-95	4-10-95	5-22-95	7-5-95
154	MN	--	48.64	48.65	49.06	49.25	49.28	49.20	48.95	48.34	48.2	48.53	--
155	FP	--	29.01	29.03	30.13	30.49	30.94	30.40	30.38	29.65	29.90	30.04	30.25
175	UCB	--	171.16	171.05	170.40	169.81	170.15	170.18	170.69	175.07	173.83	173.85	174.12
268	UBC	--	--	181.41	183.26	185.42	191.52	194.64	198.80	200.15	199.92	200.20	200.12
273	FP	--	55.17	54.59	55.17	55.59	55.76	55.56	54.46	52.45	52.08	52.21	54.12
274	MN	29.67	30.90	30.90	31.98	32.53	32.77	32.02	31.46	29.58	29.69	29.58	31.03
275	SH	19.90	21.46	21.02	22.52	22.45	23.22	21.12	20.85	18.00	14.64	19.11	20.09
276	MN	13.26	14.34	14.49	15.61	15.61	15.47	14.80	13.81	11.92	12.26	12.37	13.65
277	UCB	--	139.90	--	142.71	143.12	143.47	144.00	144.56	145.41	145.39	145.90	146.15
278	MN	29.95	31.20	31.43	32.37	32.73	32.65	32.06	31.07	29.10	27.84	29.01	30.95
279	MN	33.66	34.48	34.75	35.54	35.87	35.94	35.45	34.66	33.10	32.88	33.03	34.52
280	SH	22.45	23.38	23.77	24.71	25.06	24.82	24.45	23.25	21.95	22.00	22.46	23.57
285	MN	24.35	26.05	26.33	27.55	28.19	28.51	27.48	25.53	21.85	20.94	21.04	24.97
286	MN	24.44	25.13	25.58	26.75	27.30	27.61	26.67	24.78	21.18	20.17	20.18	24.07

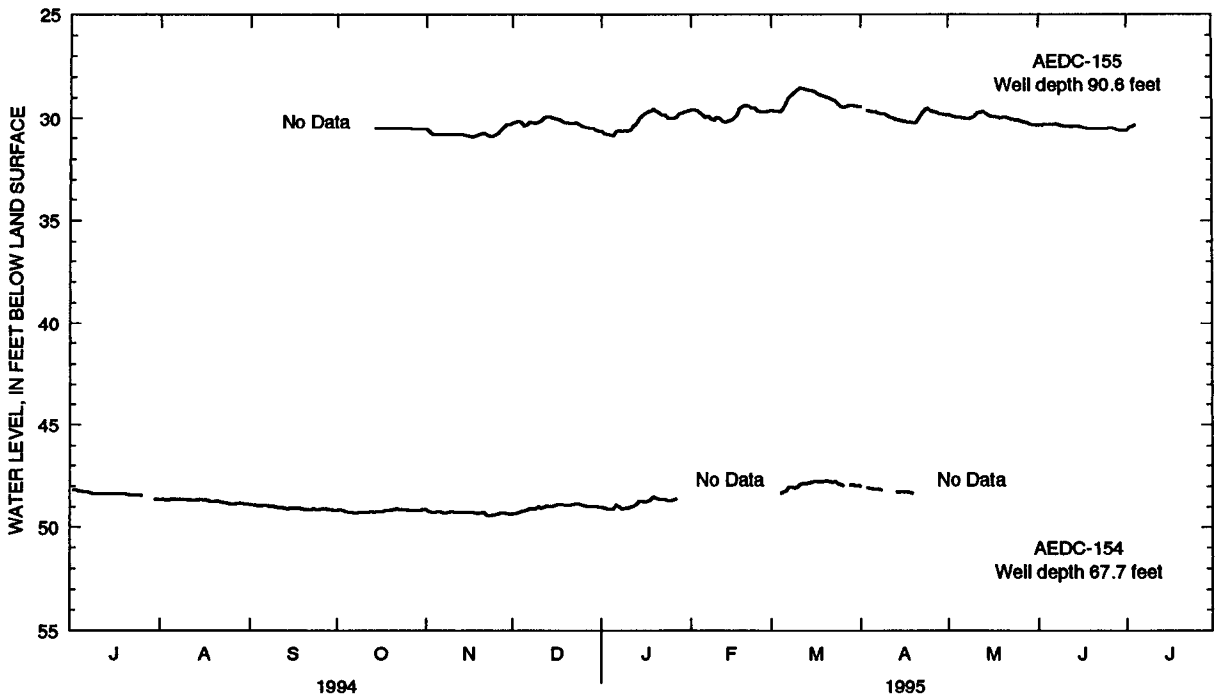


Figure 5. Water levels in wells AEDC-154 and -155 from July 1994 through June 1995.

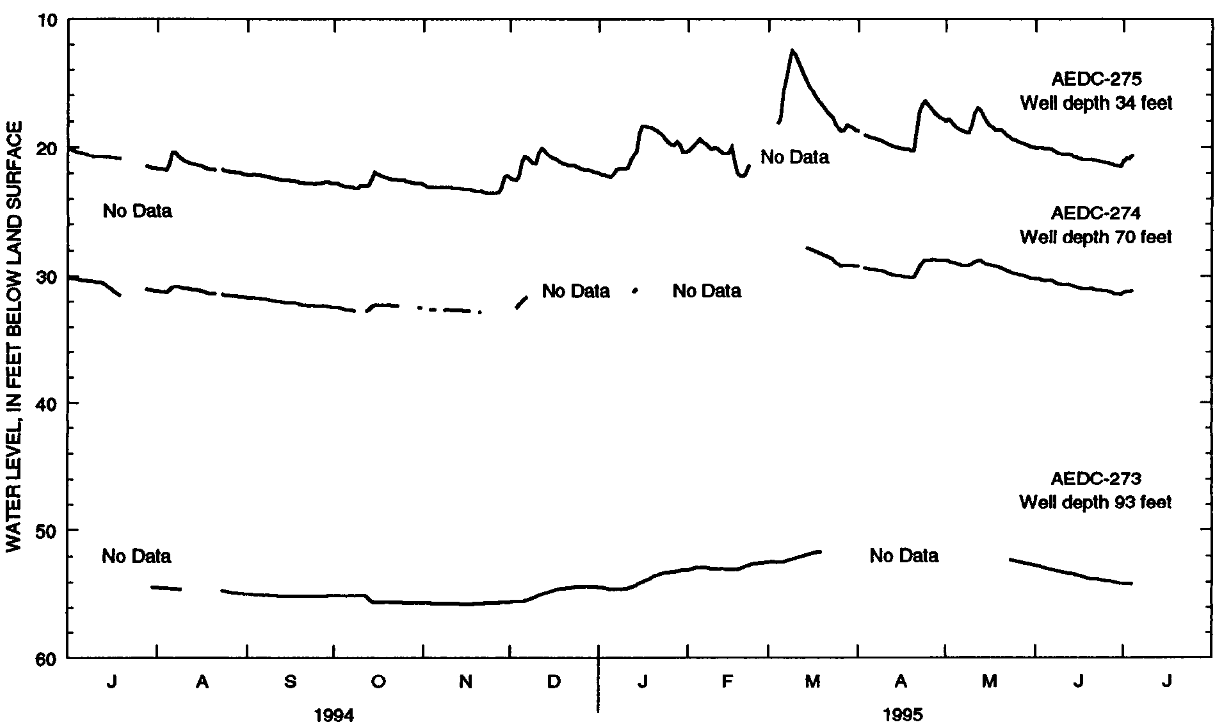


Figure 6. Water levels in wells AEDC-273, -274, and -275 from July 1994 through June 1995.

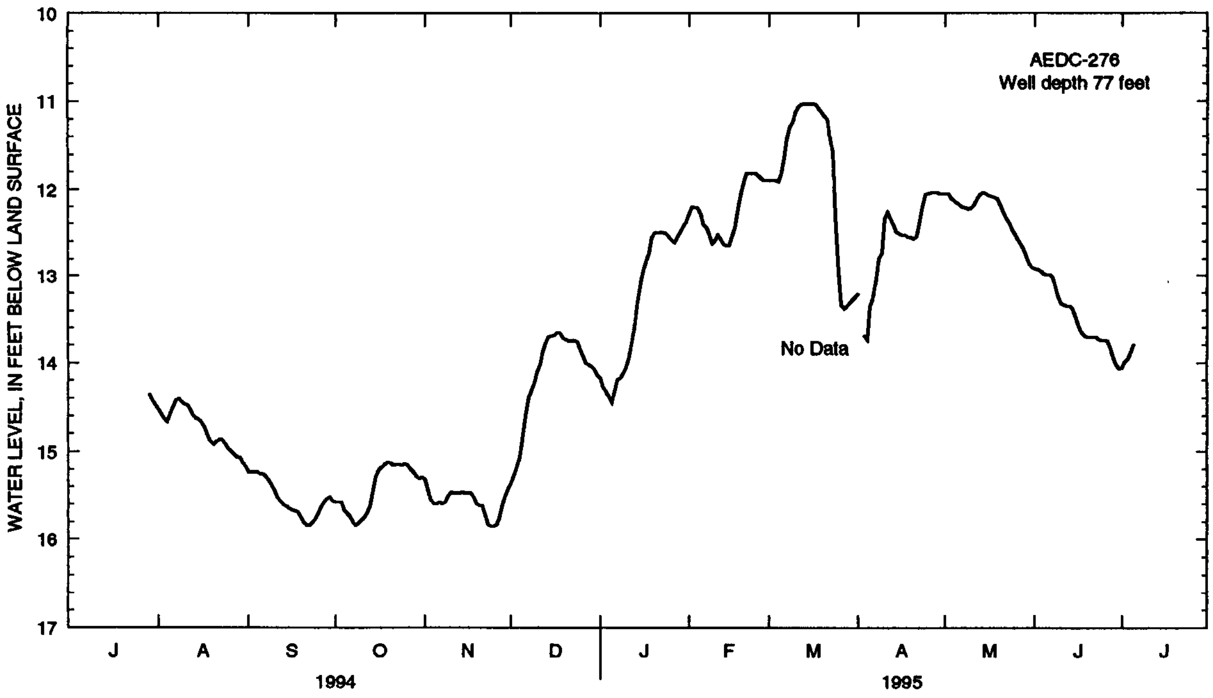


Figure 7. Water levels in well AEDC-276 from July 1994 through June 1995.

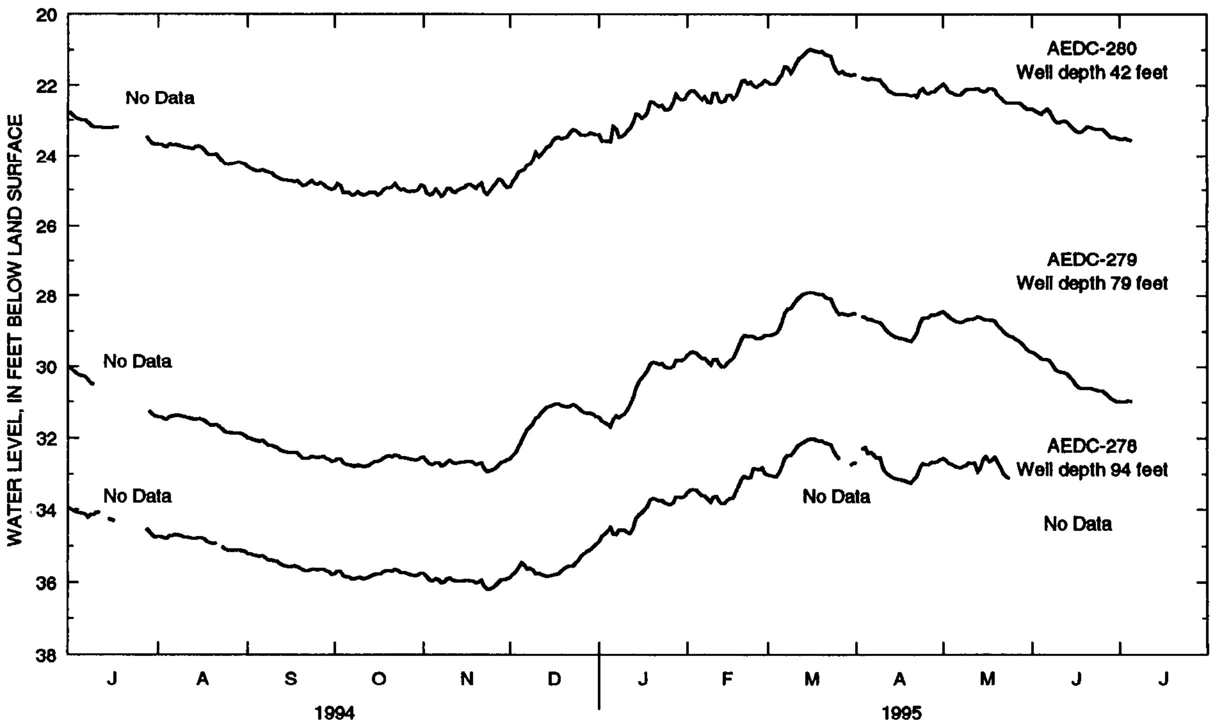


Figure 8. Water levels in wells AEDC-278, -279, and -280 from July 1994 through June 1995.

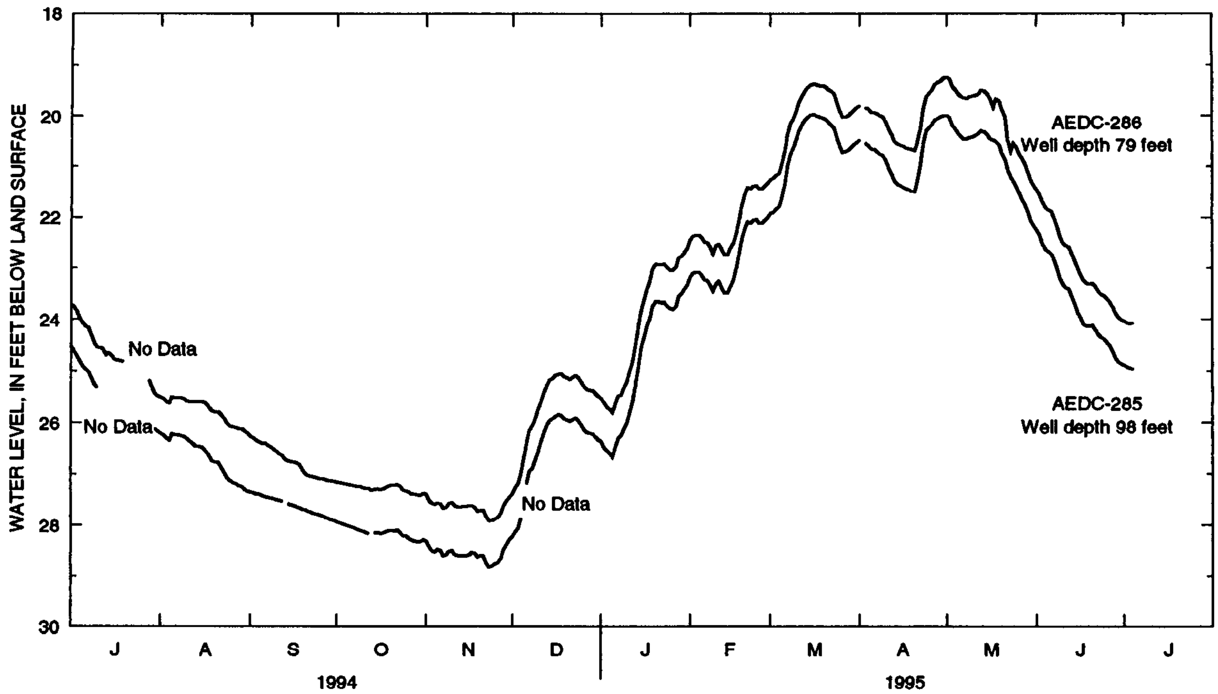


Figure 9. Water levels in wells AEDC-285 and -286 from July 1994 through June 1995.

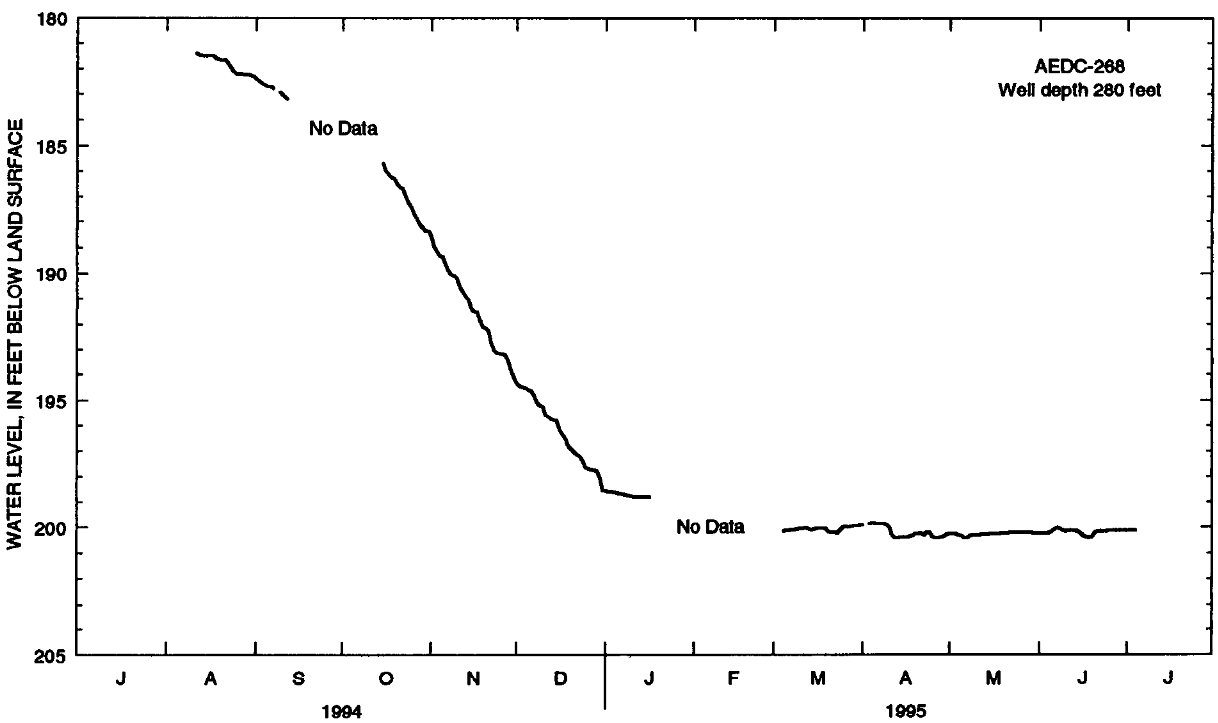


Figure 10. Water levels in well AEDC-268 from July 1994 through June 1995.

