WATER-QUALITY, LITHOLOGIC, AND WATER-LEVEL DATA FOR WELLS IN TULARE BASIN, KINGS, KERN, AND TULARE COUNTIES, CALIFORNIA, AUGUST 1990 TO FEBRUARY 1993

By Sherrill Beard, Roger Fujii, *and* W. Gary Shanks

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Conversion Factors

Multiply	By	To obtain
foot (ft)	0.3048	meter
inch (in.)	25.4	millimeter

Temperature is given in degrees Celsius (°C), which can be converted to degrees Fahrenheit (°F) by the following equation:

$$°F=1.8(°C)+32$$

Vertical Datum

Sea Level: In this report "sea level" refers to the National Geodetic Vertical Datum 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.

Water-Quality Information

Chemical concentration is given in milligrams per liter (mg/L) or micrograms per liter (µg/L). Milligrams and micrograms per liter are units expressing the weight of the solute per unit volume (liter) of water. One thousand micrograms per liter is equivalent to 1 milligram per liter. Micrograms per liter is equivalent to "parts per billion."

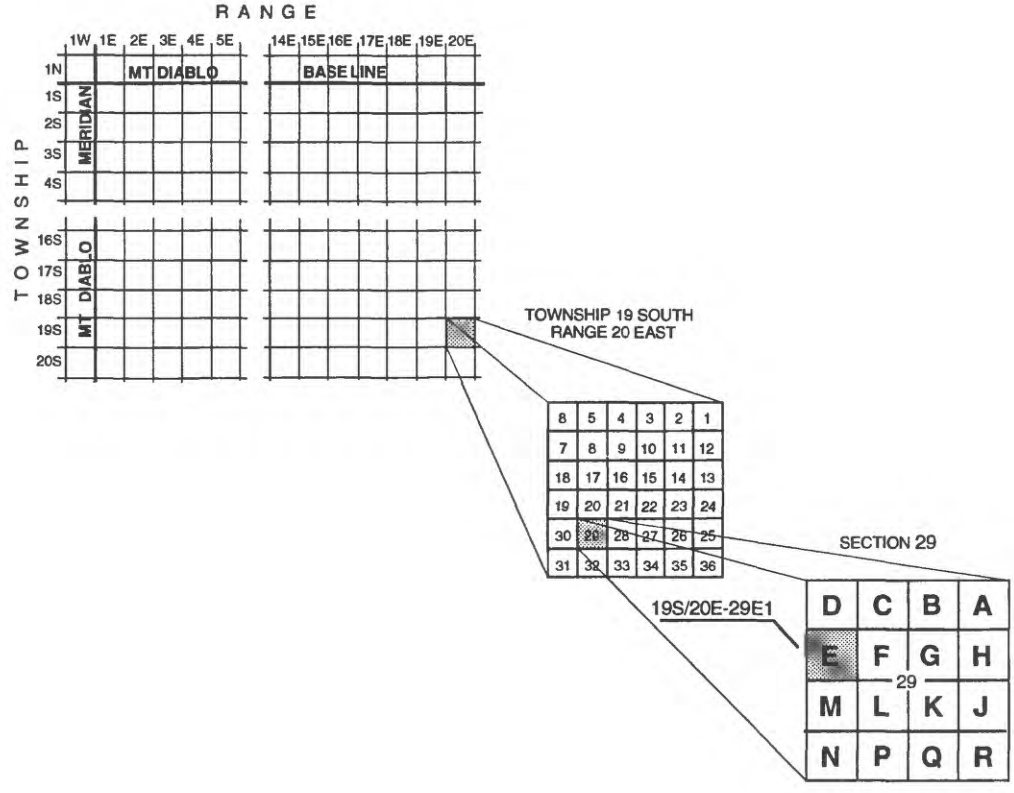
Tritium concentrations are expressed in picocuries per liter (pCi/L), which can be converted to tritium units (TU) by dividing by 3.2.

Abbreviations

µm, micrometer
mL, milliliter
mm, millimeter
µS/cm, microsiemen per centimeter at 25° Celsius

Well-Numbering System

Wells are identified and numbered according to their location in the rectangular system for the subdivision of public lands. Identification consists of the township number, north or south; the range number, east or west; and the section numbers. Each section is divided into sixteen 40-acre tracts lettered consecutively (except I and O), beginning with "A" in the northeast corner of the section and progressing in a boustrophedonic manner to "R" in the southeast corner. Within the 40-acre tract, wells are sequentially numbered in the order they are inventoried. The final letter refers to the base line and meridian. In California, there are three base lines and meridians: Humboldt (H), Mount Diablo (M), and San Bernardino (S). All wells in the study area are referenced to the Mount Diablo base line and meridian (M). Well numbers consist of 15 characters and follow the format 019S020E29E001M. In this report, well numbers are abbreviated and written 19S/20E-29E1. The following diagram shows how the number for well 19S/20E-29E1 is derived.



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Abstract

Much of the Tulare Basin is characterized by saline shallow ground water containing elevated concentrations of arsenic, selenium, and other trace elements. A comprehensive investigation of ground-water geochemistry and, to a limited extent, hydrology was initiated in response to concerns related to (1) adverse effects on migratory waterfowl of high concentrations of selenium in agricultural drainwater disposed of in evaporation ponds and (2) adverse effects on human health due to potential downward migration of ground water containing high concentrations of arsenic to regional aquifers used as drinking-water sources. This report presents data collected during the initial phase of this investigation.

A total of 20 observation wells were installed at 5 locations in the basin. Four observation wells in a cluster were installed at each location at depths of about 20, 50, 100, and 200 feet. Water samples collected from each site were analyzed for major ions, trace elements (including arsenic and selenium), nutrients, and selected isotopes. Lithologic logs and well-construction information for each site and water-level measurements for each well measured periodically from August 1990 to February 1993 also are reported.

INTRODUCTION

The Tulare Basin is at the southern end of the San Joaquin Valley, California, in Kings, Kern, and Tulare Counties and is bounded by the Sierra Nevada on the east, the Temblor Range of the Coast Ranges on the west, and the San Emigdio and Tehachapi Mountains on the south (fig. 1). Its formation is the result of structural downward warping and active tectonic activity (Davis and Green, 1962). The hydrologically closed nature of the basin also is due to the build up of sediments from the coalescing Kings River alluvial fan, originating in the Sierra Nevada, and the Los Gatos alluvial fan, originating in the Coast Ranges and the damming of east-side streams (Page, 1986). Much of the basin is adversely affected by saline shallow ground water that often requires installation of artificial subsurface-drainage systems for continued agricultural production. The shallow ground water and drainwater contain high concentrations of selenium, arsenic, and other trace elements (Swain and Duell, 1993). The disposal of agricultural drainwater in evaporation ponds is adversely affecting migratory waterfowl because of the toxic effects of trace elements, especially selenium, in the drainwater (Schroeder and others, 1988; Skorupa and Ohlendorf, 1989). In addition, potential downward migration of shallow ground water containing high concentrations of arsenic may cause contamination of regional aquifers used for drinking water, adversely affecting human health (Vallentine and others, 1979).

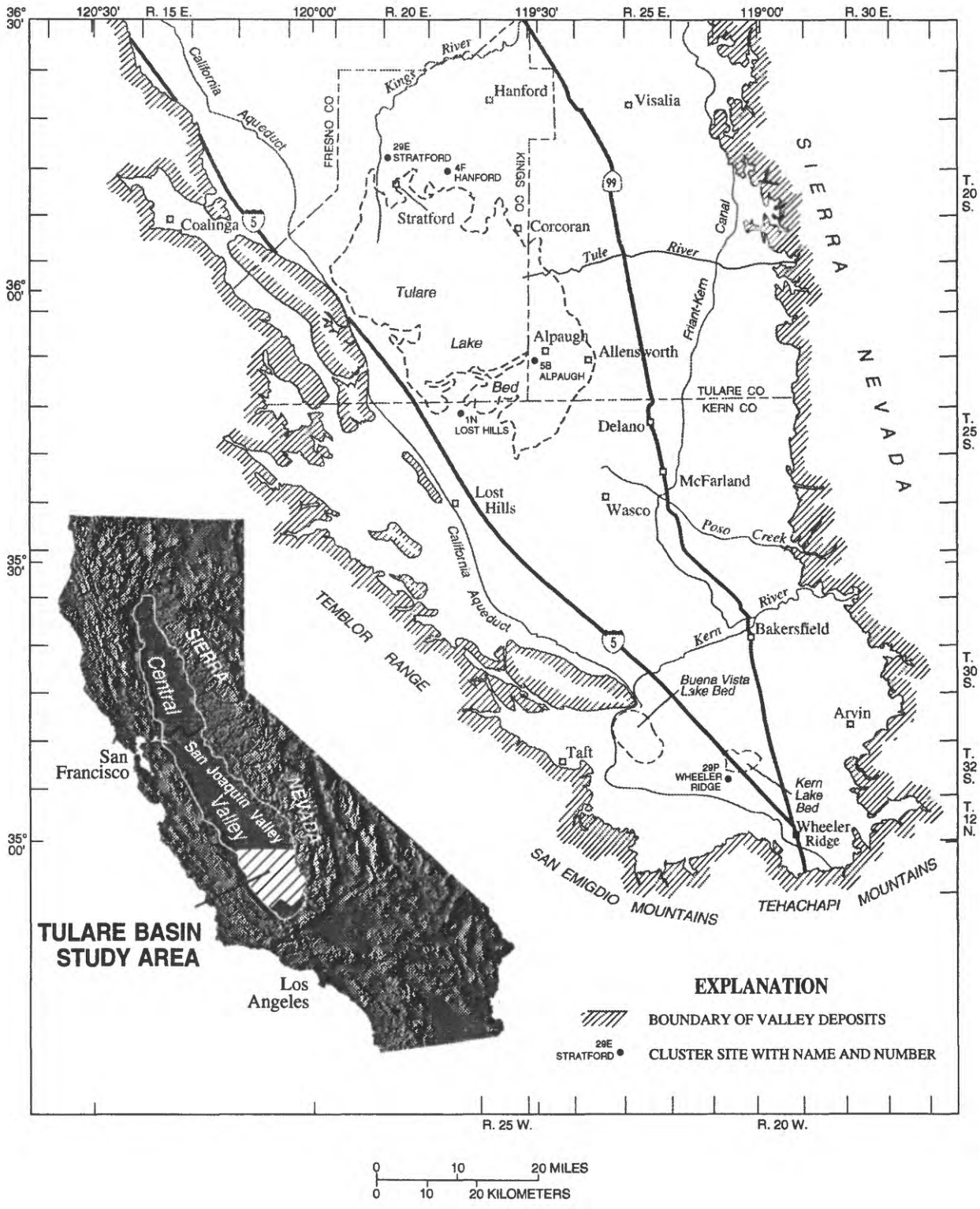

Figure 1. Location of study area and cluster sites.

In response to these concerns, the U.S. Geological Survey, in cooperation with the California Department of Water Resources, began a comprehensive study of the ground-water geochemistry and hydrology in selected areas in the Tulare Basin in 1990. The overall objective of this study is to assess the processes affecting the mobility and transport of selenium and arsenic in ground water. This report presents water-quality, lithologic, and water-level data collected from observation wells drilled during the first phase of the Tulare Basin ground-water geochemistry study.