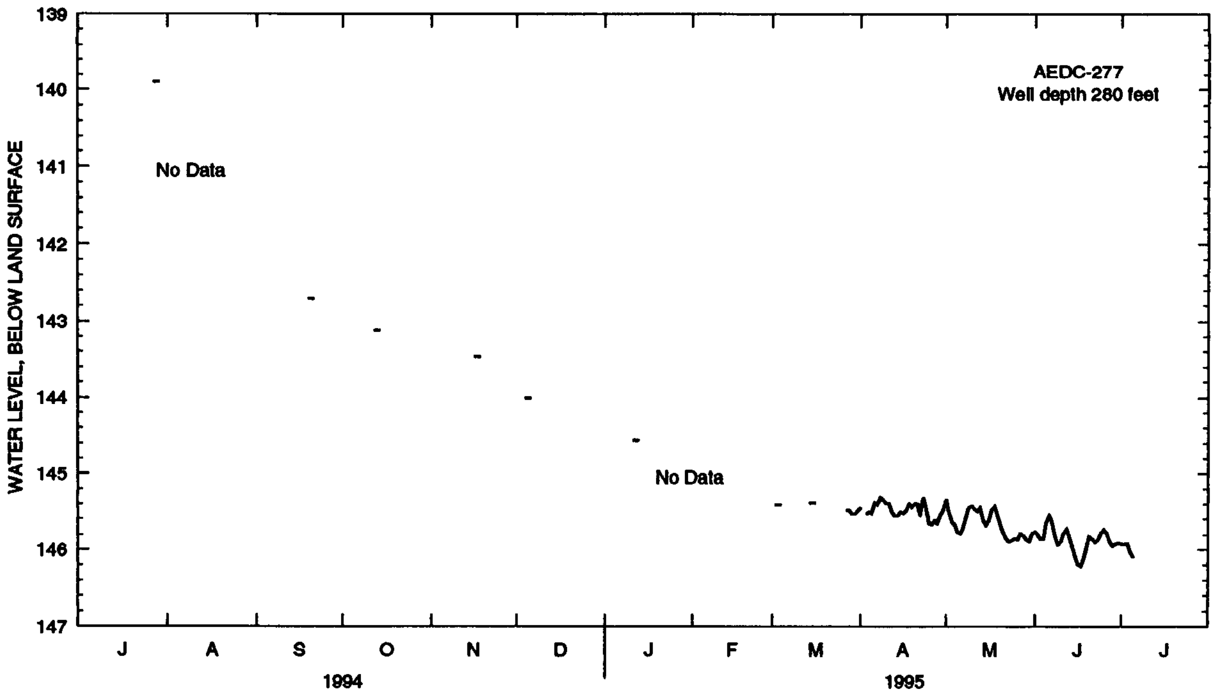


Figure 11. Water levels in well AEDC-277 from July 1994 through June 1995.

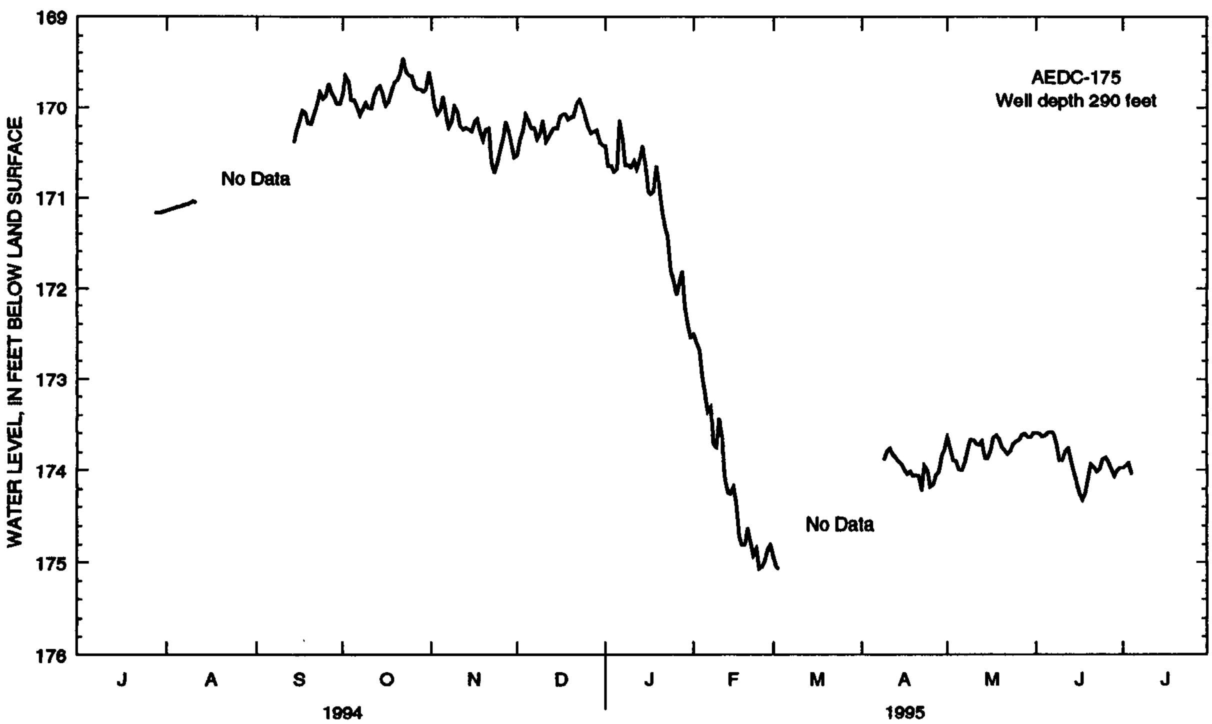


Figure 12. Water levels in well AEDC-175 from July 1994 through June 1995.

GROUND-WATER QUALITY

Water-quality samples were collected from 26 of the new wells, 9 existing wells, and the J4 test cell ground-water discharge (fig.13). The nine existing wells were chosen for sampling due to their proximity to the J4 test cell. These wells are all within 1,200 feet of the test cell. One of the new wells (AEDC-291) did not produce enough water to sample. Samples were analyzed for major inorganic constituents, trace metals, and volatile organic compounds (VOC). Samples were collected, treated, and preserved using procedures established and documented by the USGS (Wood, 1976; Claassen, 1982; Pritt and Jones, 1989; and Rose and Schroeder, 1995). Samples for dissolved analysis were filtered using an acetate membrane filter with a mean pore size of 0.45 micron. Samples for metal analysis were treated with 1 milliliter of nitric acid to lower the pH to less than 2. Samples for VOC analysis were chilled immediately after collection and kept chilled until analyzed. All samples were analyzed at the USGS water-quality laboratory in Denver, Colorado.

Wells were purged prior to sampling using a stainless-steel and teflon submersible pump. For most wells, specific conductance, temperature, and pH were monitored in a flow cell during well purging to determine when an appropriate amount of water had been purged. Samples were collected after values of these parameters had stabilized. Samples for inorganic analysis were collected from the discharge line of the submersible pump. Samples for VOC analysis were collected with a 2-inch-diameter stainless-steel bailer. Between wells, the bailer was cleaned by washing with laboratory detergent and tap water, rinsing with deionized water, and a final rinse with organic free water. The bailor was field rinsed a minimum of three times with well water before collecting the sample. The pump was cleaned by flushing with laboratory detergent and tap water, rinsing with tap water, and a final deionized water rinse.

Several of the wells had yields of less than 0.5 gallon per minute. For these wells, one casing volume was purged, then the well was allowed to recover before purging again. A minimum of three casing volumes was purged before sampling. Samples from these wells were collected using a bailer. For these wells, physical properties were monitored during purging with grab samples. These wells were AEDC-81, -270, -282, -287, and -293.

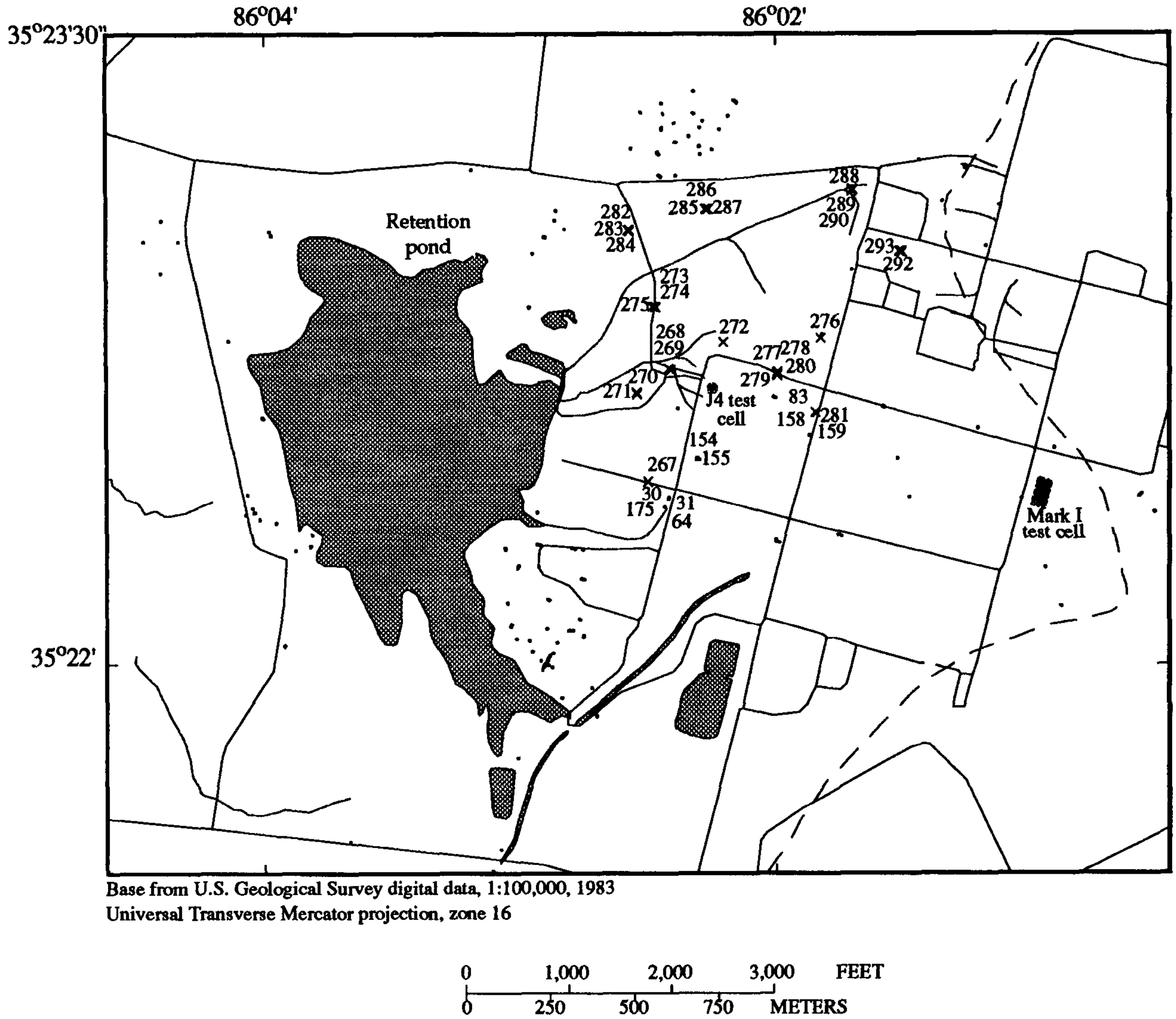
The wells completed in the upper Central Basin aquifer system had yields so low that the wells would have required a recharge period of several weeks or months in order to purge three casing volumes. At these wells, one casing volume was purged 2 weeks prior to sampling, then the sample was collected with a bailer during its recovery. These wells were AEDC-175, -268, -277, and -281.

All samples were analyzed for inorganic constituents and VOC's by the USGS National Water Quality Laboratory in Arvada, Colorado. Field quality-assurance samples also were collected for analysis for VOC's. These samples included field duplicates, equipment blanks, and trip blanks.

Inorganic Constituents and Physical Properties

Samples were analyzed for major and trace inorganic constituents. The results of the water-quality analyses indicate the variation of geochemical processes affecting water from the various aquifers. The dissolved-solids concentrations ranged from 16 milligrams per liter (mg/L) in well AEDC-284 to 8,060 mg/L in well AEDC-175. Well AEDC-284 is completed in the shallow aquifer at a depth of 38 feet below land surface; and well AEDC-175 is completed in the upper Central Basin aquifer system at a depth of 320 feet below land surface.

The median dissolved-solids concentrations were 52 mg/L in the shallow aquifer, 96 mg/L in the Manchester aquifer, 240 mg/L in the Fort Payne aquifer, and 2,140 mg/L in the upper Central Basin aquifer system. The median values of selected physical properties and constituents for each aquifer are shown in table 4. Almost all of the inorganic constituents follow a similar trend with the lowest concentrations in the shallow and Manchester aquifers and the highest concentrations in the upper Central Basin aquifer system. These data are consistent with water-quality data from wells previously sampled in the area (Haugh and others, 1992; and Haugh and Mahoney, 1993). Complete analyses are shown in Appendix 1.



Base from U.S. Geological Survey digital data, 1:100,000, 1983
Universal Transverse Mercator projection, zone 16

EXPLANATION

- — - DRAINAGE DIVIDE

× 267 WELL LOCATION AND NUMBER—Well sampled for this study

• WELL LOCATION

Figure 13. Locations of wells sampled at Arnold Engineering Development Center, Coffee County, Tennessee.

Table 4. Range and median values of selected physical properties and inorganic constituents in water from wells sampled near the J4 test cell at Arnold Engineering Development Center, Coffee County, Tennessee

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; °C, degrees Celsius; µg/L, micrograms per liter; <, less than]

Physical property/ Constituent	Number of samples, by aquifer											
	8			17			6			4		
	Shallow aquifer			Manchester aquifer			Fort Payne aquifer			Upper Central Basin aquifer		
	Minimum	Maximum	Median	Minimum	Maximum	Median	Minimum	Maximum	Median	Minimum	Maximum	Median
Specific conductance (µS/cm)	19	295	90	53	456	160	305	3,340	425	1,680	13,200	3,615
pH (standard units)	4.9	7.0	5.4	5.3	7.8	6.3	7.4	10.1	8.7	7.1	11.4	9.2
Alkalinity (mg/L as $CaCO_3$)	6	73	20	24	232	76	142	570	176	77	398	316
Hardness (mg/L as $CaCO_3$)	5	89	17	20	230	75	76	330	165	46	930	510
Calcium (mg/L)	1.0	23	4.6	6.4	67	22	14	130	51	17	250	84
Magnesium (mg/L)	.48	7.7	.74	.90	15	3.9	.14	16	9.9	.6	150	33
Sodium (mg/L)	.80	36	4.6	1.1	5.7	1.8	1.3	35	8.6	100	2,500	290
Potassium (mg/L)	<0.1	3.8	1.0	.20	2.1	.60	.2	320	33	74	340	180
Chloride (mg/L)	.70	60	2.0	.50	22	2.9	1.0	11	4.4	100	4,300	340
Sulfate (mg/L)	<0.1	56	1.9	.30	59	2.1	5.8	300	32.0	360	1,000	510
Silica (mg/L)	7.3	15	10	7.5	13	9.2	8.1	13	12	5.7	14	9.2
Solids, residue at 180°C dissolved (mg/L)	16	210	52	40	250	96	163	1,280	240	1,100	8,060	2,140
Solids, sum of constituents, dissolved (mg/L)	29	179	52	35	247	87	163	1,140	238	1,020	7,760	2,025
Barium (µg/L)	3	47	14	<2	36	5	12	65	18	17	100	34
Iron (µg/L)	4	7,100	22	<3	1,700	11	4	310	14	<3	370	78
Lithium (µg/L)	<4	<4	<4	<4	<4	<4	<4	170	22	220	4,100	740
Manganese (µg/L)	9	130	31	<1	1,400	11	<3	86	8	<1	110	10
Strontium (µg/L)	5	130	16	9	200	22	70	1,200	96	1,100	7,700	3,950

Volatile Organic Compounds

Most of the volatile organic compounds analyzed were below the detection level (Appendix 2). However, some compounds were detected. Water from all wells completed below the Chattanooga Shale in the upper Central Basin aquifer system (AEDC-268, -277, -281, and -175) contained significant amounts of aromatic hydrocarbons such as benzene, toluene, ethylbenzene, and xylenes (BTEX). These compounds occur naturally in association with petroleum deposits (natural gas and crude oil) and shale lithologies, as well as in many refined petroleum products (Swanson, 1960; Slaine and Barker, 1990). During drilling of each of these wells, small amounts of natural gas were produced. The occurrence of BTEX in the upper Central Basin aquifer system is documented in reports by Haugh and others (1992) and Haugh and Mahoney (1993).

Several wells contained water with chlorinated organic compounds such as 1,2-dichloroethane, 1,1-dichloroethylene, and trichloroethylene which exceeded the maximum contaminant levels (MCL's) for public water-supply systems (Appendix 2). These wells included AEDC-64, -83, -159, -269, -271, -272, -273, -274, -275, and -278. The highest concentrations were detected in well AEDC-274 with 45 µg/L 1,2-dichloroethane, 320 µg/L 1,1-dichloroethylene, and 1,200 µg/L trichloroethylene. The ground-water discharge from the J4 test cell also exceeds the MCL's for these VOC's. Additionally, several wells contained detectable levels of VOC's below the MCL's.

During analysis for the targeted VOC's, non-targeted organic compounds were detected in several samples and identified by the lab chemists (M.C. Noriega and D.L. Rose, U.S. Geological Survey, written commun., 1994). These data are presented in Appendix 3.

Quality-Assurance/Quality-Control Samples

Approximately 20 percent of the samples were quality-assurance/quality-control (QA/QC) samples. Field quality-assurance samples were collected and analyzed for VOC's. These samples included duplicates from wells AEDC-268 and -292, equipment blanks collected at wells AEDC-268, -277, -285, and -293, and four trip blanks. Analytical data for these samples are shown in Appendices 4 and 5.

The USGS laboratory follows standard QA/QC practices for all VOC analyses. These practices include lab blanks, quality-control standards, surrogate spikes, matrix spikes, and duplicate analysis. Reagent blanks are run once daily or 1 for every 10 samples analyzed, whichever is greater. The analysis does not proceed unless the blank is free of contaminants.

Quality-control standards are run daily for approximately 60 compounds. Recovery percentages are recorded for each compound and are expected to be within 60 to 140 percent. Recovery percentages for quality-control standards for each day that samples were analyzed are listed in Appendix 6.

Surrogate standards of D4 1,2-dichloroethane, D8 toluene, and 1,4-bromofluorobenzene are spiked into each sample analyzed. If the recovery results are less than 70 percent or greater than 130 percent, a duplicate sample (if available) is analyzed. Surrogate spike recovery percentages are listed in Appendix 7.

Laboratory duplicate samples are chosen at random, equivalent to 5 to 10 percent of the samples. If the relative percent difference is greater than 30 percent, another replicate (if available) is analyzed. One sample from this study was randomly selected by the laboratory for duplicate sample analysis. These data are presented in Appendix 8.

Matrix spikes of five compounds, 1,1-dichloroethene, benzene, trichloroethene, toluene, and chlorobenzene, are analyzed from randomly selected samples equivalent to 1 in every 20 samples. Low recoveries from matrix spikes indicate interferences from the sample matrix. None of the samples from this study were randomly chosen by the lab for matrix spikes.

J4 TEST CELL DISCHARGE

The quantity of water discharging from the J4 test cell was gaged continuously. Daily mean discharge from the J4 test cell is presented in Appendix 9 for the period October 1990 through September 1995. Most of this water is ground water dewatered from around the test cell. A small percentage of this water is cooling water from testing activities at the test cell. Rainfall data also were collected during the same period and are presented in Appendix 10.

SUMMARY

Twenty-seven wells were installed by the U.S. Geological Survey at 12 sites near the J4 test cell at Arnold Engineering Development Center in Coffee County, Tennessee. The wells were installed to provide information on subsurface lithology, aquifer characteristics, ground-water levels, and ground-water quality. This information will be used to help understand the effects of dewatering operations at the J4 test cell on the local ground-water-flow system. Six of the wells were completed in the shallow aquifer, 11 wells were completed in the chert gravels of the upper part of the Manchester aquifer, 2 wells were completed in fractures in the bedrock of the lower part of the Manchester aquifer, 5 wells were completed in the Fort Payne aquifer, and 3 wells were completed in the upper Central Basin aquifer system. Well depths ranged from 28 to 289 feet.

The amount of water discharged from the J4 test cell was monitored to estimate the average flow of ground water removed from around the J4 test cell. Ground-water levels were monitored continuously at 14 wells for 12 months. Rainfall data also were collected.

Water-quality samples were collected from 26 of the new wells, 9 existing wells, and the ground-water discharge from the J4 test cell. All samples were analyzed for common inorganic ions, trace metals, and volatile organic compounds. The median dissolved-solids concentrations were 52 mg/L in the shallow aquifer, 96 mg/L in the Manchester aquifer, 240 mg/L in the Fort Payne aquifer, and 2,140 mg/L in the upper Central Basin aquifer system. Almost all of the physical properties and inorganic constituents followed a similar trend with the lowest concentrations in the shallow and Manchester aquifers and the highest concentrations in the upper Central Basin aquifer system.

Water from all of the wells completed below the Chattanooga Shale in the upper Central Basin aquifer system (AEDC-268, -277, -281, and -175) contained significant amounts of aromatic hydrocarbons such as benzene, toluene, ethylbenzene, and xylenes (BTEX). These compounds occur naturally in association with petroleum deposits (natural gas and crude oil) and shale lithologies, as well as in many refined petroleum products.

Several wells contained water with chlorinated organic compounds such as 1,2-dichloroethane, 1,1-dichloroethylene, and trichloroethylene, which exceeded the maximum contaminant levels for public water systems. These wells included AEDC-64, -83, -159, -269, -271, -272, -273, -274, -275, and -278; the ground-water discharge from the J4 test cell also exceeded the MCL's for these same compounds. The highest concentrations were detected in well AEDC-274 with 45 µg/L 1,2-dichloroethane, 320 µg/L 1,1-dichloroethylene, and 1,200 µg/L trichloroethylene.

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APPENDIX 1

Inorganic constituents and physical properties of water from wells sampled at Arnold Engineering Development Center

Inorganic constituents and physical properties of water from wells sampled at Arnold Engineering Development Center

[mg/L, milligrams per liter; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter; deg C, degrees Celsius; NTU, nephelometric turbidity units; SH, shallow aquifer; MN, Manchester aquifer; FP, Fort Payne aquifer; UCB, upper Central Basin aquifer; --, no data. Values given as < (less than) indicate that the concentration was below the detection level of the analytical method used and does not indicate the presence or absence of the constituent]

AEDC well number	Tennessee local well number	Station number	Aquifer	Date	Specific conductance (µS/cm)	pH (standard units)	Alkalinity field (mg/L as $CaCO_3$)	Temperature water (deg C)	Turbidity (NTU)	Hardness total (mg/L as $CaCO_3$)
AEDC-30	Cf:G-102	352246086031301	SH	07-25-94	295	5.4	27	16.5	330	89
AEDC-31	Cf:G-104	352246086031303	MN	07-28-94	148	5.3	27	19.0	340	54
AEDC-64	Cf:G-103	352246086031302	MN	07-26-94	346	6.3	109	18.5	1.6	160
AEDC-83	Cf:G-099	352254086025501	SH	07-26-94	64	5.2	8	20.0	690	6
AEDC-154	Cf:G-097	352249086030902	MN	07-27-94	77	5.5	32	19.0	0.30	31
AEDC-155	Cf:G-098	352249086030903	FP	07-27-94	305	7.5	142	17.5	0.10	150
AEDC-158	Cf:G-100	352254086025502	MN	07-26-94	127	5.9	41	19.5	1.0	56
AEDC-159	Cf:G-101	352254086025503	FP	07-27-94	429	7.4	184	19.5	0.20	210
AEDC-175	Cf:G-009	352247086031301	UCB	07-25-94	13,200	8.6	350	20.5	7.9	930
AEDC-267	Cf:G-069	352247086031501	MN	07-28-94	127	6.3	42	17.5	1.0	50
AEDC-268	Cf:G-070	352258086031201	UCB	07-21-94	1,680	9.9	77	19.5	1.2	150
AEDC-269	Cf:G-071	352258086031202	MN	07-21-94	270	6.5	120	15.5	0.60	140
AEDC-270	Cf:G-072	352256086031601	FP	07-27-94	1,390	10.1	183	19.0	1.1	180
AEDC-271	Cf:G-073	352256086031602	MN	07-22-94	456	6.3	232	18.0	1.0	230
AEDC-272	Cf:G-074	352301086030601	MN	07-25-94	160	6.5	76	19.5	0.50	75
AEDC-273	Cf:G-075	352304086031401	FP	07-22-94	3,340	9.7	570	18.0	6.6	330
AEDC-274	Cf:G-076	352304086031402	MN	07-20-94	124	6.3	47	17.0	7.3	56
AEDC-275	Cf:G-077	352304086031403	SH	07-21-94	284	6.4	73	17.0	180	60
AEDC-276	Cf:G-078	352301086025501	MN	07-19-94	189	7.1	94	18.0	0.40	83
AEDC-277	Cf:G-079	352258086030001	UCB	07-25-94	4,120	11.4	398	24.5	2.8	46
AEDC-278	Cf:G-080	352258086030002	MN	07-18-94	257	7.8	131	18.0	0.30	120
AEDC-279	Cf:G-081	352258086030003	MN	07-19-94	275	7.6	134	18.0	0.20	120
AEDC-280	Cf:G-082	352258086030004	SH	07-19-94	103	6.7	15	21.5	1.3	25
AEDC-281	Cf:G-083	352254086025504	UCB	07-26-94	3,110	7.1	282	21.5	3.9	870
AEDC-282	Cf:G-084	352311086031701	FP	07-28-94	421	10.0	155	18.0	13	76
AEDC-283	Cf:G-085	352311086031702	MN	07-27-94	68	6.2	29	17.5	1.0	26
AEDC-284	Cf:G-086	352311086031703	SH	07-27-94	19	4.9	6	19.5	0.50	5
AEDC-285	Cf:G-087	352313086030801	MN	07-20-94	274	7.3	140	16.0	7.8	110
AEDC-286	Cf:G-088	352313086030802	MN	07-20-94	117	6.7	48	17.0	42	40
AEDC-287	Cf:G-089	352313086030803	SH	07-20-94	97	7.0	46	18.5	63	41
AEDC-288	Cf:G-090	352315086025101	FP	07-21-94	333	7.7	169	18.0	6.9	150
AEDC-289	Cf:G-091	352315086025102	MN	07-21-94	312	6.8	162	16.5	6.0	150
AEDC-290	Cf:G-092	352315086025103	SH	07-21-94	82	5.2	24	18.5	13	9
AEDC-292	Cf:G-094	352309086024502	MN	07-22-94	53	5.8	24	18.0	0.30	20
AEDC-293	Cf:G-095	352309086024503	SH	07-28-94	35	5.3	10	19.5	27	7
J4-test cell	Cf:G-105	352256086030601	--	07-28-94	297	6.9	126	17.5	0.20	140

Inorganic constituents and physical properties of water from wells sampled at Arnold Engineering Development Center--Continued

AEDC well number	Tennessee local well number	Calcium dis-solved (mg/L as Ca)	Magne-sium, dis-solved (mg/L as Mg)	Sodium, dis-solved (mg/L as Na)	Sodium percent	Sodium ad-sorp-tion ratio	Potas-sium, dis-solved (mg/L as K)	Chlo-ride, dis-solved (mg/L as Cl)	Sulfate dis-solved (mg/L as SO_4)
AEDC-30	Cf:G-102	23	7.7	6.4	13	0.3	1.4	60	8.5
AEDC-31	Cf:G-104	15	3.9	3.0	11	0.2	0.30	22	0.80
AEDC-64	Cf:G-103	51	8.4	1.8	2	0.1	0.30	7.0	59
AEDC-83	Cf:G-099	1.7	0.48	8.3	71	1	1.0	7.5	5.6
AEDC-154	Cf:G-097	9.8	1.6	1.1	7	0.1	0.60	2.0	0.30
AEDC-155	Cf:G-098	37	14	1.3	2	0.0	0.20	4.4	11
AEDC-158	Cf:G-100	18	2.6	2.1	8	0.1	0.40	12	0.70
AEDC-159	Cf:G-101	57	16	3.1	3	0.1	0.80	11	20
AEDC-175	Cf:G-009	120	150	2,500	84	36	74	4,300	360
AEDC-267	Cf:G-069	15	3.0	2.1	8	0.1	0.20	6.6	4.5
AEDC-268	Cf:G-070	47	8.6	100	33	4	220	100	490
AEDC-269	Cf:G-071	44	6.9	2.3	3	0.1	0.30	5.5	10
AEDC-270	Cf:G-072	72	0.14	31	14	1	180	4.4	300
AEDC-271	Cf:G-073	67	15	5.7	5	0.2	0.40	5.0	3.0
AEDC-272	Cf:G-074	22	4.8	1.8	5	0.1	0.50	1.5	2.1
AEDC-273	Cf:G-075	130	0.25	35	9	0.8	320	8.0	290
AEDC-274	Cf:G-076	20	1.4	3.5	12	0.2	0.70	5.2	5.4
AEDC-275	Cf:G-077	21	1.7	36	55	2	3.8	1.9	56
AEDC-276	Cf:G-078	27	3.7	1.7	4	0.1	1.5	1.4	1.9
AEDC-277	Cf:G-079	17	0.58	250	53	16	340	310	540
AEDC-278	Cf:G-080	41	4.3	1.4	2	0.1	1.0	2.9	1.7
AEDC-279	Cf:G-081	42	4.3	1.5	3	0.1	2.1	3.1	1.9
AEDC-280	Cf:G-082	6.7	2.1	6.6	--	0.6	<0.10	17	0.90
AEDC-281	Cf:G-083	250	58	330	41	5	140	370	1,000
AEDC-282	Cf:G-084	14	10	12	14	0.6	64	1.0	45
AEDC-283	Cf:G-085	8.5	1.2	1.1	8	0.1	0.40	1.2	0.30
AEDC-284	Cf:G-086	0.95	0.53	0.80	27	0.2	0.20	1.5	<0.10
AEDC-285	Cf:G-087	38	4.0	5.4	9	0.2	0.80	1.0	3.8
AEDC-286	Cf:G-088	12	2.5	1.5	7	0.1	1.1	0.50	6.5
AEDC-287	Cf:G-089	15	0.86	2.9	13	0.2	1.1	0.70	2.2
AEDC-288	Cf:G-090	45	9.8	5.2	7	0.2	1.9	1.1	5.8
AEDC-289	Cf:G-091	49	7.7	2.3	3	0.1	1.0	1.1	4.9
AEDC-290	Cf:G-092	2.4	0.62	1.8	31	0.3	0.10	1.7	0.70
AEDC-292	Cf:G-094	6.4	0.92	1.3	11	0.1	2.0	0.70	1.5
AEDC-293	Cf:G-095	2.1	0.51	2.0	29	0.3	2.7	2.2	1.6
J4-test cell	Cf:G-105	45	5.9	4.9	7	0.2	0.20	9.2	9.2

Inorganic constituents and physical properties of water from wells sampled at Arnold Engineering Development Center--Continued

AEDC well number	Tennessee local well number	Fluoride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO_2)	Solids, residue at 180 deg. C dissolved (mg/L)	Solids, sum of constituents, dissolved (mg/L)	Aluminum, dissolved (µg/L as AL)	Barium, dissolved (µg/L as Ba)	Cobalt, dissolved (µg/L as Co)	Iron, dissolved (µg/L as Fe)
AEDC-30	Cf:G-102	<0.10	7.3	210	131	30	47	<3	9
AEDC-31	Cf:G-104	<0.10	9.2	96	70	<10	12	<3	10
AEDC-64	Cf:G-103	<0.10	10	206	203	<10	5	6	58
AEDC-83	Cf:G-099	<0.10	9.1	39	39	<10	8	<3	4
AEDC-154	Cf:G-097	<0.10	8.9	48	44	<10	5	<3	<3
AEDC-155	Cf:G-098	0.10	9.3	163	163	<10	23	<3	12
AEDC-158	Cf:G-100	<0.10	10	88	70	<10	9	3	4
AEDC-159	Cf:G-101	0.10	12	255	230	<10	16	3	4
AEDC-175	Cf:G-009	0.30	12	8,060	7,760	50	100	<1	370
AEDC-267	Cf:G-069	0.10	9.2	72	66	10	17	<3	4
AEDC-268	Cf:G-070	0.30	5.7	1,100	1,020	<10	17	<3	<3
AEDC-269	Cf:G-071	<0.10	8.8	153	150	<10	3	<3	<3
AEDC-270	Cf:G-072	<0.10	13	746	715	4,100	12	4	310
AEDC-271	Cf:G-073	<0.10	12	250	247	<10	<2	<3	13
AEDC-272	Cf:G-074	<0.10	8.9	83	87	<10	4	5	8
AEDC-273	Cf:G-075	0.30	12	1,280	1,140	1,000	65	<9	9
AEDC-274	Cf:G-076	<0.10	13	77	77	40	3	<3	19
AEDC-275	Cf:G-077	<0.10	15	192	179	60	17	<3	21
AEDC-276	Cf:G-078	<0.10	9.0	104	103	<10	4	<3	12
AEDC-277	Cf:G-079	0.30	6.3	2,000	1,710	50	49	<9	79
AEDC-278	Cf:G-080	<0.10	9.6	144	141	30	9	<3	9
AEDC-279	Cf:G-081	<0.10	9.7	150	145	10	7	<3	8
AEDC-280	Cf:G-082	<0.10	9.5	73	--	70	17	<3	22
AEDC-281	Cf:G-083	0.40	14	2,280	2,340	<10	19	10	78
AEDC-282	Cf:G-084	0.20	8.1	226	247	40	12	<3	17
AEDC-283	Cf:G-085	<0.10	10	41	40	<10	4	<3	11
AEDC-284	Cf:G-086	<0.10	8.2	16	--	20	3	<3	6
AEDC-285	Cf:G-087	<0.10	8.5	156	146	50	11	<3	19
AEDC-286	Cf:G-088	<0.10	7.5	71	62	40	6	10	39
AEDC-287	Cf:G-089	<0.10	13	66	64	90	10	<3	54
AEDC-288	Cf:G-090	0.10	12	178	183	40	21	<3	100
AEDC-289	Cf:G-091	0.10	9.0	165	175	<10	36	7	1,700
AEDC-290	Cf:G-092	<0.10	11	32	40	20	10	20	7,100
AEDC-292	Cf:G-094	<0.10	8.2	40	35	<10	5	<3	11
AEDC-293	Cf:G-095	<0.10	12	29	29	100	18	<3	26
J4-test cell	Cf:G-105	0.10	9.2	171	159	10	6	<3	18