WELL INSTALLATION AND CONSTRUCTION

Observation wells were installed from June 11, 1990, to July 18, 1991, at five cluster sites in the Tulare Basin (fig. 1) to assess the ground-water geochemistry and to provide data to interpret hydrologic-flow characteristics. Each cluster site consists of four wells installed at different depths. Locations of the sites were selected based on results from a basin-wide shallow ground-water synoptic study (Swain and Duell, 1993). Wells were installed in areas where concentrations of arsenic, selenium, and dissolved solids were unusually high. Approximate depths of wells at each cluster site are 20, 50, 100, and 200 ft: 20-foot wells to monitor depth to ground water, 50-foot wells as intermediate wells between the 20- and 100-foot wells, and 100- and 200-foot wells to compile lithologic logs.

Three procedures were used to install and complete the wells. The shallowest wells (about 20 ft) at each site were drilled using a hollow-stem auger and jetting water deeper into the formation, if necessary. The 100-foot wells were drilled using a standard 6-inch hollow-stemmed flight auger. The 50- and 200-foot wells were drilled using a mud-rotary rig with an 8-inch bit, except for well 4F-51, which was drilled with a hollow-stemmed flight auger. All wells were cased in either 2- or 3-inch-diameter polyvinyl chloride (PVC) well casing and have a 10-foot screened interval. The 20- and 100-foot wells do not have blank casing below the screen, and the 50- and 200-foot wells have 5 ft of blank casing below the screen. The annulus is sand packed from the bottom of the well to about 5 ft above the screened interval and sealed with bentonite grout to land surface in all wells. All wells, except the 20-foot wells, are finished with a protective steel-casing cover with a locking cap and secured with a concrete pad. Construction of a typical observation well is shown in figure 2, and specific well-construction information for each well is given in table 1.

Cluster site names and well identifiers used in this report were derived from the rectangular system for the subdivision of public lands (see well-numbering system). For purposes of this report, cluster site names are abbreviated by section number, subdivision letter, and the name of a nearby town or geographic location. For example, cluster site 32S/27E-29P1 is abbreviated 29P Wheeler Ridge. Wells are identified by cluster site name and a number that is the depth, in feet below land surface, to the midpoint of the screened interval of that well. For example, well 29P-204 is in section 29, subdivision P near Wheeler Ridge, and the midpoint of the well screen is 204 ft below land surface. Table 1 includes cluster site names, well identifiers, State well numbers, drilling methods, and well-construction information.

SAMPLE COLLECTION AND ANALYTICAL METHODS

Ground-water samples for chemical analyses were collected using a peristaltic or submersible-piston pump. Ground water was sampled only after at least three well-casing volumes were pumped through a flow-through chamber equipped with calibrated specific-conductance, pH, and temperature probes and the general properties of the water had stabilized. The sampling equipment and sample containers were rinsed a minimum of three times with well water prior to sampling. Samples analyzed for major cations and dissolved trace elements, except mercury, were pumped through a 0.45-µm (micrometer) membrane filter, stored in polyethylene bottles, and acidified with nitric acid to pH less than 2. The mercury samples were collected in glass bottles with Teflon-lined caps. Samples analyzed for anions were not acidified or filtered but chilled after collection. Samples for nitrogen and phosphorus analysis were preserved with mercuric chloride ($HgCl_2$) and chilled. Unfiltered samples were collected for tritium, carbon-13, and stable oxygen and hydrogen-isotope analyses.

All samples were analyzed at U.S. Geological Survey laboratories. Major ion and trace-element samples were analyzed using standard procedures described by Fishman and Friedman (1989). Selenium was analyzed by hydride generation followed by atomic absorption spectrometry (Makita and Fujii, 1992). Oxygen-18 isotope composition was determined using a modification of the carbon-dioxide equilibration method by Epstein and Mayeda (1953), and stable hydrogen-isotope composition (delta deuterium) was determined by analyzing hydrogen quantitatively extracted from water (Kendall and

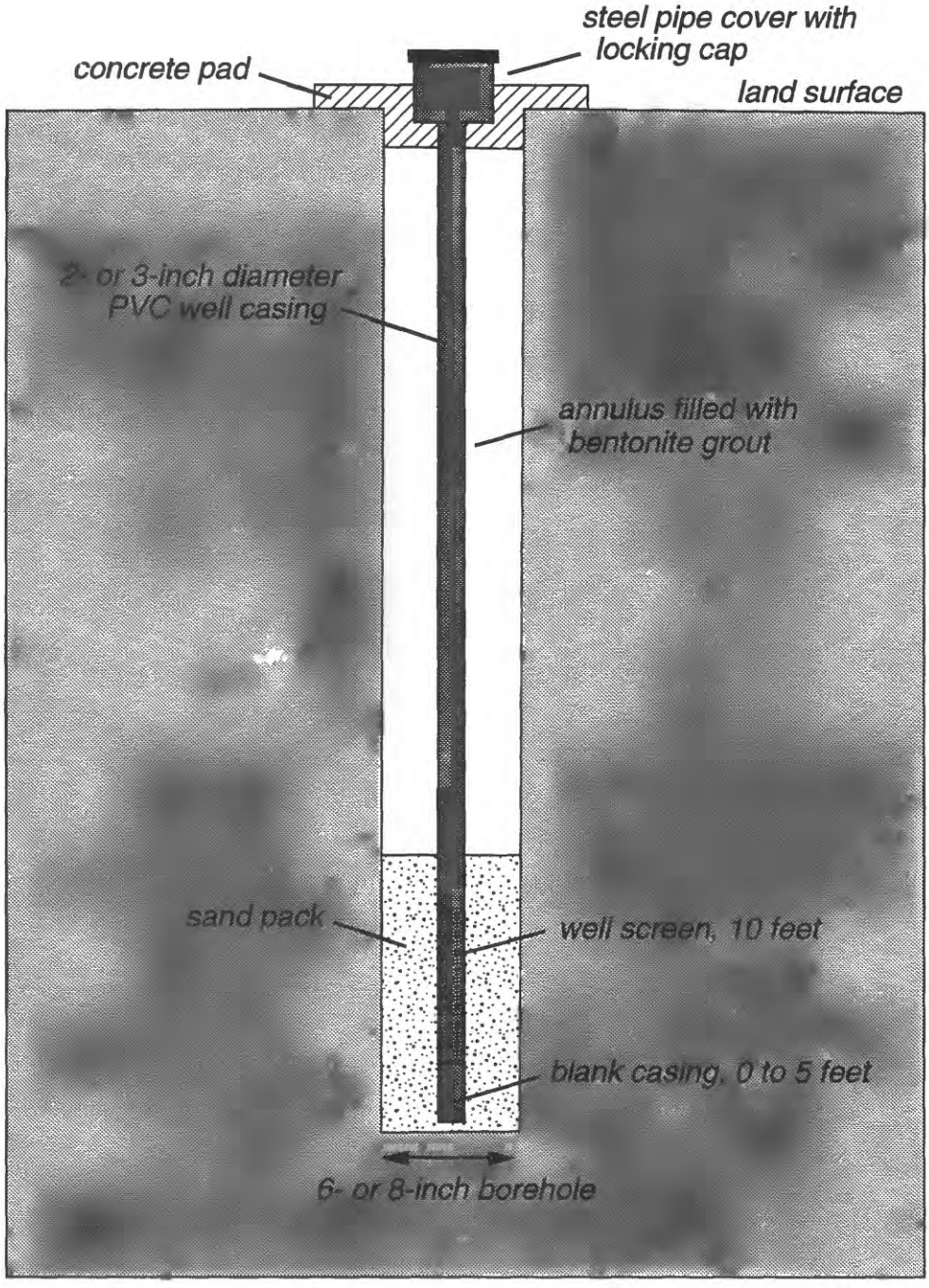

Figure 2. Construction of a typical observation well.

Coplen, 1985). Tritium was analyzed using electrolytic enrichment and liquid-scintillation counting techniques.

Specific conductance, pH, and alkalinity were measured on unfiltered samples in the field during the collection of samples for laboratory analysis. Specific conductance and pH were measured using meters that were calibrated at each site with quality-assured standard solutions. Alkalinity was measured by incrementally titrating 20- to 50-mL (milliliter) samples with dilute sulfuric acid.

WATER-QUALITY DATA

Analyses of major ions and physical and chemical properties of ground water are shown in table 2

Table 1. Cluster site, well identifier, and well-construction information of wells sampled

[Well identifier: Unique number based on cluster site name and a number that is the depth to the midpoint of the screened interval. State well No.: See Well-Numbering System on p. IV. Well identifier, bottom of casing, and screened interval in feet below land surface. Casing diameter, in inches]

Cluster site	Well identifier	State well No.	Drilling method	Casing		
				Diameter	Bottom of casing	Screened interval
29E Stratford	29E-15	19S/20E- 29E1	Auger	2	20	10-20
	29E-50	29E2	Rotary	2	60	45-55
	29E-80	29E3	Auger	2	85	75-85
	29E-190	29E4	Rotary	3	200	185-195
4F Hanford	4F-15	20S/21E- 4F1	Auger	2	20	10-20
	4F-51	4F4	Auger	2	61	46-56
	4F-98	4F3	Auger	2	108	93-103
	4F-195	4F2	Rotary	3	205	190-200
5B Alpaugh	5B-15	24S/23E- 5B3	Auger	2	20	10-20
	5B-58	5B4	Rotary	2	68	53-63
	5B-95	5B5	Auger	2	100	90-100
	5B-180	5B6	Rotary	3	190	175-185
1N Lost Hills	1N-15	25S/21E- 1N1	Auger	2	20	10-20
	1N-57	1N2	Rotary	2	67	52-62
	1N-95	1N3	Auger	2	100	90-100
	1N-194	1N4	Rotary	3	204	189-199
29P Wheeler Ridge	29P-15	32S/27E- 29P1	Auger	2	20	10-20
	29P-47	29P2	Rotary	2	57	42-52
	29P-95	29P3	Auger	2	100	90-100
	29P-204	29P4	Rotary	3	214	199-209

(at back of report). The median pH value for all wells was 7.5. The lowest pH (6.9) was in the 20-foot well (29E-15) at the Stratford site, and highest pH (8.7) was in the 100-foot well (4F-98) at the Hanford site. The median value of dissolved solids was 6,210 mg/L and ranged from 970 to 44,800 mg/L with highest concentrations reported at the Stratford site (table 2).

Chemical analyses of trace elements are shown in table 3 (at back of report). Arsenic ranged from 2 to 270 µg/L with a median value of 10 µg/L. Five of the 19 arsenic values exceeded the primary drinking-water standard of 50 µg/L (U.S. Environmental Protection Agency, 1986). All five values (5B-95 was analyzed twice) were from the Alpaugh site. Selenium ranged from the detection limit of less than 1 to a maximum of 380 µg/L in water collected from the 20-foot well (29P-15) at the Wheeler Ridge site. The median value was less than the detection limit. Four of the 18 selenium values exceeded the aquatic-life criterion for chronic exposure (4-day average of 5 µg/L) (U.S. Environmental Protection Agency, 1988).