Inorganic constituents and physical properties of water from wells sampled at Arnold Engineering Development Center--Continued

AEDC well number	Tennessee local well number	Lithium dis-solved (µg/L as Li)	Manga-nese, dis-solved (µg/L as Mn)	Molyb-denum, dis-solved (µg/L as Mo)	Nickel, dis-solved (µg/L as Ni)	Sele-nium, dis-solved (µg/L as Se)	Silver, dis-solved (µg/L as Ag)	Stron-tium, dis-solved (µg/L as Sr)	Vana-dium, dis-solved (µg/L as V)
AEDC-30	Cf:G-102	<4	130	<10	10	<1	<1	130	<6
AEDC-31	Cf:G-104	<4	15	<10	5	<1	<1	18	<6
AEDC-64	Cf:G-103	4	60	10	57	<1	<1	200	<6
AEDC-83	Cf:G-099	<4	45	<10	8	<1	<1	14	<6
AEDC-154	Cf:G-097	<4	16	<10	2	<1	<1	11	<6
AEDC-155	Cf:G-098	<4	22	<10	<1	<1	<1	70	<6
AEDC-158	Cf:G-100	<4	4	<10	4	<1	<1	16	<6
AEDC-159	Cf:G-101	6	14	<10	9	2	<1	96	<6
AEDC-175	Cf:G-009	4,100	20	<2	1	<1	<1	6,700	19,000
AEDC-267	Cf:G-069	<4	3	<10	<1	<1	<1	11	<6
AEDC-268	Cf:G-070	220	<1	90	<1	3	<1	1,200	<6
AEDC-269	Cf:G-071	<4	2	<10	2	<1	<1	34	<6
AEDC-270	Cf:G-072	37	1	160	8	3	<1	530	17
AEDC-271	Cf:G-073	<4	30	<10	2	<1	<1	35	<6
AEDC-272	Cf:G-074	<4	11	<10	2	<1	<1	13	<6
AEDC-273	Cf:G-075	170	<3	160	<1	3	<1	1,200	<18
AEDC-274	Cf:G-076	<4	5	<10	2	<1	<1	28	<6
AEDC-275	Cf:G-077	<4	79	<10	2	<1	<1	47	<6
AEDC-276	Cf:G-078	<4	2	10	<1	<1	<1	22	<6
AEDC-277	Cf:G-079	760	<3	200	3	<1	<1	1,100	<18
AEDC-278	Cf:G-080	<4	<1	10	<1	<1	<1	69	<6
AEDC-279	Cf:G-081	<4	<1	<10	<1	<1	<1	25	<6
AEDC-280	Cf:G-082	<4	55	10	3	<1	<1	18	<6
AEDC-281	Cf:G-083	730	110	40	<1	<1	<1	7,700	<18
AEDC-282	Cf:G-084	48	2	<10	<1	<1	<1	86	<6
AEDC-283	Cf:G-085	<4	15	<10	3	<1	<1	11	<6
AEDC-284	Cf:G-086	<4	9	<10	<1	<1	<1	5	<6
AEDC-285	Cf:G-087	<4	9	<10	1	<1	<1	32	<6
AEDC-286	Cf:G-088	<4	1,400	<10	49	<1	<1	11	<6
AEDC-287	Cf:G-089	<4	13	<10	2	<2	<1	33	<6
AEDC-288	Cf:G-090	8	86	<10	<1	<1	<1	95	<6
AEDC-289	Cf:G-091	5	630	<10	7	<1	<1	32	<6
AEDC-290	Cf:G-092	<4	18	<10	3	<1	<1	13	<6
AEDC-292	Cf:G-094	<4	27	10	2	<1	<1	9	<6
AEDC-293	Cf:G-095	<4	13	<10	1	<1	<1	9	<6
J4-test cell	Cf:G-105	11	5	<10	<1	<1	<1	98	<6

APPENDIX 2

Volatile organic compounds in water from wells sampled at Arnold Engineering Development Center

Volatile organic compounds in water from wells sampled at Arnold Engineering Development Center

[µg/L, microgram per liter; SH, shallow aquifer; MN, Manchester aquifer; FP, Fort Payne aquifer; UCB, upper Central Basin aquifer. Values given as < (less than) indicate that the concentration was below the detection level of the analytical method used and does not indicate the presence or absence of the constituent]

AEDC well number	Tennessee local well number	Station number	Aquifer	Date	Dibromomethane water whole recover (µg/L)	Dichlorobromomethane, total (µg/L)	Carbontetrachloride, total (µg/L)	1,2-dichloroethane, total (µg/L)	Bromoform, total (µg/L)	Chlorodibromomethane, total (µg/L)
AEDC-30	Cf:G-102	352246086031301	SH	07-25-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-31	Cf:G-104	352246086031303	MN	07-28-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-64	Cf:G-103	352246086031302	MN	07-26-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-83	Cf:G-099	352254086025501	SH	07-26-94	<0.2	<0.2	<0.2	0.3	<0.2	<0.2
AEDC-154	Cf:G-097	352249086030902	MN	07-27-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-155	Cf:G-098	352249086030903	FP	07-27-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-158	Cf:G-100	352254086025502	MN	07-26-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-159	Cf:G-101	352254086025503	FP	07-27-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-175	Cf:G-009	352247086031301	UCB	07-25-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-267	Cf:G-069	352247086031501	MN	07-28-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-268[1]	Cf:G-070	352258086031201	UCB	07-21-94	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
AEDC-269	Cf:G-071	352258086031202	MN	07-21-94	<0.2	<0.2	<0.2	1.1	<0.2	<0.2
AEDC-270	Cf:G-072	352256086031601	FP	07-27-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-271	Cf:G-073	352256086031602	MN	07-22-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-272	Cf:G-074	352301086030601	MN	07-25-94	<0.2	<0.2	<0.2	0.3	<0.2	<0.2
AEDC-273	Cf:G-075	352304086031401	FP	07-22-94	<0.2	<0.2	<0.2	9.9	<0.2	<0.2
AEDC-274	Cf:G-076	352304086031402	MN	07-20-94	<0.2	<0.2	2.0	45	<0.2	<0.2
AEDC-275	Cf:G-077	352304086031403	SH	07-21-94	<0.2	<0.2	<0.2	0.4	<0.2	<0.2
AEDC-276	Cf:G-078	352301086025501	MN	07-19-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-277	Cf:G-079	352258086030001	UCB	07-25-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-278	Cf:G-080	352258086030002	MN	07-18-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-279	Cf:G-081	352258086030003	MN	07-19-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-280	Cf:G-082	352258086030004	SH	07-19-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-281	Cf:G-083	352254086025504	UCB	07-26-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-282	Cf:G-084	352311086031701	FP	07-28-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-283	Cf:G-085	352311086031702	MN	07-27-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-284	Cf:G-086	352311086031703	SH	07-27-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-285	Cf:G-087	352313086030801	MN	07-20-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-286	Cf:G-088	352313086030802	MN	07-20-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-287	Cf:G-089	352313086030803	SH	07-20-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-288	Cf:G-090	352315086025101	FP	07-21-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-289	Cf:G-091	352315086025102	MN	07-21-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-290	Cf:G-092	352315086025103	SH	07-21-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-292	Cf:G-094	352309086024502	MN	07-22-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-293	Cf:G-095	352309086024503	SH	07-28-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
J4-test cell	Cf:G-105	352256086030601	--	07-28-94	<0.2	<0.2	<0.2	0.4	<0.2	<0.2

[1]Method reporting limits raised due to lab dilution of sample.

Volatile organic compounds in water from wells sampled at Arnold Engineering Development Center--Continued

AEDC well number	Tennessee local well number	Chloro-form, total (µg/L)	Toluene, total (µg/L)	Benzene, total (µg/L)	Acro-lein, total (µg/L)	Acrylo-nitrile, total (µg/L)	Chloro-benzene, total (µg/L)	Chloro-ethane, total (µg/L)	Ethyl-benzene, total (µg/L)
AEDC-30	Cf:G-102	<0.2	<0.2	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-31	Cf:G-104	<0.2	<0.2	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-64	Cf:G-103	0.2	0.2	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-83	Cf:G-099	1.3	0.2	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-154	Cf:G-097	<0.2	<0.2	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-155	Cf:G-098	<0.2	<0.2	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-158	Cf:G-100	3.6	<0.2	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-159	Cf:G-101	2.1	0.2	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-175	Cf:G-009	<0.2	910	1,600	<20	<20	<0.2	<2.8	68
AEDC-267	Cf:G-069	<0.2	0.2	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-268[1]	Cf:G-070	<2.0	940	2,200	<200	<200	<2.0	<2.0	77
AEDC-269	Cf:G-071	0.2	0.2	0.2	<20	<20	<0.2	0.2	<0.2
AEDC-270	Cf:G-072	<0.2	<0.2	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-271	Cf:G-073	<0.2	0.2	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-272	Cf:G-074	<0.2	<0.2	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-273	Cf:G-075	0.5	0.5	0.3	<20	<20	<0.2	<0.2	<0.2
AEDC-274	Cf:G-076	2.8	0.4	1.1	<20	<20	<0.2	<0.2	<0.2
AEDC-275	Cf:G-077	0.3	0.3	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-276	Cf:G-078	0.3	0.2	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-277	Cf:G-079	<0.2	110	130	<20	<20	<0.2	<0.2	15
AEDC-278	Cf:G-080	0.6	0.3	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-279	Cf:G-081	0.7	0.3	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-280	Cf:G-082	2.0	<0.2	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-281	Cf:G-083	<0.2	350	650	<20	<20	<0.2	<0.2	30
AEDC-282	Cf:G-084	<0.2	0.5	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-283	Cf:G-085	<0.2	<0.2	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-284	Cf:G-086	<0.2	<0.2	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-285	Cf:G-087	<0.2	0.3	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-286	Cf:G-088	<0.2	0.3	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-287	Cf:G-089	0.4	<0.2	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-288	Cf:G-090	<0.2	0.3	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-289	Cf:G-091	<0.2	0.3	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-290	Cf:G-092	<0.2	0.2	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-292	Cf:G-094	<0.2	<0.2	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-293	Cf:G-095	<0.2	<0.2	<0.2	<20	<20	<0.2	<0.2	<0.2
J4-test cell	Cf:G-105	0.6	<0.2	1.4	<20	<20	<0.2	<0.2	<0.2

[1]Method reporting limits raised due to lab dilution of sample.

Volatile organic compounds in water from wells sampled at Arnold Engineering Development Center--Continued

AEDC well number	Tennessee local well number	Methyl-bromide, total (μg/L)	Methyl-chlo-ride, total (μg/L)	Methyl-ene chlo-ride, total (μg/L)	Tetra-chloro-ethyl-ene, total (μg/L)	Tri-chloro-fluoro-methane, total (μg/L)	1,1-di-chloro-ethane, total (μg/L)	1,1-di-chloro-ethyl-ene, total (μg/L)	1,1,1-tri-chloro-ethane, total (μg/L)
AEDC-30	Cf:G-102	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-31	Cf:G-104	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-64	Cf:G-103	<0.2	<0.2	<0.2	<0.2	0.4	2.1	23	19
AEDC-83	Cf:G-099	<0.2	<0.2	<0.2	0.4	1.1	6.3	29	1.1
AEDC-154	Cf:G-097	<0.2	<0.2	<0.2	<0.2	<0.2	1.9	1.5	0.8
AEDC-155	Cf:G-098	<0.2	<0.2	<0.2	<0.2	<0.2	0.3	2.1	0.3
AEDC-158	Cf:G-100	<0.2	<0.2	<0.2	0.3	2.4	1.6	5.3	0.2
AEDC-159	Cf:G-101	<0.2	<0.2	<0.2	0.7	0.4	0.9	1.9	<0.2
AEDC-175	Cf:G-009	<0.2	<7.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-267	Cf:G-069	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.9	1.5
AEDC-268[1]	Cf:G-070	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
AEDC-269	Cf:G-071	<0.2	<0.2	<0.2	4.6	0.7	3.6	25	19
AEDC-270	Cf:G-072	<0.2	<0.2	<0.2	<0.2	0.3	<0.2	0.2	<0.2
AEDC-271	Cf:G-073	<0.2	<0.2	<0.2	0.5	<0.2	3.3	7.9	1.8
AEDC-272	Cf:G-074	<0.2	<0.2	<0.2	1.9	17	8.8	22	4.2
AEDC-273	Cf:G-075	<0.2	<0.2	<0.2	0.4	1.0	1.1	52	5.1
AEDC-274	Cf:G-076	<0.2	<0.2	0.4	0.9	14	5.3	320	35
AEDC-275	Cf:G-077	<0.2	<0.2	<0.2	<0.2	<0.2	1.2	5.2	3.2
AEDC-276	Cf:G-078	<0.2	<0.2	<0.2	<0.2	1.2	0.4	0.3	<0.2
AEDC-277	Cf:G-079	<0.2	<10	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-278	Cf:G-080	<0.2	<0.2	<0.2	0.2	2.2	1.7	12	3.7
AEDC-279	Cf:G-081	<0.2	<0.2	<0.2	1.2	1.1	0.4	2.7	1.0
AEDC-280	Cf:G-082	<0.2	<0.2	<0.2	<0.2	0.4	<0.2	<0.2	<0.2
AEDC-281	Cf:G-083	<0.2	<13	<0.2	<0.2	<0.2	0.4	<0.2	<0.2
AEDC-282	Cf:G-084	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-283	Cf:G-085	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-284	Cf:G-086	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-285	Cf:G-087	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-286	Cf:G-088	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-287	Cf:G-089	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-288	Cf:G-090	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-289	Cf:G-091	<0.2	<0.2	<0.2	<0.2	<0.2	0.4	0.2	<0.2
AEDC-290	Cf:G-092	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-292	Cf:G-094	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.7	<0.2
AEDC-293	Cf:G-095	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
J4-test cell	Cf:G-105	<0.2	<0.2	<0.2	48	49	3.5	17	27

[1]Method reporting limits raised due to lab dilution of sample.

Volatile organic compounds in water from wells sampled at Arnold Engineering Development Center--Continued

AEDC well number	Tennessee local well number	1,1,2-tri-chloro-ethane, total (µg/L)	Ethane, 1,1,2,2 tetra-chloro-wat unf, rec (µg/L)	Benzene o-chloro-water unfltrd, rec (µg/L)	1,2-di-chloro-propane, total (µg/L)	1,2-transdi chloro-ethene, total (µg/L)	Benzene 1,2,4-tri-chloro-wat unf, rec (µg/L)	Benzene 1,3-di-chloro-water unfltrd, rec (µg/L)	Benzene 1,4-di-chloro-water unfltrd, rec (µg/L)
AEDC-30	Cf:G-102	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-31	Cf:G-104	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-64	Cf:G-103	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-83	Cf:G-099	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-154	Cf:G-097	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-155	Cf:G-098	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-158	Cf:G-100	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-159	Cf:G-101	0.4	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-175	Cf:G-009	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-267	Cf:G-069	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-268[1]	Cf:G-070	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
AEDC-269	Cf:G-071	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-270	Cf:G-072	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-271	Cf:G-073	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-272	Cf:G-074	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-273	Cf:G-075	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-274	Cf:G-076	0.8	<0.2	0.5	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-275	Cf:G-077	<0.2	<0.2	<0.2	<0.2	4.5	<0.2	<0.2	<0.2
AEDC-276	Cf:G-078	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-277	Cf:G-079	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-278	Cf:G-080	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-279	Cf:G-081	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-280	Cf:G-082	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-281	Cf:G-083	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-282	Cf:G-084	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-283	Cf:G-085	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-284	Cf:G-086	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-285	Cf:G-087	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-286	Cf:G-088	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-287	Cf:G-089	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-288	Cf:G-090	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-289	Cf:G-091	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-290	Cf:G-092	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-292	Cf:G-094	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-293	Cf:G-095	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
J4-test cell	Cf:G-105	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

[1]Method reporting limits raised due to lab dilution of sample.

Volatile organic compounds in water from wells sampled at Arnold Engineering Development Center--Continued

AEDC well number	Tennessee local well number	2-Chloro-ethyl-vinyl-ether, total (µg/L)	Di-chloro-di-fluoro-methane, total (µg/L)	Naphth-alene, total (µg/L)	Trans-1,3-di-chloro-propene, total (µg/L)	Cis 1,3-di-chloro-propene, total (µg/L)	Vinyl chlo-ride, total (µg/L)	Tri-chloro-ethyl-ene, total (µg/L)	Hexa-chloro-but-adiene, total (µg/L)
AEDC-30	Cf:G-102	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-31	Cf:G-104	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-64	Cf:G-103	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	15	<0.2
AEDC-83	Cf:G-099	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	1.5	<0.2
AEDC-154	Cf:G-097	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	4.8	<0.2
AEDC-155	Cf:G-098	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	1.7	<0.2
AEDC-158	Cf:G-100	<1.0	0.7	<0.2	<0.2	<0.2	<0.2	0.5	<0.2
AEDC-159	Cf:G-101	<1.0	0.7	<0.2	<0.2	<0.2	<0.2	580	<0.2
AEDC-175	Cf:G-009	<1.0	<0.2	17	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-267	Cf:G-069	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-268[1]	Cf:G-070	<10	<2.0	10	<2.0	<2.0	<2.0	<2.0	<2.0
AEDC-269	Cf:G-071	<1.0	<0.2	<0.2	<0.2	<0.2	0.7	43	<0.2
AEDC-270	Cf:G-072	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	2.0	<0.2
AEDC-271	Cf:G-073	<1.0	<0.2	<0.2	<0.2	<0.2	0.3	17	<0.2
AEDC-272	Cf:G-074	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	0.5	<0.2
AEDC-273	Cf:G-075	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	140	<0.2
AEDC-274	Cf:G-076	<1.0	2.0	<0.2	<0.2	<0.2	<0.2	1,200	<0.2
AEDC-275	Cf:G-077	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	6.7	<0.2
AEDC-276	Cf:G-078	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-277	Cf:G-079	<1.0	<0.2	1.5	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-278	Cf:G-080	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	2.6	<0.2
AEDC-279	Cf:G-081	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	1.0	<0.2
AEDC-280	Cf:G-082	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-281	Cf:G-083	<1.0	<0.2	1.5	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-282	Cf:G-084	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-283	Cf:G-085	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-284	Cf:G-086	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-285	Cf:G-087	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-286	Cf:G-088	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-287	Cf:G-089	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-288	Cf:G-090	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-289	Cf:G-091	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-290	Cf:G-092	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-292	Cf:G-094	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	0.3	<0.2
AEDC-293	Cf:G-095	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
J4-test cell	Cf:G-105	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	240	<0.2

[1]Method reporting limits raised due to lab dilution of sample.

Volatile organic compounds in water from wells at Arnold Engineering Development Center--Continued

AEDC well number	Tennessee local well number	Cis-1,2 -di-chloro-ethene, water, total (µg/L)	Styrene, total (µg/L)	1,1-Di chloro-pro-pene, wat, wh, total (µg/L)	2,2-Di chloro-pro-pane wat, wh, total (µg/L)	1,3-Di-chloro-propane wat. wh, total (µg/L)	Pseudo-cumene water unfltrd, rec (µg/L)	Iso-propyl-benzene water, whole, rec (µg/L)	Benzene n-propy water, unfltrd, rec (µg/L)
AEDC-30	Cf:G-102	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-31	Cf:G-104	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-64	Cf:G-103	0.5	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-83	Cf:G-099	0.4	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-154	Cf:G-097	0.4	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-155	Cf:G-098	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-158	Cf:G-100	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-159	Cf:G-101	18	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-175	Cf:G-009	<0.2	2.1	<0.2	<0.2	<0.2	24	6.7	6.8
AEDC-267	Cf:G-069	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-268[1]	Cf:G-070	<2.0	4.0	<2.0	<2.0	<2.0	42	7.4	7.5
AEDC-269	Cf:G-071	8.3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-270	Cf:G-072	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-271	Cf:G-073	3.1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-272	Cf:G-074	0.4	<0.2	<0.2	<0.2	<0.2	<0.2	0.20	<0.2
AEDC-273	Cf:G-075	0.3	<0.2	<0.2	<0.2	<0.2	0.20	<0.2	<0.2
AEDC-274	Cf:G-076	0.3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-275	Cf:G-077	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-276	Cf:G-078	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-277	Cf:G-079	<0.2	0.6	<0.2	<0.2	<0.2	11	2.2	2.6
AEDC-278	Cf:G-080	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-279	Cf:G-081	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-280	Cf:G-082	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-281	Cf:G-083	1.1	1.3	<0.2	<0.2	<0.2	16	3.9	3.9
AEDC-282	Cf:G-084	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-283	Cf:G-085	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-284	Cf:G-086	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-285	Cf:G-087	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-286	Cf:G-088	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-287	Cf:G-089	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-288	Cf:G-090	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-289	Cf:G-091	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-290	Cf:G-092	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-292	Cf:G-094	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-293	Cf:G-095	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
J4-test cell	Cf:G-105	0.9	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

[1]Method reporting limits raised due to lab dilution of sample.

Volatile organic compounds in water from wells sampled at Arnold Engineering Development Center--Continued

AEDC well number	Tennessee local well number	Mesit- ylene, water, unfltrd, rec (µg/L)	O- chloro- toluene, water, whole, total, (µg/L)	Toluene p-chlor, water, unfltrd, rec (µg/L)	Methane bromo chloro-, water, unfltrd, rec (µg/L)	Benzene n-butyl, water, unfltrd, rec (µg/L)	Benzene sec butyl-, water, unfltrd, rec (µg/L)	Benzene tert- butyl-, water, unfltrd, rec (µg/L)	P-iso- propyl- toluene, water, whole, rec (µg/L)
AEDC-30	Cf:G-102	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-31	Cf:G-104	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-64	Cf:G-103	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-83	Cf:G-099	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-154	Cf:G-097	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-155	Cf:G-098	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-158	Cf:G-100	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-159	Cf:G-101	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-175	Cf:G-009	4.6	<0.2	<0.2	<0.2	1.0	1.1	<0.2	2.0
AEDC-267	Cf:G-069	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-268[1]	Cf:G-070	7.0	<2.0	<2.0	<2.00	<2.0	<2.0	<2.0	<2.0
AEDC-269	Cf:G-071	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-270	Cf:G-072	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-271	Cf:G-073	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-272	Cf:G-074	<0.2	<0.2	<0.2	<0.2	<0.2	0.2	<0.2	<0.2
AEDC-273	Cf:G-075	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-274	Cf:G-076	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-275	Cf:G-077	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-276	Cf:G-078	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-277	Cf:G-079	2.0	<0.2	<0.2	<0.2	0.4	0.5	<0.2	1.1
AEDC-278	Cf:G-080	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-279	Cf:G-081	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-280	Cf:G-082	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-281	Cf:G-083	3.3	<0.2	<0.2	<0.2	0.5	0.8	<0.2	1.2
AEDC-282	Cf:G-084	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-283	Cf:G-085	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-284	Cf:G-086	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-285	Cf:G-087	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-286	Cf:G-088	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-287	Cf:G-089	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-288	Cf:G-090	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-289	Cf:G-091	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-290	Cf:G-092	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-292	Cf:G-094	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-293	Cf:G-095	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
J4-test cell	Cf:G-105	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

[1]Method reporting limits raised due to lab dilution of sample.

Volatile organic compounds in water from wells sampled at Arnold Engineering Development Center--Continued

AEDC well number	Tennessee local well number	1,2,3-Tri chloro-propane, water, whole, total (µg/L)	Ethane, 1,1,1,2-tetra-chloro-, wat, unf, rec (µg/L)	1,2,3-Tri-chloro benzene, wat, wh, rec (µg/L)	1,2-Dibromo ethane water, whole, total (µg/L)	Freon-113 water, unfltrd, rec (µg/L)	Methyl ether tert-butyl, wat unf, rec (µg/L)	Xylene, water, unfltrd, rec (µg/L)	Bromo-benzene water, whole, total (µg/L)	Dibromo chloro-propane, water, whole, tot.rec (µg/L)
AEDC-30	Cf:G-102	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-31	Cf:G-104	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-64	Cf:G-103	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-83	Cf:G-099	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-154	Cf:G-097	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-155	Cf:G-098	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-158	Cf:G-100	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-159	Cf:G-101	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-175	Cf:G-009	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	210	<0.2	<1.0
AEDC-267	Cf:G-069	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-268[1]	Cf:G-070	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	280	<2.0	<10
AEDC-269	Cf:G-071	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-270	Cf:G-072	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-271	Cf:G-073	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-272	Cf:G-074	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-273	Cf:G-075	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.30	<0.2	<1.0
AEDC-274	Cf:G-076	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-275	Cf:G-077	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-276	Cf:G-078	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-277	Cf:G-079	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	52	<0.2	<1.0
AEDC-278	Cf:G-080	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-279	Cf:G-081	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-280	Cf:G-082	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-281	Cf:G-083	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	110	<0.2	<1.0
AEDC-282	Cf:G-084	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.50	<0.2	<1.0
AEDC-283	Cf:G-085	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-284	Cf:G-086	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-285	Cf:G-087	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-286	Cf:G-088	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-287	Cf:G-089	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-288	Cf:G-090	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-289	Cf:G-091	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-290	Cf:G-092	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-292	Cf:G-094	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-293	Cf:G-095	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
J4-test cell	Cf:G-105	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0

[1]Method reporting limits raised due to lab dilution of sample.

APPENDIX 3

Non-target volatile organic compounds detected by the laboratory

Non-target volatile organic compounds detected by the laboratory

AEDC well number	Compound	Concentration (micrograms per liter)
AEDC 64	Acetone	4,300
AEDC 155	Tetrahydrofuran	Not quantified
AEDC 175	Acetone	460
	2-ethyltoluene	7.4
	1,2,3-trimethylbenzene	18
	1,2,3,4-tetramethylbenzene	2.3
	1,2,3,5-tetramethylbenzene	0.4
	Carbon disulfide	0.2
	2-butanone	190
	2-hexanone	9
AEDC 268	2-ethyltoluene	11
	1,2,3-trimethylbenzene	34
	1,2,3,4-tetramethylbenzene	4.1
	1,2,3,5-tetramethylbenzene	9
AEDC 268 Field Duplicate	2-ethyltoluene	11
	1,2,3-trimethylbenzene	34
	1,2,3,4-tetramethylbenzene	4.0
	1,2,3,5-tetramethylbenzene	9.8
AEDC 270	Acetone	54
AEDC 273	Acetone	16
	2-ethyltoluene	0.1
	1,2,3-trimethylbenzene	0.2
	1,2,3,4-tetramethylbenzene	0.2
AEDC 277	Acetone	37
	2-ethyltoluene	2.8
	1,2,3-trimethylbenzene	6.5
	1,2,3,4-tetramethylbenzene	1.0
	1,2,3,5-tetramethylbenzene	0.2
	2-butanone	12
AEDC 281	2-ethyltoluene	4.5
	1,2,3-trimethylbenzene	12
	1,2,3,4-tetramethylbenzene	1.6
	1,2,3,5-tetramethylbenzene	0.3
AEDC 285	Acetone	7.0
J-4 Test cell	cis-1,2-dibromoethene	Not quantified
	trans-1,2-dibromoethene	Not quantified
	Tribromoethene	Not quantified

APPENDIX 4

Field quality-assurance data for volatile organic compounds for wells sampled at Arnold Engineering Development Center

Field quality-assurance data for volatile organic compounds for wells sampled at Arnold Engineering Development Center

[µg/L, microgram per liter. Values given as < (less than) indicate that the concentration was below the detection level of the analytical method used and does not indicate the presence or absence of the constituent]

Quality-assurance sample identifier	Station number	Date	Di-bromo-methane, water, whole, recover (µg/L)	Di-chloro-bromo-methane, total (µg/L)	Carbon-tetra-chlo-ride, total (µg/L)	1,2-di-chloro-ethane, total (µg/L)	Bromo-form, total (µg/L)	Chloro-di-bromo-methane, total (µg/L)
AEDC-268 Duplicate[1]	352258086031201	07-21-94	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
AEDC-292 Duplicate	352309086024502	07-22-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-268 Equipment blank	352258086031201	07-21-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-277 Equipment blank	352258086030001	07-25-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-285 Equipment blank	352313086030801	07-20-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-293 Equipment blank	352309086024503	07-28-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Trip blank A	352256086030601	07-22-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Trip blank B	352256086030601	07-27-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Trip blank C	352256086030601	07-28-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Trip blank D	352256086030601	07-28-94	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

Quality-assurance sample identifier	Chloro-form, total (µg/L)	Toluene, total (µg/L)	Benzene, total (µg/L)	Acro-lein, total (µg/L)	Acrylo-nitrile, total (µg/L)	Chloro-benzene, total (µg/L)	Chloro-ethane, total (µg/L)	Ethyl-benzene, total (µg/L)
AEDC-268 Duplicate[1]	<2.0	1,000	2,300	<200	<200	<2.0	<2.0	72
AEDC-292 Duplicate	<0.2	<0.2	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-268 Equipment blank	<0.2	0.2	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-277 Equipment blank	<0.2	<0.2	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-285 Equipment blank	<0.2	<0.2	<0.2	<20	<20	<0.2	<0.2	<0.2
AEDC-293 Equipment blank	<0.2	<0.2	<0.2	<20	<20	<0.2	<0.2	<0.2
Trip blank A	<0.2	<0.2	<0.2	<20	<20	<0.2	<0.2	<0.2
Trip blank B	<0.2	<0.2	<0.2	<20	<20	<0.2	<0.2	<0.2
Trip blank C	<0.2	<0.2	<0.2	<20	<20	<0.2	<0.2	<0.2
Trip blank D	<0.2	<0.2	<0.2	<20	<20	<0.2	<0.2	<0.2

[1]Method reporting limits raised due to lab dilution of sample.

Field quality-assurance data for volatile organic compounds for wells sampled at Arnold Engineering Development Center--Continued

Quality-assurance sample identifier	Methyl-bromide, total (µg/L)	Methyl-chlo-ride, total (µg/L)	Methyl-ene chlo-ride, total (µg/L)	Tetra-chloro-ethyl-ene, total (µg/L)	Tri-chloro-fluoro-methane, total (µg/L)	1,1-di-chloro-ethane, total (µg/L)	1,1-di-chloro-ethyl-ene, total (µg/L)	1,1,1-tri-chloro-ethane, total (µg/L)
AEDC-268 Duplicate[1]	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
AEDC-292 Duplicate	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.7	<0.2
AEDC-268 Equipment blank	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-277 Equipment blank	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-285 Equipment blank	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-293 Equipment blank	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Trip blank A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Trip blank B	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Trip blank C	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Trip blank D	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

Quality-assurance sample identifier	1,1,2-tri-chloro-ethane, total (µg/L)	Ethane, 1,1,2,2 tetra-chloro-, wat, unf, rec (µg/L)	Benzene o-chloro-water, unfltrd, rec (µg/L)	1,2-di-chloro-propane, total (µg/L)	1,2-transdi chloro-ethene, total (µg/L)	Benzene 1,2,4-tri-chloro-, wat, unf, rec (µg/L)	Benzene 1,3-di-chloro-, water, unfltrd, rec (µg/L)	Benzene 1,4-di-chloro-, water, unfltrd, rec (µg/L)
AEDC-268 Duplicate[1]	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
AEDC-292 Duplicate	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-268 Equipment blank	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-277 Equipment blank	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-285 Equipment blank	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-293 Equipment blank	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Trip blank A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Trip blank B	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Trip blank C	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Trip blank D	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

[1]Method reporting limits raised due to lab dilution of sample.

Field quality-assurance data for volatile organic compounds for wells sampled at Arnold Engineering Development Center--Continued

Quality-assurance sample identifier	2-chloro-ethyl-vinyl-ether, total (µg/L)	Di-chloro-di-fluoro-methane, total (µg/L)	Naphth-alene, total (µg/L)	Trans-1,3-di-chloro-propene, total (µg/L)	Cis 1,3-di-chloro-propene, total (µg/L)	Vinyl chlo-ride, total (µg/L)	Tri-chloro-ethyl-ene, total (µg/L)	Hexa-chloro-but-adiene, total (µg/L)
AEDC-268 Duplicate[1]	<10	<2.0	10	<2.0	<2.0	<2.0	<2.0	<2.0
AEDC-292 Duplicate	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	0.3	<0.2
AEDC-268 Equipment blank	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-277 Equipment blank	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-285 Equipment blank	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-293 Equipment blank	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Trip blank A	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Trip blank B	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Trip blank C	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Trip blank D	<1.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

Quality-assurance sample identifier	Cis-1,2 -di-chloro-ethene, water, total (µg/L)	Styrene, total (µg/L)	1,1-di chloro-pro-pene, wat, wh, total (µg/L)	2,2-di chloro-pro-pane, wat, wh, total (µg/L)	1,3-di-chloro-propane, wat. wh, total (µg/L)	Pseudo-cumene, water, unfltrd, rec (µg/L)	Iso-propyl-benzene, water, whole, rec (µg/L)	Benzene n-propy, water, unfltrd, rec (µg/L)
AEDC-268 Duplicate [1]	<2.0	4.0	<2.0	<2.0	<2.0	42	7.1	7.5
AEDC-292 Duplicate	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-268 Equipment blank	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-277 Equipment blank	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-285 Equipment blank	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-293 Equipment blank	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Trip blank A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Trip blank B	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Trip blank C	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Trip blank D	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

[1]Method reporting limits raised due to lab dilution of sample.