Stable-isotope ratios and tritium concentrations are shown in table 4 (at back of report). Stable isotopes of oxygen (oxygen-18) and hydrogen (deuterium) can be used to distinguish the source and evaporative history of water. Both oxygen and hydrogen isotopes are reported as ratios relative to Standard Mean Ocean Water (SMOW), in per mil notation. Delta oxygen-18 ranged from -12.15 to -5.80 per mil with a median of -8.90 per mil. Delta deuterium had a range of -88.5 to -57.5 per mil with a median of -70.0 per mil. The most enriched values reported for delta deuterium and delta oxygen-18 indicate the most evaporated waters. Delta carbon-13 isotope data also are expressed in per mil notation, but the standard used is Peedee belemnite [PDB (Belemnitella Americana, Peedee Formation, Cretaceous, South Carolina)] of the University of Chicago (Faure, 1977). The delta carbon-13 data, in conjunction with other data, can indicate potential

carbon sources such as marine and terrestrial. In the first phase of data collection, only one carbon-13 isotope sample was collected. The sample was analyzed from water collected at the shallow well (1N-15) at the Lost Hills site and had a reported value of -16.10 per mil (table 4).

LITHOLOGIC DATA

Lithologic logs were compiled from onsite descriptions of core samples, drill cuttings, and observations recorded during drilling of the 100- and 200-foot wells (table 5 at back of report). Generally, core samples were collected continuously during the auger drilling of the 100-foot wells. When sediment deposits made coring difficult, drill cuttings and noted observations such as variations in drill speed and drilling pressure were used to complete the lithologic logs. Continuous coring of the 100-foot well allowed detailed description of the lithology to a depth of about 100 ft. The lithologic logs for the interval between about 100 to 200 ft were compiled from cores collected about every 20 ft and drill cuttings collected during mud-rotary drilling of the 200-foot wells.

Drill-cutting and core-sample descriptions primarily are based on the Unified Soils Classification system (U.S. Soil Conservation Service, 1975). Texture, color, and other significant features such as laminae and mottling also were recorded. The color of wet samples were described using numerical color designations from the Munsell soil-color charts (Munsell Color, 1975). Other characteristics of drill cuttings and core samples were determined using Compton's field manual (Compton, 1985) and American Geological Institute data sheets (Dietrich and others, 1982).

WATER-LEVEL DATA

Water levels in all observation wells were periodically measured using a steel tape or electric sounder from August 1990 to February 1993. The tabulated water-level data for observation wells at each cluster site are shown in table 6 (at back of report).

SUMMARY

Water-quality, lithologic, and water-level data were collected for 20 observation wells at 5 locations in the Tulare Basin, California. Much of the Tulare Basin is characterized by saline shallow ground water containing high concentrations of arsenic, selenium, and other trace elements. Disposal of agricultural drainwater containing high concentrations of selenium in evaporation ponds has caused concern over adverse affects to migratory waterfowl. Potential downward migration of ground water containing high arsenic concentrations to regional aquifers used as drinking-water sources may pose a threat to human health. In response to these water-quality concerns, a comprehensive investigation of ground-water geochemistry and hydrology was initiated. Data presented are from the first phase of this investigation.

A cluster of four observation wells at each location were installed at depths of about 20, 50, 100, and 200 ft. Water samples collected from each site were analyzed for major ions, trace elements (including arsenic and selenium), nutrients, and selected isotopes. Lithologic logs and well-construction information for each site and water levels for each well measured periodically from August 1990 to February 1993 also are reported.

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Table 2. Major ions and physical and chemical properties of ground water

[Dissolved major ions are given in milligrams per liter. µS/cm, microsiemen per centimeter at 25° Celsius; °C, degrees Celsius; $CaCO_3$, calcium carbonate; N, nitrogen; P, phosphorus; C, carbon; <, actual value is less than value shown; --, no data]

Well identifier (see table 1)	Date	Specific conductance, field (µS/cm)	pH, field (standard units)	Temperature (°C)	Hardness, total	Calcium	Magnesium
29E-15	8-09-90	21,500	6.9	24.0	3,000	350	510
29E-50	8-30-90	41,700	7.7	22.0	5,400	360	1,100
29E-80	8-09-90	39,200	7.6	24.0	4,400	390	820
29E-190	8-30-90	15,200	7.7	22.0	910	150	130
4F-15	8-09-90	5,490	7.4	23.0	390	99	34
4F-51	--	--	--	--	--	--	--
4F-98	1-14-91	928	8.7	19.5	--	--	--
4F-195	8-27-90	1,530	8.3	23.0	17	3.4	2.0
5B-15	8-08-90	43,800	7.5	22.5	2,800	220	540
5B-58	8-28-90	20,300	7.3	22.5	2,300	290	390
5B-95	8-08-90	8,990	7.5	22.5	570	76	92
	8-28-90	9,350	7.4	23.0	550	69	91
5B-180	8-28-90	2,380	8.3	21.0	26	5.0	3.2
1N-15	8-09-90	1,750	7.4	29.0	330	48	51
	8-29-90	--	--	--	--	--	--
1N-57	8-29-90	12,000	7.3	24.5	1,500	300	170
1N-95	8-29-90	6,250	7.2	24.0	1,100	280	93
1N-194	8-29-90	4,540	7.6	22.5	740	210	51
29P-15	8-07-90	20,200	7.5	21.5	3,900	400	710
29P-47	8-07-90	12,800	7.9	24.0	3,000	500	420
29P-95	8-06-90	3,010	7.5	24.0	1,600	580	41
29P-204	8-08-90	1,490	7.9	23.5	600	170	41

Well identifier (see table 1)	Date	Sodium	Sodium, percent	Sodium adsorption ratio	Potassium	Alkalinity, carbonate, field (as $CaCO_3$)	Sulfate	Chloride	Fluoride
29E-15	8-09-90	5,200	79	41	8.0	448	12,000	840	<0.10
29E-50	8-30-90	12,000	83	71	14	464	29,000	2,000	4.1
29E-80	8-09-90	12,000	86	79	12	390	29,000	1,800	<.10
29E-190	8-30-90	3,600	90	52	6.8	540	7,700	980	.20
4F-15	8-09-90	1,300	88	29	2.1	1,980	650	430	1.8
4F-51	--	--	--	--	--	--	--	--	--
4F-98	1-14-91	--	--	--	--	--	--	--	--
4F-195	8-27-90	390	98	41	.60	795	22	31	1.0
5B-15	8-08-90	12,000	90	99	97	1,190	20,000	6,500	.40
5B-58	8-28-90	3,800	78	34	14	690	6,000	4,000	1.8
5B-95	8-08-90	2,000	88	36	5.0	800	2,400	1,300	1.0
	8-28-90	1,900	88	35	5.4	806	2,200	1,400	1.3
5B-180	8-28-90	570	98	49	1.0	861	140	240	1.9
1N-15	8-09-90	260	63	6	3.0	580	220	300	.90
	8-29-90	--	--	--	--	--	--	--	--
1N-57	8-29-90	2,500	79	29	4.1	580	4,600	1,300	1.2
1N-95	8-29-90	990	66	13	3.4	216	1,500	1,200	<.10

Table 2. Major ions and physical and chemical properties of ground water--*Continued*

Well identifier (see table 1)	Date	Sodium	Sodium, percent	Sodium adsorption ratio	Potassium	Alkalinity, carbonate, field (as $CaCO_3$)	Sulfate	Chloride	Fluoride
1N-194	8-29-90	630	65	10	2.8	110	420	1,200	.10
29P-15	8-07-90	4,200	70	29	24	218	11,000	1,500	1.2
29P-47	8-07-90	2,500	64	20	19	129	600	1,400	.10
29P-95	8-06-90	190	20	2.0	6.7	96.0	1,600	17	.50
29P-204	8-08-90	120	30	2.0	7.4	110	640	28	.90

Well identifier (see table 1)	Date	Bromide	Iodide	Silica	Dissolved solids, sum of constit-uents	Nitrogen, nitrite (as N)	Nitrogen, nitrite plus nitrate (as N)	Phos-phorus, ortho (as P)	Carbon, organic, total (as C)
29E-15	8-09-90	--	--	29	19,300	0.08	13	0.06	9.9
29E-50	8-30-90	3.4	1.5	13	44,800	<.01	<.10	.23	7.2
29E-80	8-09-90	3.4	1.3	9.2	44,300	.02	<.10	.21	4.1
29E-190	8-30-90	2.0	.50	18	12,900	<.01	<.10	.45	2.6
4F-15	8-09-90	2.2	.88	32	3,860	2.7	25	.57	26
4F-51	--	--	--	--	--	--	--	--	--
4F-98	1-14-91	--	--	--	--	--	--	--	--
4F-195	8-27-90	.65	.02	28	970	.03	<.10	3.7	27
5B-15	8-08-90	18	2.5	29	40,200	2.3	9.1	.63	61
5B-58	8-28-90	9.3	1.2	39	15,000	.18	2.1	.66	10
5B-95	8-08-90	2.5	1.3	42	6,410	<.01	<.10	.26	4.0
	8-28-90	2.7	1.3	44	6,210	<.01	<.10	.29	4.1
5B-180	8-28-90	.67	.41	28	1,510	.02	<.10	1.2	18
1N-15	8-09-90	1.2	.20	31	1,270	<.01	<.10	.13	2.3
	8-29-90	--	--	--	--	--	--	--	--
1N-57	8-29-90	3.7	1.4	30	9,280	<.01	<.10	.25	3.3
1N-95	8-29-90	5.1	1.9	54	4,260	<.01	<.10	.08	1.3
1N-194	8-29-90	6.2	2.3	25	2,620	<.01	<.10	.05	1.0
29P-15	8-07-90	8.2	.81	20	18,100	.21	18	.03	7.6
29P-47	8-07-90	6.7	.47	28	5,570	.06	.40	.05	5.3
29P-95	8-06-90	.09	.11	20	2,520	<.01	<.10	.02	--
29P-204	8-08-90	.10	.03	21	1,100	<.01	<.10	.02	.5

Table 3. Trace elements in ground water

[Trace elements in micrograms per liter; <, actual value is less than value shown; --, no data]

Well identifier (see table 1)	Date	Aluminum	Arsenic	Barium	Boron	Cadmium	Chromium	Cobalt	Copper	Iron	Lead
29E-15	8-09-90	10	7	<100	13,000	<4.0	<3	<4	<4	2,700	<4
29E-50	8-30-90	<40	2	300	44,000	<5.0	<5	<5	<5	140	<5
29E-80	8-09-90	50	9	<100	41,000	<4.0	<4	<4	<4	160	<4
29E-190	8-30-90	<20	5	100	12,000	<2.0	<2	<2	<2	40	<2
4F-15	8-09-90	40	15	<100	9,200	<1.0	<1	5	21	20	<1
4F-51	--	--	--	--	--	--	--	--	--	--	--
4F-98	--	--	--	--	--	--	--	--	--	--	--
4F-195	8-27-90	30	4	20	3,000	1.0	<1	1	2	100	1
5B-15	8-08-90	30	270	<100	24,000	<5.0	<5	<5	<5	190	<5
5B-58	8-28-90	<20	82	<100	6,900	<4.0	<3	<4	4	50	<4
5B-95	8-08-90	<10	110	<100	7,300	<1.0	<1	1	2	30	<1
	8-28-90	<10	150	<100	7,600	<2.0	<1	<2	2	20	<2
5B-180	8-28-90	70	69	<100	2,800	<1.0	6	<1	1	130	<1
1N-15	8-09-90	10	6	11	870	1.0	<1	<1	1	6	<1
	8-29-90	--	--	--	--	--	--	--	--	--	--
1N-57	8-29-90	30	16	<100	9,400	<2.0	<2	<2	<2	120	<2
1N-95	8-29-90	<10	10	100	2,100	<1.0	<1	<1	<1	40	<1
1N-194	8-29-90	<10	8	<100	1,300	<1.0	1	1	<1	20	<1
29P-15	8-07-90	10	2	<100	17,000	<2.0	5	<2	<2	90	<2
29P-47	8-07-90	20	4	<100	7,100	<2.0	3	2	2	60	<2
29P-95	8-06-90	20	22	<100	860	<1.0	3	1	1	130	<1
29P-204	8-08-90	20	10	20	460	1.0	<1	<1	3	8	1