Field quality-assurance data for volatile organic compounds for wells sampled at Arnold Engineering Development Center--Continued

Quality-assurance sample identifier	Mesit-ylene, water, unfltrd, rec (µg/L)	O-chloro-toluene, water, whole, total (µg/L)	Toluene p-chlor, water, unfltrd, rec (µg/L)	Methane bromo chloro-, water, unfltrd, rec (µg/L)	Benzene n-butyl, water, unfltrd, rec (µg/L)	Benzene sec butyl-, water, unfltrd, rec (µg/L)	Benzene tert-butyl-, water, unfltrd, rec (µg/L)	P-iso-propyl-toluene water, whole, rec (µg/L)
AEDC-268 Duplicate[1]	6.5	<2.0	<2.0	<2.00	<2.0	<2.0	<2.0	<2.0
AEDC-292 Duplicate	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-268 Equipment blank	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-277 Equipment blank	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-285 Equipment blank	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
AEDC-293 Equipment blank	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Trip blank A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Trip blank B	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Trip blank C	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Trip blank D	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

Quality-assurance sample identifier	123-tri chloro-propane, water, whole, total (µg/L)	Ethane, 1112-tetra-chloro-, wat, unf, rec (µg/L)	1,2,3-tri-chloro benzene, wat, wh, rec (µg/L)	1,2-dibromo ethane, water, whole, total (µg/L)	Freon-113, water, unfltrd, rec (µg/L)	Methyl ether tert-butyl, wat, unf, rec (µg/L)	Xylene, water, unfltrd, rec (µg/L)	Bromo-benzene, water, whole, total (µg/L)	Dibromo chloro-propane, water, whole, tot.rec (µg/L)
AEDC-268 Duplicate[1]	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	280	<2.0	<10
AEDC-292 Duplicate	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-268 Equipment blank	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-277 Equipment blank	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-285 Equipment blank	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
AEDC-293 Equipment blank	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
Trip blank A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
Trip blank B	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
Trip blank C	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0
Trip blank D	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<1.0

[1]Method reporting limits raised due to lab dilution of sample.

APPENDIX 5

Field duplicate-sample analysis

Field duplicate-sample analysis

[µg/L, microgram per liter; --, no data. Values given as < (less than) indicate that the concentration was below the detection level of the analytical method used and does not indicate the presence or absence of the constituent]

Compound	AEDC-268[1]			AEDC-292		
	Original (µg/L)	Duplicate (µg/L)	Relative percent difference[2]	Original (µg/L)	Duplicate (µg/L)	Relative percent difference[2]
Dichlorodifluoromethane	<2.0	<2.0	--	<0.2	<0.2	--
Chloromethane	<2.0	<2.0	--	<0.2	<0.2	--
Vinyl chloride	<2.0	<2.0	--	<0.2	<0.2	--
Bromomethane	<2.0	<2.0	--	<0.2	<0.2	--
Chloroethane	<2.0	<2.0	--	<0.2	<0.2	--
Trichlorofluoromethane	<2.0	<2.0	--	<0.2	<0.2	--
Acrolein	<200	<200	--	<20	<20	--
1,1-Dichloroethene	<2.0	<2.0	--	0.7	0.7	0.0
Methylene chloride	<2.0	<2.0	--	<0.2	<0.2	--
Trans-1,2-Dichloroethene	<2.0	<2.0	--	<0.2	<0.2	--
Acrylonitrile	<200	<200	--	<20	<20	--
MTBE	<2.0	<2.0	--	<0.2	<0.2	--
1,1-Dichloroethane	<2.0	<2.0	--	<0.2	<0.2	--
2,2-Dichloropropane	<2.0	<2.0	--	<0.2	<0.2	--
Bromochloromethane	<2.0	<2.0	--	<0.2	<0.2	--
Cis-1,2-Dichloroethene	<2.0	<2.0	--	<0.2	<0.2	--
Chloroform	<2.0	<2.0	--	<0.2	<0.2	--
1,1,1-Trichloroethane	<2.0	<2.0	--	<0.2	<0.2	--
Carbon tetrachloride	<2.0	<2.0	--	<0.2	<0.2	--
1,1-Dichloropropene	<2.0	<2.0	--	<0.2	<0.2	--
Benzene	2,200	2,300	4.4	<0.2	<0.2	--
1,2-Dichloroethane	<2.0	<2.0	--	<0.2	<0.2	--
Trichloroethene	<2.0	<2.0	--	0.3	0.3	0.0
1,2-Dichloropropane	<2.0	<2.0	--	<0.2	<0.2	--
Bromodichloromethane	<2.0	<2.0	--	<0.2	<0.2	--
Dibromomethane	<2.0	<2.0	--	<0.2	<0.2	--
2-chloroethylvinylether	<10	<10	--	<1.0	<1.0	--
Cis-1,3-Dichloropropene	<2.0	<2.0	--	<0.2	<0.2	--
Toluene	940	1,000	6.2	<0.2	<0.2	--
Trans-1,3-Dichloropropene	<2.0	<2.0	--	<0.2	<0.2	--
1,1,2-Trichloroethane	<2.0	<2.0	--	<0.2	<0.2	--

[1]Method reporting limits raised due to lab dilution of sample.

[2]The relative percent difference is calculated as the difference between the reported values divided by their average.

Field duplicate-sample analysis—Continued

Compound	AEDC-268[1]			AEDC-292		
	Original (µg/L)	Duplicate (µg/L)	Relative percent difference[2]	Original (µg/L)	Duplicate (µg/L)	Relative percent difference[2]
Tetrachloroethene	<2.0	<2.0	--	<0.2	<0.2	--
1,3-Dichloropropane	<2.0	<2.0	--	<0.2	<0.2	--
Dibromochloromethane	<2.0	<2.0	--	<0.2	<0.2	--
1,2-dibromoethane (EDB)	<2.0	<2.0	--	<0.2	<0.2	--
Chlorobenzene	<2.0	<2.0	--	<0.2	<0.2	--
1,1,1,2-Tetrachloroethane	<2.0	<2.0	--	<0.2	<0.2	--
Ethylbenzene	77	72	6.7	<0.2	<0.2	--
Xylenes (total)	280	280	0.0	<0.2	<0.2	--
Styrene	4.0	4.0	0.0	<0.2	<0.2	--
Bromoform	<2.0	<2.0	--	<0.2	<0.2	--
Isopropyl benzene	7.4	7.1	4.1	<0.2	<0.2	--
1,1,2,2-Tetrachoroethane	<2.0	<2.0	--	<0.2	<0.2	--
Bromobenzene	<2.0	<2.0	--	<0.2	<0.2	--
1,2,3-Trichloropropane	<2.0	<2.0	--	<0.2	<0.2	--
N-Propylbenzene	7.5	7.5	0.0	<0.2	<0.2	--
2-Chlorotoluene	<2.0	<2.0	--	<0.2	<0.2	--
tert-Butylbenzene	<2.0	<2.0	--	<0.2	<0.2	--
1,2,4-Trimethylbenzene	42	42	0.0	<0.2	<0.2	--
sec-Butylbenzene	<2.0	<2.0	--	<0.2	<0.2	--
p-Isopropyltoluene	<2.0	<2.0	--	<0.2	<0.2	--
1,3-Dichlorobenzene (meta)	<2.0	<2.0	--	<0.2	<0.2	--
1,4-Dichlorobenzene (para)	<2.0	<2.0	--	<0.2	<0.2	--
N-Butylbenzene	<2.0	<2.0	--	<0.2	<0.2	--
1,2-Dichlorobenzene (ortho)	<2.0	<2.0	--	<0.2	<0.2	--
1,2-Dibromo-3-Chloropropane	<10	<10	--	<1.0	<1.0	--
1,2,4-Trichlorobenzene	<2.0	<2.0	--	<0.2	<0.2	--
Hexachlorobutadiene	<2.0	<2.0	--	<0.2	<0.2	--
Naphthalene	10	10	0.0	<0.2	<0.2	--
1,2,3-Trichlorobenzene	<2.0	<2.0	--	<0.2	<0.2	--
4-Chlorotoluene	<2.0	<2.0	--	<0.2	<0.2	--
Trichlorotrifluoroethane	<2.0	<2.0	--	<0.2	<0.2	--
1,3,5-Trimethylbenzene	7.0	6.5	7.4	<0.2	<0.2	--

[1]Method reporting limits raised due to lab dilution of sample.
[2]The relative percent difference is calculated as the difference between the reported values divided by their average.

APPENDIX 6

Laboratory quality-control standards recovery percentages

Laboratory quality-control standards recovery percentages

Compound	Date of Analysis				
	07-27-94a	07-27-94b	07-28-94a	07-28-94b	07-29-94a
Dichlorodifluoromethane	120	117	287	129	287
Chloromethane	111	113	71	107	71
Vinyl chloride	108	107	50	104	50
Bromomethane	111	114	48	114	48
Chloroethane	113	115	31	117	31
Trichlorofluoromethane	82	80	109	67	109
Acrolein	103	91	107	93	107
1,1-Dichloroethene	104	100	129	95	129
Methylene chloride	101	99	112	101	112
Trans-1,2-dichloroethene	105	100	112	104	112
Acrylonitrile	97	88	85	95	85
MTBE	101	95	92	109	92
1,1-Dichloroethane	96	99	99	102	99
2,2-Dichloropropane	99	96	117	116	117
Bromochloromethane	104	103	104	102	104
Cis-1,2-dichloroethene	96	95	98	93	98
Chloroform	100	100	103	110	103
1,1,1-Trichloroethane	106	105	117	122	117
Carbon tetrachloride	105	103	113	120	113
1,1-Dichloropropene	104	104	114	110	114
Benzene	100	101	103	96	103
1,2-Dichloroethane	103	101	90	119	90
Trichloroethene	102	103	105	104	105
1,2-Dichloropropane	98	97	98	97	98
Bromodichloromethane	102	101	98	113	98
Dibromomethane	101	100	94	105	94
2-chloroethylvinylether	108	100	103	104	103
Cis-1,3-dichloropropene	108	106	111	112	111
Toluene	102	101	106	100	106
Trans-1,3-dichloropropene	106	104	108	116	108
1,1,2-Trichloroethane	99	99	102	97	102

Laboratory quality-control standards recovery percentages--Continued

Compound	Date of Analysis				
	07-27-94a	07-27-94b	07-28-94a	07-28-94b	07-29-94a
Tetrachloroethene	98	99	128	97	128
1,3-Dichloropropane	95	93	99	96	99
Dibromochloromethane	91	91	104	100	104
1,2-dibromoethane (EDB)	97	96	106	100	106
Chlorobenzene	96	97	114	95	114
1,1,1,2-Tetrachloroethane	100	99	114	105	114
Ethylbenzene	97	97	121	100	121
Xylenes (total)	98	97	114	102	114
Styrene	99	99	121	99	121
Bromoform	91	93	118	99	118
Isopropyl benzene	99	100	127	104	127
1,1,2,2-Tetrachoroethane	97	93	99	93	99
Bromobenzene	102	101	117	101	117
1,2,3-Trichloropropane	95	91	97	99	97
N-Propylbenzene	98	98	121	99	121
2-Chlorotoluene	91	88	112	102	112
tert-Butylbenzene	97	97	120	101	120
1,2,4-Trimethylbenzene	98	98	116	102	116
sec-Butylbenzene	98	98	128	102	128
p-Isopropyltoluene	102	103	129	105	129
1,3-Dichlorobenzene (meta)	96	94	109	94	109
1,4-Dichlorobenzene (para)	96	98	107	95	107
N-Butylbenzene	99	100	118	101	118
1,2-Dichlorobenzene (ortho)	97	97	104	94	104
1,2-Dibromo-3-chloropropane	84	76	90	95	90
1,2,4-Trichlorobenzene	102	104	115	91	115
Hexachlorobutadiene	94	96	121	89	121
Naphthalene	100	99	103	87	103
1,2,3-Trichlorobenzene	99	103	109	88	109
4-Chlorotoluene	98	97	119	98	119
Trichlorotrifluoroethane	98	96	121	95	121
1,3,5-Trimethylbenzene	99	98	122	104	122

Laboratory quality-control standards recovery percentages--Continued

Compound	Date of analysis			
	07-29-94b	07-30-94	08-02-94	08-04-94
Dichlorodifluoromethane	129	129	116	106
Chloromethane	107	105	104	98
Vinyl chloride	104	103	102	97
Bromomethane	114	111	85	85
Chloroethane	117	116	108	109
Trichlorofluoromethane	67	113	93	107
Acrolein	93	35	98	88
1,1-Dichloroethene	95	104	98	100
Methylene chloride	101	105	102	103
Trans-1,2-dichloroethene	104	106	105	109
Acrylonitrile	95	36	95	100
MTBE	109	110	111	112
1,1-Dichloroethane	102	105	103	103
2,2-Dichloropropane	116	114	111	106
Bromochloromethane	102	107	100	103
Cis-1,2-dichloroethene	93	97	92	94
Chloroform	110	113	106	107
1,1,1-Trichloroethane	122	126	116	115
Carbon tetrachloride	120	124	115	112
1,1-Dichloropropene	110	112	107	108
Benzene	96	99	97	98
1,2-Dichloroethane	119	126	115	118
Trichloroethene	104	107	102	101
1,2-Dichloropropane	97	99	99	98
Bromodichloromethane	113	116	113	110
Dibromomethane	105	109	103	105
2-chloroethylvinylether	104	103	108	105
Cis-1,3-Dichloropropene	112	112	110	104
Toluene	100	102	99	99
Trans-1,3-dichloropropene	116	117	115	108
1,1,2-Trichloroethane	97	102	101	101

Laboratory quality-control standards recovery percentages--Continued

Compound	Date of analysis			
	07-29-94b	07-30-94	08-02-94	08-04-94
Tetrachloroethene	97	96	94	92
1,3-Dichloropropane	96	98	98	101
Dibromochloromethane	100	102	103	96
1,2-dibromoethane (EDB)	100	101	102	102
Chlorobenzene	95	98	97	97
1,1,1,2-Tetrachloroethane	105	106	106	104
Ethylbenzene	100	101	101	101
Xylenes (total)	102	104	102	102
Styrene	99	101	99	100
Bromoform	99	98	103	90
Isopropyl benzene	104	105	104	104
1,1,2,2-Tetrachoroethane	93	96	99	98
Bromobenzene	101	102	98	97
1,2,3-Trichloropropane	99	101	98	99
N-Propylbenzene	99	101	98	98
2-Chlorotoluene	102	95	101	92
tert-Butylbenzene	101	103	101	101
1,2,4-Trimethylbenzene	102	106	104	104
sec-Butylbenzene	102	104	102	102
p-Isopropyltoluene	105	106	105	104
1,3-Dichlorobenzene (meta)	94	97	93	92
1,4-Dichlorobenzene (para)	95	98	96	93
N-Butylbenzene	101	103	104	105
1,2-Dichlorobenzene (ortho)	94	97	93	94
1,2-Dibromo-3-chloropropane	95	98	104	91
1,2,4-Trichlorobenzene	91	97	96	96
Hexachlorobutadiene	89	92	87	83
Naphthalene	87	101	100	109
1,2,3-Trichlorobenzene	88	95	94	94
4-Chlorotoluene	98	100	98	98
Trichlorotrifluoroethane	95	103	96	94
1,3,5-Trimethylbenzene	104	105	103	104

APPENDIX 7

Holding times and surrogate spike recovery percentages

Holding times and surrogate spike recovery percentages

[S1, D-4 1,2-dichloroethane; S2, D-8 toluene; S3, 1,4-bromofluorobenzene]

AEDC well number	Date sampled	Date analyzed	Holding time (days)	S1	S2	S3
AEDC-30	07-25-94	07-30-94	5	126	101	101
AEDC-31	07-26-94	08-05-94	10	132	102	103
AEDC-64	07-26-94	08-05-94	10	131	102	106
AEDC-83	07-26-94	08-05-94	10	123	101	105
AEDC-154	07-27-94	08-05-94	9	127	100	110
AEDC-155	07-27-94	08-06-94	10	110	99	106
AEDC-158	07-26-94	08-05-94	10	124	99	102
AEDC-159	07-27-94	08-05-94	9	129	100	105
AEDC-175	07-25-94	07-30-94	5	7[1]	164[1]	99
AEDC-267	07-28-94	08-07-94	10	110	101	102
AEDC-268	07-21-94	07-29-94	8	65	97	100
AEDC-269	07-21-94	07-28-94	7	96	100	97
AEDC-270	07-27-94	08-05-94	9	126	102	105
AEDC-271	07-22-94	07-30-94	8	128	101	99
AEDC-272	07-25-94	07-30-94	5	129	102	104
AEDC-273	07-22-94	07-30-94	8	130	101	106
AEDC-274	07-20-94	07-29-94	9	125	96	101
AEDC-275	07-21-94	07-29-94	8	99	101	97
AEDC-276	07-19-94	07-28-94	9	125	101	103
AEDC-277	07-25-94	07-30-94	5	116	109	105
AEDC-278	07-18-94	07-27-94	9	100	99	100
AEDC-279	07-19-94	07-28-94	9	126	101	103
AEDC-280	07-19-94	07-28-94	9	123	99	103
AEDC-281	07-26-94	08-05-94	10	25[1]	133[1]	104
AEDC-282	07-28-94	08-06-94	9	108	98	105
AEDC-283	07-27-94	08-06-94	10	111	102	104
AEDC-284	07-27-94	08-05-94	9	133	101	103

[1]Surrogate recovery out due to matrix effects

Holding times and surrogate spike recovery percentages—Continued

[S1, D-4 1,2-dichloroethane; S2, D-8 toluene; S3, 1,4-bromofluorobenzene]

AEDC well number	Date sampled	Date analyzed	Holding time (days)	S1	S2	S3
AEDC-285	07-20-94	07-29-94	9	125	101	101
AEDC-286	07-20-94	07-29-94	9	121	99	104
AEDC-287	07-20-94	07-29-94	9	124	101	102
AEDC-288	07-21-94	07-29-94	8	91	99	92
AEDC-289	07-21-94	07-29-94	8	95	102	101
AEDC-290	07-21-94	07-29-94	8	91	99	95
AEDC-292	07-22-94	08-02-94	11	116	100	107
AEDC-293	07-28-94	08-07-94	10	109	101	106
J-4 test cell	07-28-94	08-07-94	10	113	101	109
AEDC-268 Field duplicate	07-21-94	07-29-94	8	74	98	90
AEDC-292 Field duplicate	07-22-94	07-30-94	8	126	100	106
AEDC-287 Lab duplicate	07-20-94	07-29-94	9	123	101	105
AEDC-277 Equipment blank	07-25-94	07-30-94	5	127	102	102
AEDC-285 Equipment blank	07-20-94	07-27-94	7	101	100	95
AEDC-268 Equipment blank	07-21-94	07-29-94	8	97	101	95
AEDC-293 Equipment blank	07-28-94	08-06-94	9	114	101	101
Trip Blank A	07-22-94	07-29-94	7	121	99	102
Trip Blank B	07-27-94	08-04-94	8	118	99	105
Trip Blank C	07-28-94	08-06-94	9	107	100	103
Trip Blank D	07-28-94	08-06-94	9	110	101	103

APPENDIX 8

Laboratory duplicate-sample analysis

Laboratory duplicate-sample analysis

[Values given as < (less than) indicate that the concentration was below the detection level of the analytical method used and does not indicate the presence or absence of the constituent; --, no data]

Compound	AEDC-287		
	Original	Duplicate	Relative percent difference[1]
Dichlorodifluoromethane	<0.2	<0.2	--
Chloromethane	<0.2	<0.2	--
Vinyl chloride	<0.2	<0.2	--
Bromomethane	<0.2	<0.2	--
Chloroethane	<0.2	<0.2	--
Trichlorofluoromethane	<0.2	<0.2	--
Acrolein	<20	<20	--
1,1-Dichloroethene	<0.2	<0.2	--
Methylene Chloride	<0.2	<0.2	--
Trans-1,2-Dichloroethene	<0.2	<0.2	--
Acrylonitrile	<20	<20	--
MTBE	<0.2	<0.2	--
1,1-Dichloroethane	<0.2	<0.2	--
2,2-Dichloropropane	<0.2	<0.2	--
Bromochloromethane	<0.2	<0.2	--
Cis-1,2-Dichloroethene	<0.2	<0.2	--
Chloroform	0.4	0.4	0.0
1,1,1-Trichloroethane	<0.2	<0.2	--
Carbon Tetrachloride	<0.2	<0.2	--
1,1-Dichloropropene	<0.2	<0.2	--
Benzene	<0.2	<0.2	--
1,2-Dichloroethane	<0.2	<0.2	--
Trichloroethene	<0.2	<0.2	--
1,2-Dichloropropane	<0.2	<0.2	--
Bromodichloromethane	<0.2	<0.2	--
Dibromomethane	<0.2	<0.2	--
2-chloroethylvinylether	<1.0	<1.0	--
Cis-1,3-Dichloropropene	<0.2	<0.2	--
Toluene	<0.2	<0.2	--
Trans-1,3-Dichloropropene	<0.2	<0.2	--
1,1,2-Trichloroethane	<0.2	<0.2	--

[1]The relative percent difference is calculated as the difference between the reported values divided by their average.

Laboratory duplicate-sample analysis--Continued

Compound	AEDC-287		
	Original	Duplicate	Relative percent difference[1]
Tetrachloroethene	<0.2	<0.2	--
1,3-Dichloropropane	<0.2	<0.2	--
Dibromochloromethane	<0.2	<0.2	--
1,2-dibromoethane (EDB)	<0.2	<0.2	--
Chlorobenzene	<0.2	<0.2	--
1,1,1,2-Tetrachloroethane	<0.2	<0.2	--
Ethylbenzene	<0.2	<0.2	--
Xylenes (total)	<0.2	<0.2	--
Styrene	<0.2	<0.2	--
Bromoform	<0.2	<0.2	--
Isopropyl benzene	<0.2	<0.2	--
1,1,2,2-Tetrachoroethane	<0.2	<0.2	--
Bromobenzene	<0.2	<0.2	--
1,2,3-Trichloropropane	<0.2	<0.2	--
N-Propylbenzene	<0.2	<0.2	--
2-Chlorotoluene	<0.2	<0.2	--
tert-Butylbenzene	<0.2	<0.2	--
1,2,4-Trimethylbenzene	<0.2	<0.2	--
sec-Butylbenzene	<0.2	<0.2	--
p-Isopropyltoluene	<0.2	<0.2	--
1,3-Dichlorobenzene (meta)	<0.2	<0.2	--
1,4-Dichlorobenzene (para)	<0.2	<0.2	--
N-Butylbenzene	<0.2	<0.2	--
1,2-Dichlorobenzene (ortho)	<0.2	<0.2	--
1,2-Dibromo-3-Chloropropane	<1.0	<1.0	--
1,2,4-Trichlorobenzene	<0.2	<0.2	--
Hexachlorobutadiene	<0.2	<0.2	--
Naphthalene	<0.2	<0.2	--
1,2,3-Trichlorobenzene	<0.2	<0.2	--
4-Chlorotoluene	<0.2	<0.2	--
Trichlorotrifluoroethane	<0.2	<0.2	--
1,3,5-Trimethylbenzene	<0.2	<0.2	--

[1]The relative percent difference is calculated as the difference between the reported values divided by their average.

APPENDIX 9

Daily mean discharge from the J4 test cell

Daily mean discharge from the J4 test cell

[--, no data]

Day	Discharge, in gallons per minute, water year October 1990 to September 1991 Mean values											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
1	5.4	6.7	6.9	128	386	360	115	41	104	140	161	162
2	4.3	5.9	7.1	286	74	103	117	25	103	304	161	161
3	4.0	5.4	643	169	114	145	112	40	106	295	161	167
4	439	5.4	6.7	56	318	150	183	48	140	177	164	173
5	6.7	383	6.3	63	160	149	191	51	187	174	169	424
6	6.6	5.8	5.4	66	110	148	104	66	187	178	173	69
7	5.4	5.4	362	76	135	134	103	115	185	177	175	99
8	8.6	5.4	6.7	153	462	269	52	115	185	182	173	117
9	464	417	6.7	590	70	67	86	114	185	185	173	125
10	251	6.7	227	37	111	73	192	108	185	185	1,330	273
11	11	5.5	6.8	52	135	79	117	109	185	185	161	8.9
12	6.7	5.4	6.6	72	397	83	110	111	186	185	1,110	212
13	6.7	69	326	77	66	--	111	112	190	185	156	75
14	5.8	236	446	443	104	--	119	113	195	185	145	75
15	5.4	277	5.8	37	421	--	230	115	196	185	150	75
16	5.4	210	6.7	55	66	--	188	113	197	185	150	81
17	5.4	118	264	242	108	--	153	110	197	1,460	150	84
18	592	118	55	60	159	--	143	109	200	616	150	89
19	6.7	199	102	74	179	--	87	110	201	220	150	94
20	5.9	268	75	81	160	--	45	109	206	220	150	89
21	5.4	245	402	366	150	--	65	109	213	220	150	106
22	6.3	220	75	48	569	--	188	82	208	192	150	115
23	6.7	161	62	76	103	--	17	104	208	183	150	119
24	322	118	68	223	103	--	26	103	156	197	150	127
25	237	119	89	343	929	--	115	104	136	186	150	125
26	739	113	109	56	128	--	141	103	145	180	156	122
27	6.7	106	121	96	343	--	109	103	193	1,490	161	120
28	6.1	114	127	126	118	112	109	103	300	161	161	122
29	5.4	114	128	128	--	133	105	103	100	161	165	115
30	5.4	43	133	441	--	123	104	105	112	161	163	109
31	450	--	131	108	--	118	--	103	--	161	162	--
TOTAL	3,636.0	3,705.6	4,016.7	4,828	6,178	--	3,537	2,956	5,291	8,915	7,030	3,832.9
MEAN	117	124	130	156	221	--	118	95.4	176	288	227	128
MAX	739	417	643	590	929	--	230	115	300	1,490	1,330	424
MIN	4.0	5.4	5.4	37	66	--	17	25	100	140	145	8.9

Daily mean discharge from the J4 test cell—Continued

Day	Discharge, in gallons per minute, water year October 1991 to September 1992 Mean values											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
1	106	74	291	75	66	99	75	156	75	76	75	94
2	104	75	111	86	66	103	75	164	75	75	82	101
3	103	75	90	82	66	104	75	171	79	78	75	54
4	103	75	75	84	66	103	74	176	70	75	79	7.0
5	104	75	75	84	68	103	71	187	75	79	84	6.7
6	103	75	35	84	1,420	103	71	1,260	75	76	84	6.7
7	97	75	9.5	84	595	101	75	128	75	77	84	5.6
8	77	75	17	86	102	94	75	135	75	78	84	72
9	81	73	44	84	94	97	98	128	78	78	87	75
10	73	66	69	84	85	107	130	126	75	78	88	78
11	66	66	1,410	84	80	103	123	123	75	75	85	82
12	70	112	1,200	84	75	103	122	118	74	75	91	84
13	66	138	74	85	75	103	120	110	75	75	94	84
14	68	138	9.3	84	75	103	118	103	75	71	94	86
15	75	138	22	84	79	103	122	102	73	68	94	94
16	75	138	47	84	84	100	119	101	66	68	92	396
17	75	138	56	84	81	94	119	94	66	67	84	149
18	75	138	65	84	83	91	116	94	85	67	84	119
19	75	138	173	84	125	87	116	114	542	67	84	116
20	75	138	19	84	1,390	86	116	131	103	89	84	115
21	75	140	42	84	883	87	155	128	94	108	89	108
22	75	152	53	85	107	88	150	125	85	107	94	114
23	77	139	61	85	80	85	150	121	79	108	95	103
24	75	138	66	87	83	85	150	118	75	108	94	103
25	75	138	66	731	95	84	148	110	79	108	94	103
26	82	104	66	75	92	84	145	83	77	105	94	106
27	75	75	66	1,210	88	79	145	75	79	106	99	103
28	75	32	69	73	93	80	145	75	77	105	103	103
29	75	5.6	71	75	94	75	145	74	76	84	103	103
30	75	58	74	75	--	75	149	75	79	63	103	103
31	75	--	75	72	--	75	--	75	--	72	97	--
TOTAL	2505	3,001.6	4,600.8	4,326	6,390	2,884	3,492	4,780	2,786	2,566	2,773	2,874.0
MEAN	80.8	100	148	140	220	93.0	116	154	92.9	82.8	89.5	95.8
MAX	106	152	1,410	1,210	1,420	107	155	1,260	542	108	103	396
MIN	66	5.6	9.3	72	66	75	71	74	66	63	75	5.6

Daily mean discharge from the J4 test cell—Continued

Day	Discharge, in gallons per minute, water year October 1992 to September 1993 Mean values											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
1	--	--	36	84	38	84	103	15	28	56	47	277
2	--	--	278	84	40	85	103	23	28	56	388	250
3	--	--	294	84	47	84	101	41	28	61	19	94
4	--	--	11	84	47	85	103	50	335	65	19	126
5	--	--	15	84	183	89	102	37	19	66	21	124
6	--	--	17	85	32	89	143	37	19	66	40	115
7	--	--	20	89	37	89	85	37	19	66	38	108
8	--	--	22	88	37	89	84	38	313	66	37	66
9	--	--	24	85	37	91	85	38	7.3	66	37	67
10	--	23	174	84	37	89	84	37	9.0	94	37	66
11	--	28	234	93	42	85	84	417	328	86	37	66
12	--	36	13	93	47	84	86	18	5.4	90	343	66
13	--	37	17	93	47	84	84	23	5.4	90	87	66
14	--	41	17	94	47	84	84	28	209	84	84	66
15	--	47	14	94	48	84	77	28	172	78	84	73
16	--	630	21	93	55	86	452	33	47	75	84	75
17	--	27	376	91	358	85	75	37	24	75	311	75
18	--	40	94	87	37	84	75	47	95	75	156	75
19	--	27	141	93	37	84	293	671	5.8	60	664	75
20	--	16	146	85	37	84	132	110	13	29	28	52
21	--	15	81	90	44	84	88	5.9	196	37	30	28
22	--	23	78	86	47	91	52	6.9	131	37	28	80
23	--	184	91	89	411	114	8.5	9.2	17	37	28	64
24	--	18	84	93	562	96	9.7	49	157	39	28	557
25	--	18	84	90	426	94	30	516	60	41	35	71
26	--	21	84	92	84	96	35	300	74	46	294	72
27	--	23	85	85	84	97	37	7.3	75	43	319	81
28	--	24	84	84	84	98	38	9.0	177	47	38	37
29	--	25	84	50	--	98	39	9.4	37	47	37	37
30	--	30	84	29	--	99	390	19	42	47	38	37
31	--	--	84	33	--	98	--	38	--	47	46	--
TOTAL	--	--	2,887	2,588	3,032	2,783	3,162.2	2,734.7	2,675.9	1,872	3,482	3,046
MEAN	--	--	93.1	83.5	108	89.8	105	88.2	89.2	60.4	112	102
MAX	--	--	376	94	562	114	452	671	335	94	664	557
MIN	--	--	11	29	32	84	8.5	5.9	5.4	29	19	28

Daily mean discharge from the J4 test cell—Continued

Day	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
	Discharge, in gallons per minute, water year October 1993 to September 1994 Mean values											
1	37	186	28	28	56	175	69	2540	53	146	500	118
2	37	37	234	28	56	278	79	46	62	130	9.4	120
3	37	55	17	38	66	37	89	124	71	121	113	124
4	37	7.3	36	38	521	183	94	14	78	112	194	128
5	37	9.8	28	50	28	35	104	54	86	104	89	127
6	37	9.4	259	56	37	37	104	71	93	103	9.4	127
7	37	14	13	613	37	181	103	84	94	103	16	121
8	444	95	9.4	10	324	103	103	91	99	103	165	118
9	11	18	11	22	16	111	103	94	427	103	139	119
10	13	19	13	28	52	108	124	153	62	103	123	119
11	27	19	15	32	47	111	115	150	70	104	291	115
12	19	19	19	37	42	109	117	150	75	158	295	101
13	19	19	19	37	48	114	115	150	86	174	403	91
14	19	27	22	299	56	114	115	151	92	165	445	91
15	19	272	28	23	56	115	126	151	99	133	415	90
16	26	13	28	28	56	115	126	112	108	108	9.4	168
17	28	18	37	37	56	111	126	93	360	115	56	11
18	28	9.4	37	37	397	103	126	94	61	130	84	32
19	28	32	37	37	34	180	126	94	75	115	84	50
20	464	19	528	45	40	262	126	90	79	110	86	55
21	5.4	19	9.5	46	54	262	126	85	89	106	90	60
22	6.9	269	9.4	51	386	262	126	89	187	115	87	63
23	8.9	66	277	55	23	173	126	94	225	115	92	73
24	9.4	36	6.0	445	36	126	126	94	520	111	98	77
25	9.4	9.4	8.6	25	39	126	224	99	85	103	108	77
26	19	12	9.4	34	47	127	150	271	91	107	120	78
27	26	20	9.4	43	51	146	152	536	323	116	126	75
28	276	19	16	43	56	122	144	9.4	166	115	132	147
29	35	25	19	47	--	115	173	14	155	115	534	63
30	41	28	19	47	--	112	1,960	39	155	115	79	63
31	39	--	23	51	--	337	--	47	--	115	142	--
TOTAL	1,880	1,401.3	1,824.7	2,410	2,717	4,490	5,497	5,883.4	4,226	3,673	5,134.2	2,801
MEAN	60.6	46.7	58.9	77.7	97.0	145	183	190	141	118	166	93.4
MAX	464	272	528	613	521	337	1,960	2,540	520	174	534	168
MIN	5.4	7.3	6.0	10	16	35	69	9.4	53	103	9.4	11