Well identifier (see table 1)	Date	Lithium	Manganese	Molybdenum	Nickel	Selenium	Silver	Strontium	Vanadium	Zinc
29E-15	8-09-90	70	880	900	8	<2	<4.0	4,600	32	20
29E-50	8-30-90	180	2,900	1,300	<5	<1	<5.0	4,200	41	40
29E-80	8-09-90	160	1,200	1,300	8	<2	<4.0	8,400	60	50
29E-190	8-30-90	50	560	560	<2	<1	<2.0	1,900	19	20
4F-15	8-09-90	20	410	1,200	10	2	<1.0	1,000	88	<10
4F-51	--	--	--	--	--	--	--	--	--	--
4F-98	--	--	--	--	--	--	--	--	--	--
4F-195	8-27-90	<4	45	30	1	<1	2.0	64	63	9
5B-15	8-08-90	330	140	13,000	10	6	<5.0	11,000	500	40
5B-58	8-28-90	210	1,200	3,000	<4	15	<4.0	7,000	180	30
5B-95	8-08-90	140	280	1,600	2	<2	<1.0	2,400	180	20
	8-28-90	150	350	1,400	<2	<1	<2.0	2,400	210	<10
5B-180	8-28-90	10	50	34	1	<1	<1.0	70	52	<10
1N-15	8-09-90	87	58	88	1	<1	<2.0	810	19	4
	8-29-90	--	--	--	--	--	--	--	--	--
1N-57	8-29-90	120	3,500	1,800	<2	--	<2.0	4,000	27	10
1N-95	8-29-90	110	2,600	230	<1	<1	<1.0	90	31	10
1N-194	8-29-90	30	810	22	1	<1	<1.0	2,400	19	30
29P-15	8-07-90	160	70	620	4	380	<2.0	7,800	32	20
29P-47	8-07-90	60	1,200	250	2	9	<2.0	8,200	23	50
29P-95	8-06-90	30	410	220	1	<2	<1.0	5,100	4	10
29P-204	8-08-90	61	180	31	2	<2	<1.0	1,700	1	14

Table 4. Stable-isotope ratios and tritium concentrations in ground water

[<, actual value is less than value shown; pCi/L, picocuries per liter; --, no data]

Well identifier (see table 1)	Date	Delta oxygen-18 (per mil)	Delta deuterium (per mil)	Delta carbon-13 (per mil)	Tritium (pCi/L)
29E-15	8-09-90	-10.25	-81.5	--	19.7
29E-50	8-30-90	-8.20	-69.0	--	<.8
29E-80	8-09-90	-8.10	-67.0	--	<.8
29E-190	8-30-90	-9.00	-70.0	--	1.9
4F-15	8-09-90	-10.95	-84.5	--	25.6
4F-51	--	--	--	--	--
4F-98	1-14-91	--	--	--	--
4F-195	8-27-90	-12.15	-88.5	--	<.8
5B-15	8-08-90	-5.80	-57.5	--	1.6
5B-58	8-28-90	-6.85	-60.0	--	<.8
5B-95	8-08-90	-7.95	-66.0	--	--
	8-28-90	-7.80	-64.5	--	1.8
5B-180	8-28-90	-10.30	-77.5	--	<.8
1N-15	8-09-90	-7.80	-66.0	--	11.7
	8-29-90	--	--	-16.10	--
1N-57	8-29-90	-7.30	-66.0	--	<.8
1N-95	8-29-90	-8.90	-71.0	--	<.8
1N-194	8-29-90	-9.55	-72.5	--	<.8
29P-15	8-07-90	--	--	--	6.2
	2-26-91	-8.35	-67.0	--	--
29P-47	8-07-90	-9.25	-73.0	--	1.3
29P-95	8-06-90	-10.20	-73.0	--	<.8
29P-204	8-08-90	-10.35	-75.5	--	<.8

Table 5. Lithologic logs for wells at cluster sites

[See table 1 for explanation of well identifier; because of close proximity, the wells at about 100 and 200 feet at each cluster site were used to compile the following logs. Color shade: Y, yellow; R, red; YR, yellow red; GY, gray yellow; BG, blue gray. e, estimated; ft, foot; mm, millimeter; HCl, hydrochloric acid]

Description	Depth (ft)	
	From	To
Well 29E-80. Altitude of land surface, approximately 208 ft. Drilled by Datum Exploration with a hollow-stem auger. Total depth, 108 ft. Screened interval, 75.0 to 85.0 ft.		
Sand, dusky brown (5YR 2/2), very-fine grained, about 15- to 20-percent silt and clay, poorly graded, micaceous; dry.	0	2.7
Sand, clayey, dusky yellowish brown (10YR 2/2), about 70-percent fine-grained sand; low plastic silt and clay; dry.	2.7	e3.6
Sand, moderate yellowish brown (10YR 5/4), about 10- to 15-percent silt and clay, poorly graded; moist.	e3.6	4.3
Sand, dark yellowish brown (10YR 4/2), medium grained, with some fine-grained sand, less than 5-percent silt and clay, poorly graded, micaceous/greenish-gold flakes; wet.	4.3	5.0
Sand, pale brown (5YR 5/2), medium and coarse grained, subangular; contains quartz, mica, feldspar, gypsum, lithic fragments; little to no silt and clay; wet.	5.0	8.0
Sand, same as above, saturated, some fine-grained sand, well graded.	8.0	11.9
Clay, high plasticity, light olive gray (5Y 5/2), slightly mottled with dark gray and reddish brown (streaked concretions); root casts present, little to no sand, stiff; wet.	11.9	15.5
No sample.	15.5	e16.5
Silt, light olive brown (5Y 5/6), moderate dilatancy, medium plasticity; little to no sands; elastic silt, stiff; wet.	e16.5	18.0
Sand, grayish olive (10Y 4/2), very-fine grained, 15- to 20-percent silt and clay, poorly graded, micaceous; saturated.	18.0	e20.0
Silt, moderate olive brown (5Y 4/4), rapid dilatancy, slight to nonplastic; little to no sands, mottled grayish olive (10Y 4/2) with light olive brown (5Y 5/6), micaceous, moderately stiff; saturated.	e20.0	22.0
Sand, silty, light olive gray (5Y 5/2), very-fine grained, poorly graded, slightly cohesive, large mica flakes (greenish gold).	22.0	22.5
Sand, light olive gray (5Y 5/2), fine, medium, and coarse grained, well graded; contains mostly subrounded quartz with little feldspars and coarse black mica flakes; saturated.	22.5	29.5
Clay, high plasticity, grayish olive green (5GY 3/2), some reddish-brown concentrations, little to no sand, stiff to hard; moist.	29.5	e31.0
Clay, high plasticity, moderate yellowish brown (10YR 5/4), little to no sand, stiff; wet.	e31.0	36.0
Clay, high plasticity, same as above, contains very-fine grained sand and few calcareous nodules 1/4-inch long and 1/8-inch diameter.	36.0	37.0
Sand, silty, dark yellowish brown (10YR 4/2), about 50-percent very-fine grained sand and 50-percent silt; cohesive.	37.0	e38.5

Table 5. Lithologic logs for wells at cluster sites--*Continued*

Description	Depth (ft) From	Depth (ft) To
Well 29E-80--*Continued.*		
Clay, high plasticity, moderate yellowish brown (10YR 5/4), some fine-grained sand (micaceous), large gypsum crystals (up to 1/2-inch long); some reworked gypsum nodules in the lower 1 ft.	e38.5	e42.0
Silt, moderate yellowish brown (10YR 5/4), rapid delatancy, slight to nonplastic, firm; reworked gypsum nodules; wet.	e42.0	e43.5
Clay, high plasticity, moderate yellowish brown (10YR 5/4), small amounts of fine-grained sand, stiff; moist.	e43.5	e45.5
Sand.	e45.5	e47.5
Clay, low plasticity, moderate yellowish brown (10YR 5/4), mottled with light olive gray (5Y 5/2), very-fine grained sand, smoky-white crystals (gypsum); associated with the gray (earthy gypsum) small gypsum crystals.	e47.5	50.5
Sand, silty, dark yellowish brown (10YR 4/2), very-fine grained sand and silt, poorly graded; saturated.	50.5	e52.5
Clay, high plasticity, moderate yellowish brown (10YR 5/4), about 5-percent white crystal clusters that are slightly effervescent in the dilute HCl.	e52.5	e54.0
Clay, silty, moderate yellowish brown (10YR 5/4), low to slight plasticity, crystal clusters, stiff. Small sand stringer in sample tube, fine-grained sand at 54.2 ft. Salt crystals at 55.8 ft.	e54.0	e59.5
Sand, silty, very-fine to fine grained (10YR 5/4 to 10YR 4/2), poorly graded; saturated.	e59.5	e61.5
Silt, dark yellowish brown (10YR 4/2), slight to low plasticity, gypsum crystals and mica flakes with very-fine grained sand; saturated.	e61.5	e62.5
Silt, same as above, nonplastic.	e62.5	e64.0
Clay, high plasticity, moderate olive brown (5Y 4/4), mottled with olive gray (5Y 3/2), blocky texture, conchoidal fracture, very stiff to hard.	e64.0	66.0
Clay, high plasticity, moderate yellowish brown (10YR 5/4); some fine-grained sand; some earthy-white crystals with small gypsum crystals.	66.0	73.5
Silt, sandy, dark yellowish brown (10YR 4/2), very-fine grained sand and silt, slight plasticity, firm, micaceous; saturated.	73.5	74.0
Clay, high plasticity, light olive gray (5Y 5/4), some very-fine grained sand, some reddish brown staining, white streaks, nodular texture.	74.0	75.5
Sand, dark yellowish brown (10YR 4/2), fine to medium grained, cohesive, 15- to 20-percent silt and clay, poorly graded; quartz and lithic fragments.	75.5	76.5
Clay, high plasticity, grayish olive (10Y 4/2), very stiff to hard; some fine-grained sand, moist; small earthy-white crystals, and larger gypsum crystals.	76.5	83.0