Daily mean discharge from the J4 test cell—Continued

Day	Discharge, in gallons per minute, water year October 1994 to September 1995 Mean values											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
1	65	466	74	86	107	101	105	98	99	78	90	70
2	68	7.6	73	86	115	101	100	98	258	82	89	75
3	71	66	75	85	106	100	101	371	84	376	90	69
4	74	15	88	85	100	100	101	57	84	43	89	66
5	76	33	85	82	97	110	100	65	83	57	92	66
6	76	45	89	86	93	110	99	69	170	58	99	67
7	76	50	239	85	92	115	99	72	75	58	53	69
8	77	392	122	87	85	126	99	75	331	62	31	67
9	83	106	650	88	88	116	98	189	182	64	38	68
10	82	55	66	88	91	116	97	74	19	67	60	71
11	83	56	63	90	107	113	261	142	40	71	71	80
12	84	56	322	91	101	110	49	73	57	74	76	82
13	112	65	15	93	110	108	65	74	62	75	77	215
14	87	74	40	104	104	107	70	78	66	78	76	62
15	87	77	54	103	99	107	75	81	69	79	78	62
16	87	79	61	101	111	108	78	170	74	81	77	70
17	86	84	69	102	108	109	79	82	77	82	79	67
18	311	83	69	101	109	111	82	84	79	82	79	69
19	58	88	224	106	109	107	86	86	80	82	80	70
20	61	86	54	107	110	113	361	87	81	437	81	72
21	62	87	59	110	107	120	53	86	84	238	83	295
22	65	260	396	109	101	121	65	90	86	89	82	35
23	68	75	94	110	101	120	71	90	362	91	82	47
24	70	8.1	94	107	102	118	75	91	42	88	81	52
25	71	18	93	99	100	116	78	91	56	88	380	56
26	72	43	93	95	99	114	83	92	61	90	17	59
27	300	61	89	96	102	120	81	94	64	90	43	61
28	44	66	88	99	102	115	84	97	68	90	50	62
29	48	68	87	100	--	110	88	96	72	88	55	236
30	49	72	87	100	--	110	91	96	81	89	58	132
31	50	--	87	99	--	107	--	94	--	89	66	--
TOTAL	2,703	2,741.7	3,799	2,980	2,856	3,459	2,974	3,142	3,046	3,216	2502	2572
MEAN	87.2	91.4	123	96.1	102	112	99.1	101	102	104	80.7	85.7
MAX	311	466	650	110	115	126	361	371	362	437	380	295
MIN	44	7.6	15	82	85	100	49	57	19	43	17	35

APPENDIX 10

Rainfall data at Arnold Engineering Development Center

Rainfall data at Arnold Engineering Development Center

[--, no data; e, estimated value]

Day	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
	Rainfall, in inches, water year October 1990 to September 1991											
1	0.00	0.00	0.00	0.00	0.00	0.74	0.00	0.00	0.00	0.00	0.00	0.00
2	.00	.00	.00	.00	.00	.06	.00	.00	.00	.35	.00	.00
3	.15	.00	1.44	.00	.00	.92	.00	.00	.00	.00	.00	.00
4	.78	.00	.00	.00	.01	.00	.00	.92	.50	.23	.00	.00
5	.00	.27	.00	.00	.26	.00	.32	.83	.00	.00	.00	.00
6	.00	.00	.00	.65	.12	.00	.00	.03	.00	.00	.00	.00
7	.02	.00	.00	1.66	.00	.00	.00	.00	.00	.00	.04	.00
8	1.72	.45	.00	.00	.00	.00	.48	.30	.00	.00	.00	.00
9	.00	1.05	.00	.00	.00	.00	.22	.00	.00	.05	.00	.00
10	.16	.00	.00	.87	.00	.00	.20	.02	.00	.14	.11	.28
11	.00	.00	.00	.12	.00	.00	.00	.00	.03	.03	.00	.30
12	.00	.00	.00	.00	.00	.63	.31	.78	.14	.00	.00	.12
13	.00	.00	.32	.00	1.22	.02	.66	.00	.00	.02	.00	.00
14	.00	.00	.00	.00	.00	.00	.47	.00	.00	.00	.00	.04
15	.00	.00	.18	.05	.00	.00	.76	.00	.00	.05	.00	.00
16	.00	.06	.30	.21	.00	.00	.00	.00	.00	.00	.00	.00
17	.00	.00	.51	.00	1.50	.38	.00	.00	.00	.02	.00	.00
18	.43	.00	.36	.00	3.24	.00	.00	.02	.00	.00	.09	.00
19	.00	.00	.00	.11	2.86	.00	.15	2.15	.00	.00	.10	.00
20	.00	.00	1.11	.04	.11	.00	.00	.01	.02	.00	.00	.00
21	.00	.00	3.22	.00	.00	.00	.00	.00	1.03	.00	.00	.00
22	.57	.06	5.49	.00	.15	.43	.00	.00	.06	.00	.00	.00
23	.48	.01	.10	.00	.01	.72	.00	.28	.00	.00	.00	.03
24	.01	.00	.00	.00	.00	.00	.00	.00	.00	.49	.00	1.71
25	.16	.00	.00	.00	.10	.00	.00	.00	.06	.00	.14	.00
26	.00	.00	.06	.00	.01	.00	.00	.16	.00	.00	.48	.00
27	.00	.93	1.13	.04	.00	.08	.12	.00	.00	.00	.00	.00
28	.00	.24	.09	.02	.00	.24	.30	.00	.02	.00	.00	.00
29	.00	.00	.08	.00	--	2.51	.68	.00	.00	.00	.53	.00
30	.00	.00	.64	.53	--	.42	.02	.00	.00	.00	.00	.00
31	.00	--	.00	.00	--	.00	--	.00	--	.00	.02	--
TOTAL	4.48	3.07	15.03	4.30	9.59	7.15	4.69	5.50	1.86	1.38	1.51	2.48

Rainfall data at Arnold Engineering Development Center—Continued

Day	Rainfall, in inches, water year October 1991 to September 1992											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
1	0.00	1.10	e3.03	e2.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.01
2	.00	.09	e2.57	e.11	.00	.00	.00	.00	.00	.00	.00	1.41
3	.00	.00	e2.15	e1.78	.00	.00	.00	.04	1.08	.85	.00	.12
4	.00	1.28	.00	e.76	.00	.00	.00	.02	.62	.00	.00	.50
5	.37	.30	.00	.00	.00	.01	.00	.00	.00	.89	.00	.00
6	.00	.00	.00	.00	.00	.06	.24	.00	.00	.03	.05	.00
7	.00	.00	.00	.00	.00	.00	.22	.03	.00	.00	.00	.00
8	.16	.01	.00	.00	.00	.00	.00	.30	.13	.00	.00	.00
9	.00	.03	e.66	e.72	.00	.22	.00	.00	1.08	.00	.74	.00
10	.22	.00	e1.80	.00	.00	1.21	.00	.00	.00	.00	1.51	.07
11	.00	.05	.00	.00	.00	.00	.00	.00	.02	.00	.28	.00
12	.00	.78	.00	e.01	.05	.01	.00	.96	.16	.00	.36	.00
13	.00	.00	e.51	e.21	.29	.00	.00	.00	.00	.00	.23	.00
14	.82	.00	e1.75	e.51	.30	.00	.00	.00	.00	.06	.00	.00
15	.23	.00	.00	.00	.18	.00	1.10	.00	.00	.00	.00	.00
16	.53	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
17	.00	.00	.00	.00	.17	.00	.00	.00	.00	.40	.00	.19
18	.00	.00	.00	.00	.11	.81	.00	.00	1.10	.00	.00	.19
19	.00	.00	.00	.00	.00	.23	.11	.00	.00	.00	.00	.00
20	.00	.15	.00	.00	.00	.00	.30	.00	.00	.00	.00	.00
21	.00	.22	e.05	.00	.00	.00	1.05	.00	.00	.08	.54	.00
22	.00	.48	e.13	.37	.00	.71	.00	.00	.00	.09	.02	2.00
23	.70	.00	e.71	.41	1.39	.00	.00	.00	.00	.19	.40	.00
24	.00	.48	e.31	.00	.00	.00	.16	.00	.00	.00	.06	.00
25	.00	.01	.00	.00	.86	.21	.00	.00	.72	.00	.00	.00
26	.00	.00	.00	.00	.12	.07	.00	.00	.26	.00	.00	.69
27	1.39	.00	.00	.00	.00	.02	.01	.00	.01	.07	1.06	.02
28	.02	.00	e.91	.03	.00	.00	.00	.02	.00	.00	.22	.00
29	.00	.00	e.41	.00	.00	.06	.01	.26	.00	.00	.00	.00
30	.80	e.11	.00	.00	--	.03	.00	.03	.92	.02	.00	.00
31	.04	--	.00	.00	--	.00	--	.00	--	.22	.00	--
TOTAL	5.28	5.09	14.99	6.91	3.47	3.65	3.20	1.66	6.10	3.10	5.47	5.20

Rainfall data at Arnold Engineering Development Center—Continued

Day	Rainfall, in inches, water year October 1992 to September 1993											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
1	0.00	e1.10	0.00	0.00	0.00	0.00	0.16	0.11	0.00	0.00	0.02	0.00
2	.00	e.09	.00	.00	.01	.58	.00	.03	.00	.00	.00	.17
3	.00	.00	.00	.00	.00	.08	.00	2.57	.00	.00	.00	.28
4	.81	e1.28	.69	.62	.00	.08	.09	.94	.00	.00	.02	.00
5	.00	e.30	.00	.00	.00	.02	.48	.00	.17	.00	.72	.00
6	.00	.00	.06	.00	.00	.00	.01	.00	.00	.00	1.24	.00
7	.00	.00	.02	.38	.00	.02	.00	.00	.00	.00	.00	.00
8	e.16	.00	.00	.08	.00	.00	.00	.00	.00	.00	.00	.47
9	e.01	.00	.01	.00	.00	.00	.34	.00	.00	.00	.00	.28
10	e.22	e.01	.17	.04	.00	.00	.00	.00	.21	.07	.00	.00
11	.00	e.05	.00	.65	.47	.00	.00	.07	.10	.00	.00	.00
12	.00	e.78	.00	.15	.05	.00	.00	.08	.34	.68	.03	.00
13	.00	.00	.00	.03	.00	.00	.05	.30	.00	.01	.23	.00
14	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
15	.00	.00	.28	.00	.65	.00	.06	.00	.27	.00	.00	.82
16	e.53	.00	.53	.00	.05	.20	.00	.00	.00	.00	.00	.00
17	.00	.00	.09	.00	.00	.02	.00	.00	.00	.06	.00	.00
18	.00	.00	.00	.00	.00	.00	.00	1.71	.00	.00	.36	.00
19	.00	.00	.27	.31	.00	.00	.00	.09	.00	.00	.00	.00
20	.00	e.15	1.18	.25	.10	.00	.70	.02	.05	.00	.27	.05
21	.00	e.22	.20	.40	.48	.00	.01	.00	.40	.00	.00	.01
22	.00	e.48	.08	.00	.00	1.32	.00	.00	.00	.00	.00	.00
23	.00	.00	1.16	.00	.00	1.68	.00	.00	.00	.00	.00	.09
24	.00	e.48	.00	.71	.00	.00	.00	.00	.16	.00	.00	.00
25	.00	e.01	.17	.00	.00	.00	1.67	.21	.19	.00	.10	.18
26	.00	.00	.00	.00	.00	.68	.00	.00	.00	.00	.00	.35
27	e1.39	.00	.35	.01	.00	.16	.00	.00	.02	.00	.00	.00
28	e.02	.00	.02	.00	.00	.00	.00	.00	.02	.00	.00	.00
29	.00	.00	.00	.00	--	.00	.00	.00	.00	.00	.00	.00
30	e.80	.00	.00	.00	--	.00	.00	.46	.00	.00	.00	.00
31	e.04	--	.02	.00	--	.24	--	1.06	--	:00	.00	--
TOTAL	3.98	4.95	5.30	3.63	1.81	5.08	3.57	7.65	1.93	0.82	2.99	2.70

Rainfall data at Arnold Engineering Development Center—Continued

Day	Rainfall, in inches, water year October 1993 to September 1994											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
1	0.00	0.00	0.00	0.06	0.00	1.47	0.01	0.50	0.00	0.00	0.00	1.35
2	.00	.00	.00	.00	.00	.38	.00	.00	.00	.04	.07	.04
3	.00	.00	.43	.73	.00	.00	.27	1.11	.00	.01	.09	.00
4	.00	.50	2.45	.03	.04	.00	.00	.00	.00	.00	.30	.00
5	.00	.19	.00	.00	.31	.00	1.53	.00	.65	.43	1.99	.07
6	.00	.00	.00	.00	.00	.00	.27	.00	.08	.04	.00	.00
7	.00	.00	.00	1.16	.00	.00	.00	.87	.08	.00	.00	.00
8	.00	.00	.00	.00	.15	.11	.00	.05	.00	.00	.02	.00
9	.43	.00	.65	.00	1.03	1.24	.00	.00	.43	.10	.00	.00
10	.00	.00	.58	.00	.54	.00	2.82	.00	.00	.56	.00	.00
11	.03	.00	.00	.36	1.68	.00	.11	.00	.01	.25	.00	.00
12	.00	.00	.00	.03	.00	.00	.39	.00	.00	.16	.00	.00
13	.00	.00	.07	.00	.01	.08	.00	.00	.12	.24	.00	.00
14	.00	1.61	.39	.04	.00	.00	.00	.58	.00	.00	.05	.00
15	.18	.25	.09	.00	.00	.00	2.00	.16	.00	.11	.03	.29
16	.43	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.02
17	.02	.60	.00	.86	.00	.00	.00	.00	.00	.29	.00	.24
18	.20	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
19	.00	.02	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
20	.00	.00	.61	.00	.67	.02	.00	.00	.00	.00	.47	.00
21	.08	.00	.01	.00	1.06	.23	.00	.00	.00	.37	.88	.00
22	.00	.00	.00	.18	1.83	.00	.00	.00	.35	.00	.00	.00
23	.00	.00	.00	.00	.60	.08	.00	.00	.00	.04	.00	1.20
24	.00	.00	.00	.00	.00	1.26	.00	.00	.12	.00	.00	.08
25	.00	.00	.00	.38	.00	.08	.00	.00	.16	.00	.00	.00
26	.00	.04	.00	.67	.00	.35	.00	1.68	1.03	.15	.00	.80
27	.00	.34	.01	1.27	.00	3.97	.87	.01	.00	.58	.00	.00
28	.00	.00	.72	.00	.00	.51	.00	.00	.00	.00	.00	.00
29	.41	.00	.02	.00	--	.00	.00	.00	.00	.00	.00	.00
30	.23	.00	.00	.00	--	.47	.00	.00	.00	.00	.00	.00
31	.09	--	.00	.00	--	.00	--	--	--	.10	.06	--
TOTAL	2.10	3.55	6.03	5.77	7.92	10.25	8.27	--	3.03	3.47	3.96	4.09

Rainfall data at Arnold Engineering Development Center—Continued

Day	Rainfall, in inches, water year October 1994 to September 1995											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.48	0.00	0.00	0.21
2	.29	.00	.00	.00	.00	.00	.00	.00	.10	.00	.00	.00
3	.04	.00	.44	.00	.00	.07	.00	.00	.00	1.26	.00	.00
4	.00	.00	1.11	.00	.00	.14	.01	.30	.00	.22	.03	.00
5	.00	.88	.13	.00	.00	1.23	.00	.00	.00	.05	.73	.00
6	.00	.00	.00	1.25	.00	.02	.00	.00	.24	.02	1.13	.00
7	.00	.00	.00	.00	.00	1.06	.00	.00	.00	.00	.00	.00
8	.00	.00	.00	.00	.00	.57	.00	.00	.02	.00	3.37	.00
9	.89	.33	.00	.00	.00	.00	.00	.65	.00	.00	.00	.00
10	.00	.05	.93	.00	.26	.00	.00	.30	.00	.12	.01	.00
11	.00	.00	.00	.71	.00	.00	.07	.00	.72	.00	.05	1.09
12	.49	.00	.00	.00	.00	.00	.37	.00	.08	.00	.00	.04
13	1.12	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.51
14	.05	.00	.00	1.02	.00	.00	.00	.04	.00	.07	.00	.52
15	.00	.00	.00	.11	.28	.00	.00	.01	.00	.04	.00	.00
16	.00	.00	.11	.00	1.10	.00	.00	.00	.00	--.00	.00	2.09
17	.00	.00	.02	.00	.00	.00	.30	.00	.05	.00	.00	.00
18	.00	.00	.00	.00	.00	.00	.00	.92	.00	.00	.00	.00
19	.14	.00	.00	.18	.00	.00	.26	.01	.58	.00	.00	.00
20	.11	.00	.00	.00	.00	.17	1.30	.00	.00	.00	.11	.02
21	.00	.00	.00	.00	.00	.00	1.24	.00	.01	.03	.00	.15
22	.62	.00	.00	.00	.00	.00	.00	.00	.12	.92	.00	.36
23	.00	.00	.00	.00	.11	.00	.34	.00	.14	.44	.04	.00
24	.00	.00	.00	.00	.00	.00	.00	.00	.03	.13	.00	.00
25	.00	.00	.00	.00	.00	.00	.00	.06	.00	.01	.24	.00
26	.01	.52	.00	.00	.00	.00	.00	.00	.00	.00	.01	.13
27	.00	2.24	.00	.18	.24	.88	.00	.00	.00	.03	.00	.00
28	.00	.23	.00	.66	.47	.00	.00	.24	.00	.00	.05	.00
29	.00	.00	.00	.00	--	.00	.00	.00	.00	.00	.00	.00
30	.00	--	.00	.00	--	.00	.13	.00	1.17	.00	.00	.00
31	.03	--	.01	.00	--	.00	--	.18	--	.04	.00	--
TOTAL	3.79	--	2.75	4.11	2.46	4.14	4.02	3.19	3.70	3.38	5.77	5.12