Table 5. Lithologic logs for wells at cluster sites--*Continued*

Description	Depth (ft) From	Depth (ft) To
Well 29E-80--*Continued.*		
Sand, grayish olive (10Y 4/2), fine- and medium-grained sand, poorly graded, slightly cohesive, mostly quartz with some lithic fragments, fining downward and increase in silt and clay.	83.0	e85.0
Clay, high plasticity, moderate olive brown (5Y 4/4), stiff, about 5-percent fine earthy-white crystals; moist.	e85.0	85.5
Clay, low to medium plasticity, light olive brown (5Y 5/6), mottled with light olive gray (5Y 5/2), stiff, some fine-grained sand, some clay nodules.	85.5	87.5
Clay, same as above, high plasticity.	87.5	91.0
Clay, same as above, contains few small earthy-white crystals.	91.0	95.5
Clay, high plasticity, light olive brown (5Y 5/6), some very-fine grained sand, slightly mottled with gray, very stiff.	95.5	e97.5
Clay, silty, dark yellowish brown (10YR 4/2), firm, slight to low plasticity, some very-fine grained sand; micaceous.	e97.5	e100.0
Clay, high plasticity, dark yellowish brown (10YR 4/2), very stiff to hard, some fine-grained sand; moist.	e100.0	e101.5
Clay, high plasticity, light olive gray (5Y 5/2) with reddish-brown nodules, fine-grained sand, sugary texture, very stiff to hard; moist.	e101.5	e104.0
Clay, silty, moderate yellowish brown (10YR 5/4), some reddish-brown staining, slight to low plasticity, firm, micaceous.	e104.0	e106.5
Clay, high plasticity, dark yellowish brown (10YR 4/2), very stiff to hard, some fine-grained sand (not mottled).	e106.5	108.0
Bottom of augered hole.	108.0	
Well 29E-190. Altitude of land surface, approximately 208 ft. Drilled by the U.S. Geological Survey with a rotary rig. Total depth, 200 ft. Screened interval, 185.0 to 195.0 ft.		
Rotary cores. Rotary cores were not sampled below 163 ft because of flowing sands.		
Clay, light olive gray (5Y 5/2), moderate amount of silt.	120	122
Clay, light olive gray (5Y 5/2), some silt, abundant earthy gypsum nodules.	140	142
Sand, light olive gray (5Y 5/2), medium grained, poorly graded; some small faded zones of oxidation.	161	162
Clay, light olive green (5Y 5/2), very stiff.	162	163
Well 4F-98. Altitude of land surface, approximately 326 ft. Drilled by Layne Environmental with a hollow-stem auger. Total depth, 100.5 ft. Screened interval, 93.0 to 103.0 ft.		
Sand, pale green, fine to medium grained; subangular to subround quartz and mica.	0.0	2.0

Table 5. Lithologic logs for wells at cluster sites--*Continued*

Description	Depth (ft)	
	From	To
Well 4F-98--*Continued.*		
Sand with clay, greenish-brown, very fine to fine grained; subangular to subround quartz and mica.	2.0	3.0
Same as interval 0.0 to 2.0 ft, slightly darker (more brown), larger grained, abundant mica.	3.0	3.5
Sand with trace amounts of clay, pale greenish brown, fine to medium grained; quartz and mica, traces of coarse-grained mica.	3.5	5.5
Sand with trace amounts of clay, dark green-brown. Hard, crumbles into pebble-sized fragments, which crumble to very fine- to medium-grained quartz and mica grains.	5.5	6.5
Sand, clayey, pale green, very-fine to medium grained with trace amounts (less than 5 percent) of coarse mica and quartz, subangular to subround.	6.5	7.5
Sand with trace amounts of clay, pale green, fine to medium grained, trace amounts of coarse fragments, abundant mica; moist.	7.5	8.0
Sand with clay, pale green with tan streaks, very-fine to medium grained, micaceous; very moist.	8.0	8.5
Sand, very light gray brown, fine to coarse grained; mostly quartz and mica; trace amounts of feldspar, angular to subround, coarsens near bottom; saturated.	8.5	9.5
Sand, tan, fine to coarse grained; angular to subround quartz and mica.	9.5	10.5
Sand, pale green, medium grained, angular to subround quartz and mica; trace amounts of clay.	10.5	11.0
Same as above, slightly more clay.	11.0	12.0
Sand, tan, fine to medium grained, subangular to subround quartz and mica.	12.0	12.5
Sand, tan, very-fine to coarse grained, angular to subround quartz and mica.	12.5	13.0
Sand, tan, fine to coarse grained, angular to subround mica, quartz, and feldspar, well graded.	13.0	13.5
Same as above, oxidized splotches.	13.5	15.5
Sand, pale tan matrix with dark orange, very-fine to medium grained, about 10- to 15-percent coarse mica.	15.5	16.0
Silt, clayey with trace amounts of sand, green and black, soft, slight plasticity.	16.0	16.5
Clay, pale green, moderately stiff, moderate plasticity.	16.5	17.0
Clay, silty, green, brown splotches, moderately stiff, moderate plasticity.	17.0	18.0
Sand, pale tan-gray, mostly medium grained; angular to subround quartz; abundant mica, poorly graded.	18.0	19.0
Same as above, slightly finer grained but still primarily medium grained.	19.0	22.5

Table 5. Lithologic logs for wells at cluster sites--*Continued*

Description	Depth (ft) From	Depth (ft) To
Well 4F-98--*Continued.*		
Sand, brown, medium grained; subangular to subround quartz and mica.	22.5	23.0
Sand, pale tan, fine to coarse grained; angular to subround quartz and mica, about 20-percent coarse.	23.0	24.5
Same as above, less coarse fraction.	24.5	25.0
Sand, pale tan-gray, very-fine to medium grained, trace amounts of coarse grained.	25.0	26.5
Sand, pale tan-gray, fine to medium grained; angular to subround quartz and mica.	26.5	27.0
Sand, pale gray-tan, fine to coarse grained; angular to subround quartz and mica; trace amounts of very coarse mica flakes.	27.0	27.5
Top half of sample is the same as above, darker gray. Bottom half of sample is silty clay, pale green with abundant brown splotches, crumbly, low plasticity.	27.5	28.0
Sand, pale gray tan, very-fine to coarse grained but primarily medium grained; angular to subround quartz and mica.	28.0	29.0
Sand, pale gray tan, medium grained; angular to subround quartz and mica.	29.0	29.5
Sand, dark gray, medium grained.	29.5	30.0
Sand, silty, dark green with dark brown splotches, very-fine to fine grained.	30.0	30.5
Sand, dark gray, medium grained, trace amounts of coarse grained.	30.5	43.0
Same as above, slight clay content.	43.0	45.5
Clay, blue green, soft, low plasticity.	45.5	46.5
Sand, silty, gray green, some coarse grained (about 15 percent), very micaceous; angular to subangular quartz and mica.	46.5	48.0
Sand, dark gray-green, fine to medium grained, about 5-percent coarse; angular to subround quartz and mica.	48.0	48.5
Same as above, darker gray.	48.5	49.0
Same as sample 48.0 to 48.5 ft, charcoal gray.	49.0	51.0
Sand, charcoal gray, medium grained.	51.0	52.0
Same as above, wood slivers.	52.0	53.0
Sand, blue gray, fine to medium grained, slight coarse fraction (about 5 percent); trace amounts of wood fragments.	53.0	54.0
Sand, blue gray, medium grained; subangular to subround mica and quartz.	54.0	55.5
Sand, gray green, very-fine to coarse grained, about 20-percent coarse; angular to subround quartz and mica.	55.5	58.0

Table 5. Lithologic logs for wells at cluster sites--*Continued*

Description	Depth (ft)	
	From	To
Well 4F-98--*Continued.*		
Sand, gray green, very-fine to medium grained, about 5- to 10-percent coarse quartz and mica.	58.0	60.5
No sample.	60.5	62.5
Sand, clayey, blue gray, fine to coarse grained, about 20-percent clay.	62.5	63.0
Sand, gray, fine to coarse grained, about 30-percent coarse; angular to subangular quartz and mica.	63.0	65.5
Sand, gray, fine to medium grained.	65.5	66.5
Sand, blue gray, about 5- to 10-percent very coarse; fine- to coarse-grained mica and quartz.	66.5	68.0
Sand, gray, very-fine to coarse grained; angular to subround quartz and mica, about 25-percent coarse.	68.0	70.5
Same as sample 68.0 to 70.5 ft.	70.5	78.0
Sand, blue gray, fine to medium grained; subangular to subround quartz and mica.	78.0	79.0
Sand, dark gray, fine to coarse grained; angular to subround quartz and mica, very micaceous.	79.0	80.5
Sand, blue gray, fine to medium grained; subangular to subround quartz and mica.	80.5	81.5
Gravel with clay, blue gray; some fine- to medium-grained sand, all grains angular to subround quartz and mica.	81.5	82.0
Sand, blue gray, very-fine to coarse-grained quartz and mica.	82.0	82.5
Silt with clay, blue gray, low plasticity.	82.5	83.0
Silt, clayey with fine-grained sand, low plasticity, very soft sand, very micaceous.	83.0	83.5
Clay, blue gray, soft, low to medium plasticity.	83.5	84.0
Silt, blue gray, low plasticity; trace amounts of clay.	84.0	85.5
Sand, green gray, very-fine to coarse grained, very micaceous.	85.5	86.5
Same as above, dark gray green.	86.5	88.0
Sand, dark gray, fine to medium grained, very micaceous.	88.0	90.0
Same as above, dark gray green and slightly finer grained.	89.5	90.5
Clay with sand, dark green gray, soft, low plasticity.	90.5	91.0
Silt with clay, green gray, very soft, low plasticity.	91.0	91.5
Sand, blue gray, fine grained, micaceous.	91.5	93.0
Sand, green gray, fine to coarse grained, very micaceous.	93.0	93.5

Table 5. Lithologic logs for wells at cluster sites--*Continued*

Description	Depth (ft) From	Depth (ft) To
Well 4F-98--*Continued.*		
Clay, gravelly, green gray, very soft, low plasticity.	93.5	94.0
Clay, silty, green gray, very soft, low plasticity.	94.0	94.5
Sand, green gray, very-fine to medium grained, very micaceous.	94.5	95.0
Sand, green gray, very-fine to fine grained, micaceous.	95.0	95.5
No sample.	95.5	97.0
Sand, silty, gray green, very-fine to fine-grained mica and quartz.	97.0	98.0
Sand, green gray, medium grained, very micaceous.	98.0	100.5
Bottom of augered hole.	100.5	
Well 4F-195. Altitude of land surface, approximately 326 ft. Drilled by the U.S. Geological Survey with a rotary rig. Total depth, 205.0 ft. Screened interval, 190.0 to 200.0 ft.		
No sample. The presence of sands under hydraulic pressure did not permit sampling of cores in this interval.	100.5	205.0
Well 5B-95. Altitude of land surface, approximately 210 ft. Drilled by Datum Exploration with a hollow-stem auger. Total depth, 103.5 ft. Screened interval, 90.0 to 100.0 ft.		
Silt, grayish brown (5YR 3/2), nonplastic, firm, micaceous, some fine-grained sand; moist.	0	5.0
Clay, high plasticity, dark yellowish brown (10YR 4/2), stiff, micaceous, some fine-grained sand; moist.	e5.0	e7.2
Clay, high plasticity, same as above, wet, small shells (probably snail shells), some whole shells (about 1 mm), and some shell fragments (up to 2.5 mm).	e7.2	e9.0
Silt, dark yellowish brown (10YR 4/2), slight to no plasticity, rapid dilatancy, micaceous, some fine-grained sand, some shells as above; saturated.	e9.0	10.0
Clay, sandy, grayish brown (5YR 3/2), 25- to 30-percent fine- and medium-grained sand, low plasticity; snail shells (4 mm) and shell fragments, granular structure.	10.0	11.2
Clay, high plasticity, moderate olive brown (5Y 4/4) mottled with olive gray (5Y 3/2), stiff; some fine-grained sand; wet.	11.2	12.8
Sand, clayey, dusky yellowish brown (10YR 2/2) with moderate brown (5Y 4/4) and moderate olive brown (5Y 4/4), about 30- to 40-percent silt and clay, low plasticity, medium-grained sand, granular texture (possibly iron and manganese concretions).	12.8	13.5
Clay, high plasticity, light olive gray (5Y 5/2), 5- to 10-percent medium-grained sand, stiff; wet.	13.5	15.5
Sand, moderate olive-brown (5Y 5/6) concretions, micaceous, very-fine grained sand, poorly graded; saturated.	15.5	16.7

Table 5. Lithologic logs for wells at cluster sites--*Continued*

Description	Depth (ft) From	Depth (ft) To
Well 5B-95--*Continued.*		
Clay, low to medium plasticity, light olive gray (5Y 5/2), about 5-percent medium-grained sand, reddish-brown concretions, and few earthy-white crystals, micaceous, stiff; wet.	16.7	18.0
Sand and low plasticity clay, interbedded fine-grained sand with clay (about 4-inches thick); saturated; fine-grained sand, light olive gray (5Y 5/2), poorly graded; micaceous, light olive-brown (5Y 5/6) nodules; some olive-gray clay (5Y 5/2) at 18.5 ft; moderate reddish-brown (10R 4/6) stained areas with small white crystals.	18.0	e20.5
Clay, high plasticity with sand, light olive gray (5Y 5/2) mottled with moderate olive brown (5Y 4/4), olive-gray (5Y 3/2) specs, firm, granular texture, possibly interbedded with clayey sand; some very small mica flakes.	20.5	21.0
Clay, high plasticity, light olive gray (5Y 5/2), earthy-white crystals and olive-gray (5Y 3/2) specs, very stiff.	21.0	23.0
Clay, high plasticity, light olive gray (5Y 5/2) with moderate olive-brown (5Y 4/4) small pieces of clay; soft, sticky, gypsum crystals and small earthy-white crystals; saturated.	23.0	24.0
Clay, high plasticity, light olive gray (5Y 5/2), very stiff; olive-gray (5Y 3/2) nodules and small white crystals, nodular structure; abundant gypsum crystals (possible stringer) at 27.0 ft; moist. At 28.0 ft, same as above, contains abundant rust and dark gray nodules (iron and manganese concretions).	24.0	28.3
Clay, high plasticity, light olive gray (5Y 5/2), nodular structure, soft, some fine-grained sand or nodules; saturated.	28.3	29.0
Clay, high plasticity, same as above, stiff; nodules of radiating gypsum crystals (about 5 mm in diameter) and cemented nodules of fine-grained sand (calcareous) about 10 to 15 mm.	29.0	31.5
Clay, high plasticity, light olive gray (5Y 5/2), firm to stiff; some fine-grained sand; some white crystals and dark gray specs (stiffens downward); nodular texture (lower 1 ft is about 30-percent fine-grained sand).	31.5	35.5
Sand, moderate olive brown (5Y 5/6) mottled with light olive brown (5Y 5/6) and olive gray (5Y 3/2), very-fine grained, poorly graded; 10- to 15-percent silt and clay; micaceous, dark reddish-brown (10R 3/2) nodules (pebble size).	35.5	e36.6
Sand, same as above, more olive-gray mottling.	36.6	38.5
Sand and high plasticity clay, interbedded, light olive gray (5Y 5/2); sand is very fine grained, about 80-percent quartz, micaceous (gold colored), poorly graded; clay is firm to stiff.	e38.5	e39.0
Clay, high plasticity, light olive gray (5Y 5/2), very stiff; earthy-white crystals and dark gray specs, nodular structure, small (about 1 mm) concretions (not effervescent in HCl) and large nodules (about 15 mm) of cemented sand (effervescent in HCl).	39.0	e48.0
Sand, pale olive (10Y 6/2), very-fine grained sand, loose, about 90-percent quartz, calcareous, poorly graded, little to no silt and clay.	48.0	50.0

Table 5. Lithologic logs for wells at cluster sites--*Continued*

Description	Depth (ft) From	Depth (ft) To
Well 5B-95--*Continued.*		
Clay, high plasticity with sand, light olive gray (5Y 5/2), 20- to 25-percent fine-grained sand, very stiff; micaceous.	50.0	50.5+
Clay, interbedded, high plasticity (same as 50.0 ft) and fine-grained sand (same as 48.0 ft).	51.5	e53.0
Clay, high plasticity, dark yellowish brown (10YR 4/2), firm, 15- to 20-percent fine-grained sand, micaceous, saturated.	e53.0	55.0
Sand, dark yellowish orange (10YR 6/6), fine, medium, and coarse grained; well graded, loose, about 80-percent quartz, 10-percent feldspars, 10-percent rock fragments, 1-mm gold mica flakes; subangular and subrounded, little to no silt and clay.	55.0	e63.0
Silt, light olive gray (5Y 5/2) with light brown (5YR 5/6) stained elongated zoned areas (about 15-mm long) dispersed over 5 percent of core, nonplastic; some fine-grained sand, micaceous.	e63.0	e64.0
Sand, pale brown (5YR 5/2), fine grained, poorly graded, abundant goldish mica, about 90-percent quartz, about 5-percent black (magnetite), less than 5-percent rock fragments.	e64.0	80.5+
Clay, low plasticity, moderate olive brown (5Y 4/4), very stiff, some fine-grained sand, micaceous; wet.	e81.0	e82.5
Silt, grayish olive (10Y 4/2), nonplastic, dense, micaceous; wet.	82.5	85.5
Silt, same as above, loose silt (possibly mixed with sluff sand from above).	85.5	86.0
No sample.	86.0	87.0
Silt, same as above, dense (and more clay).	87.0	88.0
Clay, low plasticity, light olive gray (5Y 5/2), some fine-grained sand, stiff, micaceous; earthy-white crystal streaks (about 10-mm long), nodular structure; wet.	88.0	e91.0
Sand, light olive gray (5Y 5/2), very-fine grained, poorly graded; little to no silt and clay; abundant mica (greenish gold), loose (with some oxidized - light olive-brown (5Y 5/6) zones at 93 ft); large gold mica flakes at 93.5 ft; saturated.	e91.0	93.0+
Same as above.		95.5
Sand, medium grained, same as sample e91.0 to 93.0+.	96.0	e96.5
Silt, clayey, light olive gray (5Y 4/2), slight plasticity, some very-fine grained sand, micaceous.	e96.5	98.2
Clay, high plasticity, moderate olive brown (5Y 4/4), hard; some very-fine grained sand; small amounts of mica; moist.	98.2	103.5
Bottom of augered hole.	103.5	

Table 5. Lithologic logs for wells at cluster sites--*Continued*

Description	Depth (ft) From	To
Well 5B-180. Altitude of land surface, approximately 210 ft. Drilled by the U.S. Geological Survey with a rotary rig. Total depth, 190 ft. Screened interval, 175.0 to 185.0 ft.		
Rotary cores		
Sand, light olive gray (5Y 5/2), very-fine grained; abundant silt; abundant quartz and mica, massive, cohesive.	122	124
Sand, between dusky yellow green (5GY 5/2) and grayish olive green (5GY 3/2), very-fine to fine grained; very little silt, similar to the above sample but coarser grained.	140	142
Clay, dense with earthy gypsum nodules, light olive gray (5Y 5/2); bottom one-third is a brownish black (5YR 2/1) clay, hard, dense.	160	162
Clay, dusky yellow green (5GY 5/2), some very-fine grained sand, massive.	180	182
Well 1N-95. Altitude of land surface, approximately 290 ft. Drilled by Datum Exploration with a hollow-stem auger. Total depth, 100 ft. Screened interval, 90 to 100 ft.		
Clay, high plasticity, dusky yellowish brown (10YR 2/2), about 5- to 10-percent medium- and fine-grained sand, hard; contains white streaks (effervescent in dilute HCl); dry.	0.0	e2.5
Clay, high plasticity, dusky yellowish brown (10YR 2/2), mottled with light olive brown (5Y 5/6) and moderate olive brown (5Y 4/4), stiff; some fine-grained sand and very-fine mica flakes; damp.	e2.5	e3.5
Clay, high plasticity, light olive brown (5Y 5/6) with rust-colored streaks (about 1-mm long); 15- to 20-percent fine-grained sand, micaceous, stiff; damp.	3.5	e5.0
Clay, low plasticity, dusky yellow (5Y 6/4); abundant (about 25 percent) very-fine grained sand, micaceous, firm, light olive gray at bottom (5Y 5/2); moist.	5.0	e7.5
Sand, light olive gray (5Y 5/2), very-fine grained, poorly graded, micaceous; about 90-percent quartz, less than 5-percent black sand (magnetite).	e7.5	e8.5
Sand, light olive gray (5Y 5/2), fine grained, poorly graded; little to no silt and clay, loose; about 85- to 90-percent quartz, micaceous; saturated. At 15.5 ft, lighter gray color, medium-grained sand, greenish-gold mica, large flakes; at 19.5 ft, some dark yellowish-orange staining.	e8.5	e22.0
Sand, clayey, light olive gray (5Y 5/2), very-fine grained, about 30-percent silt and clay (slightly plastic), poorly graded, dense, micaceous.	e22.0	e23.5
Clay, sandy, high plasticity, light olive gray (5Y 5/2), about 10- to 15-percent fine-grained sand, calcareous nodules. Black nodules and stringers increase with depth, micaceous.	e23.5	e28.0
Silt, light olive gray (5Y 5/2) with rust-colored staining, nonplastic; very-fine grained sand, micaceous, firm at about 29 ft, about 15-percent small, dark manganese nodules, stiff; moist.	e28.0 29.0+	
Sand, light olive gray (5Y 5/2), very-fine grained; some silt (nonplastic), firm, rust-colored staining on about 5 percent of sample at 33.0 ft, darker gray, no rust color.	29.0+	e33.2

Table 5. Lithologic logs for wells at cluster sites--*Continued*

Description	Depth (ft) From	Depth (ft) To
Well 1N-95--*Continued.*		
Clay, sandy, low plasticity, light olive gray (5Y 5/2), 25- to 30-percent fine-grained sand, stiff, nodular structure; percentage of sand increases downward.	e33.2	35.5
Sand, pale olive (10Y 6/2), medium and fine grained; no silt or clay, mostly clean quartz sand, very little to no mica, loose, subrounded quartz with angular white feldspar, few rock fragments, biotite and phlogopite mica.	35.5	50.0+
Sand, mottled grayish orange (10YR 7/4) and greenish gray (5GY 6/1), mostly greenish gray, fine to medium grained, very clayey, some small grain-like salt crystals, some small earthy gypsum nodules.	60.0	62.0
Same as above, reduced sand, bottom of augered hole.	100.0	
Well 1N-194. Altitude of land surface, approximately 290 ft. Drilled by the U.S. Geological Survey with a rotary rig. Total depth, 204 ft. Screened interval, 189 to 199 ft.		
Rotary cores		
Sand, light olive gray (5Y 5/2), medium grained, mottled with oxidized (dark yellowish orange 10YR 6/6) and reduced (greenish gray 5GY 6/1) zones, mostly quartz, micaceous.	103.5	105.5
Clay, dusky yellowish green (10GY 3/2), some clasts of reduced medium-grained sand, some light brown (5YR 5/6) mottling, micaceous, sparkly, massive and blocky.	120	122
Clay, dusky yellow green (5GY 5/2); some silt; some earthy gypsum nodules, massive.	140	142
Clay, dusky yellow green (5GY 5/2); some fine-grained sand.	160	162
Sand, dusky yellow green (5GY 5/2), fine to medium grained; some clay; some very faint oxidized zones.	180	182
Sand, greenish gray (5G 6/1), medium grained; clean.	200	202
Well 29P-95. Altitude of land surface, approximately 326 ft. Drilled by Datum Exploration with a hollow-stem auger. Total depth, 100 ft. Screened interval, 90.0 to 100.0 ft.		
Clay, low plasticity, dark yellowish brown (10YR 4/2); some very-fine grained sand, slightly micaceous, firm; dry.	0.0	e2.0
Clay, same as above, more fine-grained sand.	e2.0	e3.0
Clay, low plasticity, pale brown (5YR 5/2), firm, micaceous, some very-fine grained sand; the matrix strongly effervesces with dilute HCl; moist. Small earthy-white crystals in 5-mm diameter clusters dissolve but do not effervesce in HCl. At 6.0 ft, there is 10- to 15-percent fine-grained sand, at 8.0 ft, the sand content increases to about 25 to 30 percent.	e3.0	e8.3
Clay, low plasticity, pale brown (5YR 5/2), 5- to 10-percent very-fine grained sand, micaceous, firm, about 10-percent earthy-white crystals; moist. Soil does not effervesce, nonplastic, silt at 10.0 ft.	e8.3	e10.5

Table 5. Lithologic logs for wells at cluster sites--*Continued*

Description	Depth (ft) From	Depth (ft) To
Well 29P-95--*Continued.*		
Sand, clayey, pale brown (5YR 5/2), about 60-percent fine-grained sand, about 40-percent slightly plastic clay; sand is quartz mixed with lithic fragments, loose, not effervescent, slightly micaceous; saturated.	e10.5	e15.0
Sand, silty, dark yellowish brown (10YR 4/2), about 70-percent very-fine grained sand and 30-percent nonplastic silt and clay, micaceous, firm.	e15.0	e16.5
Sand, dark yellowish brown (10YR 4/2), medium grained, poorly graded, about 10- to 15-percent silt and clay, sand is greater than 50-percent quartz and contains some weakly cemented sand pebbles.	e16.5	e17.5
Clay, low plasticity, pale yellowish brown (10YR 6/2), some fine-grained sand, micaceous, soft; saturated.	e17.5	e18.0
Sand, pale brown (5YR 5/2), fine grained, poorly graded, about 10- to 20-percent silt and clay, effervesces with dilute HCl.	e18.0	e21.0
Sand, pale yellowish brown (10YR 6/2), fine, medium, and very coarse grained, well graded, less than 5-percent silt and clay, loose, subangular.	e21.0	e22.0
Sand, clayey, dark yellowish brown (10YR 4/2), fine-grained sand, about 30- to 35-percent silt and clay.	e22.0	e23.0
Sand, pale brown (5YR 5/2), fine, medium, and coarse grained, well graded, little to no silt and clay, subangular, quartz and rock fragments, loose, micaceous; saturated.	23.0	e23.5
Sand, silty, pale brown (5YR 5/2), very-fine grained, firm, micaceous.	23.5	e27.0
Clay, low plasticity, pale brown (5YR 5/2), firm; some very-fine grained sand; no dilatancy, weak effervescence in dilute HCl.	e27.0	e27.8
Sand, dark yellowish brown (10YR 4/2), fine and medium grained, subangular; little silt and clay.	27.8	e30.0
Sand, pale yellowish brown (10YR 6/2), fine-, medium-, and coarse-grained sand and medium gravel, well graded, gravel is rock fragments of quartzite, shale, and metamorphic rock, no gravel at 33.0 ft.	e30.0	33.0
Clay, low plasticity, pale brown (5YR 5/2), some fine-grained sand, micaceous, firm; moist.	e34.0	e35.5
Sand, clayey, pale brown (5YR 5/2), fine-, medium-, and coarse-grained sand, about 30-percent silt and clay, contains over 38.0 quartz and rock fragments.	e35.5	
Sand, clayey, same as above, fine- and medium-grained sand with little coarse-grained sand.		38.5
Clay, high plasticity, pale brown (5YR 5/2), stiff; moist; stringers of earthy-white crystals, noneffervescent, little very-fine grained sand, micaceous, some rust-colored concretions; clay nodules (about 10 mm), dry inside.	39.0	41.2
Sand, clayey, dark yellowish brown (10YR 4/2), fine grained, poorly graded, about 35- to 40-percent plastic silt and clay, firm to dense.	e41.2	e42.5

Table 5. Lithologic logs for wells at cluster sites--*Continued*

Description	Depth (ft) From	Depth (ft) To
Well 29P-95--*Continued.*		
Clay, low plasticity, dark yellowish brown (10YR 4/2), stiff; moist; some fine-grained sand, micaceous, contains earthy-white crystals.	e42.5	45.0
Sand, clayey, light olive gray (5Y 5/2), very-fine grained sand, 30- to 40-percent silt and clay, micaceous, poorly graded, slight effervescence in HCl, loose, saturated.	45.0	47.0
Sand, silty, light olive gray (5Y 5/2), very-fine grained, dense, micaceous.	47.0	e47.8
Sand, clayey, grayish olive (10Y 4/2), fine- and medium-grained sand, 20- to 40-percent plastic silt and clay, firm, micaceous (grades into sandy silt at 50.0 ft); saturated.	e47.8	e51.5
Sand, silty, grayish olive (10Y 4/2), very-fine grained with nonplastic silt and clay; abundant mica flakes; dense; rust staining.	e51.5	53.0
Silt, sandy, grayish olive (10Y 4/2), abundant mica flakes; rust staining; soft; saturated.	53.0	e53.5
Clay, high plasticity, grayish olive (10Y 4/2), stiff, some very-fine grained sand; micaceous, rust-colored rootlets (oxidized); moist.	e53.5	e54.5
Sand, silty, light olive gray (5Y 5/2), very-fine grained, 20- to 30-percent nonplastic silt and clay, micaceous; moist.	54.5	e55.5
Silt, light olive gray (5Y 5/2), dense, nonplastic, micaceous; moist.	55.5	e57.0
Clay, sandy, low plasticity, light olive gray (5Y 5/2); fine-grained sand, black (organics) and rust (oxidized) staining, strong effervescence in dilute HCl.	57.0	58.0
Clay, low plasticity, grayish blue (5PB 5/2) mottled with grayish red (10R 4/2), small clear crystals, matrix strongly effervescent in dilute HCl, crystals dissolve.	58.0	59.0
Sand, moderate brown (5YR 3/4), mottled with light olive gray (5Y 5/2), fine and medium grained with few coarse, micaceous, quartz and rock fragments, slight effervescence; little to no silt and clay.	59.0	60.0
Sand, grayish blue (5PB 5/2), fine grained, poorly graded, mostly quartz, cemented sand nodules, effervescent in dilute HCl.	e60.0	e62.0
Sand, light olive gray (5Y 5/2) fine grained, poorly graded, little to no silt and clay, clean, loose, weak effervescence in dilute HCl, no noted cemented sand.	62.0	e64.0
Silt, grayish blue (5PB 5/2), mottled with grayish red (10R 4/2), nonplastic, saturated, small clear crystals, matrix strongly effervescent.	e64.0	e65.0
Sand, silty, abundant mica (black and silver), very-fine grained, poorly graded, quartz and rock fragments, effervescent.	e65.0	e66.0
Clay, low plasticity, light olive gray (5Y 5/2), stiff, some very-fine grained sand, slightly micaceous, some grayish-blue mottling, strong effervescence, contains very-fine grained mica-rich blebs.	e66.0	67.5
Sand, silty, light olive gray (5Y 5/2), very-fine grained, micaceous, loose, effervesces, poorly graded.	67.5	e68.5

Table 5. Lithologic logs for wells at cluster sites--*Continued*

Description	Depth (ft) From	Depth (ft) To
Well 29P-95--*Continued.*		
Silt, sand, very-fine to fine grained, moderate olive brown (5Y 4/4), mottled with grayish blue (5PB 5/2), nonplastic, some very-fine grained mica, dense.	e68.5	e70.0
Sand, silty, same as above.	e70.0	72.0
Silt, moderate olive brown (5Y 4/4) mottled with grayish blue (5PB 5/2), nonplastic, very-fine grained mica, dense, laminar structure, strong effervescence; wet.	72.0	e74.0
Sand, silty, same as sample e70.0 to 72.0 ft; moist.	e74.0	77.5
Clay, high plasticity, moderate olive brown (5Y 4/4), mottled with bluish gray (5BG 5/1) with white stringers, firm to stiff, some very-fine grained sand with mica, effervescent, earthy-white crystals laminar structure; moist.	77.5	e78.5
Clay, low plasticity, same as above, medium to low plasticity.	78.5	81.0
Silt, light olive gray (5Y 5/2) mottled with light olive brown (5Y 5/6), nonplastic, micaceous, laminar structure, rust-colored stringers parallel to laminations.	e81.0	83.0+
Sand, grayish olive (10Y 4/2), fine grained, poorly graded, little silt and clay, quartz-rich, micaceous, slight effervescence, loose; saturated; light olive brown (5Y 5/6) at 84.5 ft.	e84.0	e86.0
Silt, same as sample 81.0 to 83.0+ ft.	e86.0	88.5
Clay, high plasticity, grayish olive green (5GY 3/2), some fine- and medium-grained sand, very stiff, earthy-white crystals, weak effervescence; moist.	e88.5	e90.0
Sand, light olive gray (5Y 5/2), fine grained (coarsens downward to a medium and coarse grained), poorly graded, little to no silt and clay, weak effervescence in dilute HCl, subangular, subrounded, micaceous.	90.0	92.5
Silt, grayish olive green (5GY 3/2), mottled with light olive brown (5Y 5/6), small white stringers, laminar structure, earthy-white crystals to parallel lamination; matrix is effervescent, slight plasticity; moist.	92.5	95.5
Sand, silty, light olive gray (5Y 5/2) mottled with light olive brown (5Y 5/6), very-fine grained, poorly graded.	95.5	97.0
Silt, same as sample 92.5 to 95.5 ft.	97.0	97.5
Sand, same as sample 95.5 to 97.0 ft.	97.5	98.0
Sand, light olive gray (5Y 5/2), medium grained, poorly graded, quartz rich, micaceous, loose; saturated.	98.0	101.0
Silt, same as sample 92.5 to 95.5 ft, not effervescent, stiff.	101.0	103.0
Bottom of augered hole.	103.0	

Table 5. Lithologic logs for wells at cluster sites--*Continued*

Description	Depth (ft) From	Depth (ft) To
Well 29P-204. Altitude of land surface, approximately 326 ft. Drilled by the U.S. Geological Survey with a rotary rig. Total depth, 214 ft. Screened interval, 199.0 to 204.0 ft.		
Rotary cores		
Silt, mottled blue (5G 5/2 to 10G 6/2) and brown (10YR 5/4), abundant mica, thinly laminated, dark gray to black laminae.	120.0	122.0
Silt, mottled grayish olive green (5GY 3/2), abundant mica, laminations of olive brown (5Y 5/6).	140.0	142.0
Clay, grayish olive green (10Y 4/2), some silt, abundant mica, tan laminations and light olive-brown (5Y 5/6) mottling.	160.0	162.0
Silty, pale olive (10Y 6/2) to grayish olive (10Y 4/2) with light olive-brown (5Y 5/6) laminae, fine to medium grained, some clay micaceous.	180.0	182.0
Silt, light olive brown (5Y 5/6) to medium olive brown (5Y 4/4), some clay, abundant mica; abundant light olive-gray (5Y 5/2) laminae.	200.0	202.0
Rotary cuttings		
Gravel, arkosic, 3- to 5-mm diameter; quartz, feldspar, amphiboles.	205.0	215.0

Table 6. Periodic water-level data

[Water level in feet below land surface]

Date	Water level	Date	Water level	Date	Water level	Date	Water level
Well 29E-15							
8-09-90	9.25	7-24-91	5.36	1-31-92	6.25	8-04-92	4.76
1-31-91	7.46	8-30-91	5.69	3-06-92	5.28	9-09-92	5.99
3-08-91	7.41	10-08-91	6.88	4-03-92	5.38	10-01-92	6.67
4-08-91	7.29	11-05-91	7.28	4-30-92	5.21	11-30-92	7.19
5-02-91	7.32	12-02-91	7.37	6-03-92	5.87	12-23-92	7.24
5-30-91	5.71	1-02-92	6.97	7-01-92	4.52	2-03-93	5.61
7-02-91	5.09						
Well 29E-50							
8-30-90	8.64	7-02-91	5.14	1-31-92	7.63	8-04-92	6.69
1-08-91	7.95	7-24-91	6.32	3-06-92	6.32	9-09-92	7.35
1-31-91	8.32	8-30-91	6.87	4-03-92	6.65	10-01-92	8.06
3-08-91	8.07	10-08-91	7.95	4-30-92	6.59	11-30-92	8.68
4-08-91	7.85	11-05-91	8.48	6-03-92	7.24	12-23-92	8.70
5-02-91	7.90	12-02-91	8.65	7-01-92	6.47	2-04-93	6.88
5-30-91	5.85	1-02-92	8.33				
Well 29E-80							
8-09-90	17.96	7-24-91	16.91	1-31-92	18.05	8-04-92	17.19
1-31-91	18.09	8-30-91	17.05	3-06-92	17.24	9-09-92	17.69
3-08-91	17.88	10-08-91	17.73	4-03-92	17.26	10-01-92	18.14
4-08-91	17.75	11-05-91	18.19	4-30-92	17.23	11-30-92	18.74
5-02-91	17.79	12-02-91	18.45	6-03-92	17.60	12-23-92	18.75
5-30-91	17.27	1-02-92	18.35	7-01-92	17.06	2-04-93	17.94
7-02-91	16.99						
Well 29E-190							
8-30-90	79.89	7-24-91	81.98	1-31-92	81.62	8-04-92	85.55
1-31-91	78.35	8-30-91	83.29	3-06-92	81.51	9-09-92	86.94
3-08-91	79.00	10-08-91	84.31	4-03-92	81.81	10-01-92	87.07
4-08-91	79.85	11-05-91	84.34	4-30-92	82.51	11-30-92	85.69
5-02-91	80.03	12-02-91	83.68	6-03-92	83.52	12-23-92	84.63
5-30-91	80.35	1-02-92	82.58	7-01-92	84.25	2-04-93	82.96
7-02-91	81.05						
Well 4F-15							
8-09-90	9.11	7-24-91	9.03	1-31-92	10.83	8-04-92	11.25
1-31-91	8.83	8-30-91	9.52	3-06-92	10.71	9-09-92	11.38
3-08-91	9.11	10-08-91	10.17	4-03-92	10.77	10-01-92	11.55
4-08-91	8.47	11-05-91	10.44	4-30-92	10.84	11-30-92	11.80
5-02-91	8.86	12-02-91	10.63	6-03-92	11.04	12-23-92	11.84
5-30-91	9.21	1-02-92	10.76	7-01-93	11.19	2-03-93	11.81
7-02-91	8.99						
Well 4F-51							
8-30-91	15.67	1-31-92	13.39	6-03-92	17.36	10-01-92	14.77
10-08-91	13.57	3-06-92	13.96	7-01-92	14.52	11-30-92	14.73
11-05-91	13.56	4-03-92	13.49	8-04-92	15.04	12-23-92	14.68
12-02-91	13.41	4-30-92	13.82	9-09-92	14.61	2-03-93	14.75
1-02-92	13.39						

Table 6. Periodic water-level data--*Continued*

Date	Water level	Date	Water level	Date	Water level	Date	Water level
			Well 4F-98				
8-30-91	28.25	1-31-92	27.00	6-03-92	29.70	10-01-92	30.83
10-08-91	27.72	3-06-92	26.77	7-01-92	30.28	11-30-92	29.62
11-05-91	29.22	4-03-92	27.36	8-04-92	31.89	12-23-92	29.14
12-02-91	28.46	4-30-92	28.14	9-09-92	31.00	2-03-93	28.88
1-02-92	28.05						
			Well 4F-195				
8-27-90	54.58	7-02-91	52.07	1-02-92	51.40	7-01-92	55.47
1-31-91	47.05	7-24-91	53.13	1-31-92	50.33	8-04-92	58.00
3-08-91	49.27	8-30-91	56.03	3-06-92	49.60	9-09-92	58.64
4-08-91	49.48	10-08-91	55.71	4-03-92	51.04	10-01 92	58.06
5-02-91	49.53	11-05-91	54.43	4-30-92	51.82	12-23-92	59.08
5-30-91	49.80	12-02-91	52.63	6-03-92	53.99	2-03-93	52.26
			Well 5B-15				
8-08-90	8.75	7-24-91	7.13	1-31-92	9.48	8-04-92	7.89
1-31-91	10.75	8-30-91	7.49	3-06-92	6.79	9-09-92	9.21
3-08-91	8.34	10-08-91	7.88	4-03-92	7.24	10-01-92	9.92
4-08-91	7.04	11-05-91	10.80	4-30-92	6.99	11-30-92	10.88
5-02-91	7.32	12-02-91	10.20	6-03-92	7.35	12-23-92	11.00
5-30-91	7.31	1-02-92	10.44	7-01-92	7.47	2-03-93	10.35
7-02-91	6.79						
			Well 5B-58				
8-28-90	9.08	7-02-91	8.13	1-02-92	10.22	8-04-92	8.57
1-31-91	10.36	7-24-91	7.93	1-31-92	10.31	9-09-92	9.00
3-08-91	9.71	8-30-91	8.95	3-06-92	9.26	10-01-92	9.44
4-08-91	8.44	10-08-91	8.67	4-03-92	8.89	11-30-92	10.49
5-02-91	8.08	11-05-91	9.43	4-30-92	8.41	12-23-92	10.67
5-30-91	7.98	12-02-91	9.90	6-03-92	8.42	2-03-93	10.78
			Well 5B-95				
8-08-90	9.61	7-02-91	8.21	1-31-92	10.47	8-04-92	8.69
8-28-90	9.50	7-24-91	8.01	3-06-92	9.41	9-09-92	9.12
1-31-91	10.48	8-30-91	8.02	4-03-92	8.98	10-01-92	9.59
3-08-91	9.82	10-08-91	8.75	4-30-92	8.52	11-30-92	10.61
4-08-91	8.53	11-05-91	9.51	6-03-92	8.52	12-23-92	10.81
5-02-91	8.14	12-02-91	10.06	7-01-92	8.50	2-03-93	10.93
5-30-91	8.04	1-02-92	10.39				
			Well 5B-180				
8-28-90	60.30	7-24-91	64.87	1-31-92	63.74	8-04-92	59.40
1-31-91	65.09	8-30-91	65.26	3-06-92	60.94	9-09-92	60.15
3-08-91	64.41	10-08-91	66.32	4-03-92	58.96	10-01-92	59.82
4-08-91	64.74	11-05-91	67.42	4-30-92	59.38	11-30-92	61.14
5-02-91	64.40	12-02-91	67.21	6-03-92	59.30	12-23-92	61.18
5-30-91	64.58	1-02-92	65.66	7-01-92	59.12	2-03-93	61.24
7-02-91	64.96						
			Well 1N-15				
8-09-90	7.71	7-02-91	7.73	1-02-92	10.53	7-01-92	10.42
1-31-91	7.29	7-24-91	8.22	1-31-92	10.34	8-04-92	10.38
3-08-91	7.29	8-30-91	9.05	3-06-92	10.37	9-09-92	10.29
4-08-91	7.03	10-08-91	9.74	4-03-92	10.39	10-01-92	10.29
5-02-91	7.04	11-05-91	10.04	4-30-92	10.40	12-01-92	10.30
5-30-91	7.25	12-02-91	10.19	6-03-92	10.43	2-04-93	10.34

Table 6. Periodic water-level data--*Continued*

Date	Water level	Date	Water level	Date	Water level	Date	Water level
			Well 1N-57				
8-29-90	6.30	7-02-91	7.44	1-02-92	9.92	7-01-92	9.78
1-31-91	6.84	7-24-91	8.13	1-31-92	9.90	8-04-92	9.76
3-08-91	6.82	8-30-91	9.10	3-06-92	9.87	9-09-92	9.74
4-08-91	6.62	10-08-91	9.82	4-03-92	9.87	10-01-92	9.76
5-02-91	6.54	11-05-91	9.94	4-30-92	9.84	12-01-92	9.73
5-30-91	6.73	12-02-91	9.95	6-03-92	9.81	2-04-93	9.71
			Well 1N-95				
8-29-90	8.00	7-02-91	7.08	1-02-92	9.46	7-01-92	9.24
1-31-91	6.58	7-24-91	7.70	1-31-92	9.45	8-04-92	9.25
3-08-91	6.53	8-30-91	8.66	3-06-92	9.38	9-09-92	9.28
4-08-91	6.29	10-08-91	9.38	4-03-92	9.36	10-01-92	9.29
5-02-91	6.19	11-05-91	9.56	4-30-92	9.33	12-01-92	9.28
5-30-91	6.41	12-02-91	9.54	6-03-92	9.28	2-04-93	9.21
			Well 1N-194				
8-29-90	6.18	7-02-91	4.73	1-02-92	6.78	7-01-92	6.74
1-31-91	4.80	7-24-91	5.18	1-31-92	6.79	8-04-92	6.89
3-08-91	4.71	8-30-91	5.89	3-06-92	6.62	9-09-92	7.03
4-08-91	4.36	10-08-91	6.45	4-03-92	6.66	10-01-92	7.07
5-02-91	4.29	11-05-91	6.73	4-30-92	6.68	12-01-92	7.14
5-30-91	4.34	12-02-91	6.83	6-03-92	6.69	2-04-93	6.96
			Well 29P-15				
8-07-90	8.57	7-24-91	7.46	1-31-92	7.86	8-04-92	7.93
1-31-91	8.34	8-30-91	7.20	3-06-92	7.31	9-09-92	8.57
3-08-91	8.04	10-08-91	7.61	4-03-92	7.92	10-01-92	8.65
4-08-91	7.51	11-05-91	7.81	4-30-92	6.90	12-01-92	8.94
5-02-91	7.83	12-02-91	8.10	6-03-92	7.28	12-24-92	8.96
5-30-91	7.74	1-02-92	8.04	7-01-92	8.06	2-05-93	8.57
7-02-91	7.65						
			Well 29P-47				
8-07-90	7.48	7-24-91	6.58	1-31-92	7.08	8-04-92	7.83
1-31-91	7.60	8-30-91	6.29	3-06-92	6.60	9-09-92	7.52
3-08-91	7.45	10-08-91	6.78	4-03-92	6.05	10-01-92	7.73
4-08-91	7.15	11-05-91	7.04	4-30-92	6.10	12-01-92	7.88
5-02-91	7.18	12-02-91	7.28	6-03-92	6.51	12-24-92	8.08
5-30-91	6.92	1-02-92	7.28	7-01-92	7.27	2-05-93	7.58
7-02-91	6.80						
			Well 29P-95				
8-06-90	11.46	7-24-91	11.50	1-31-92	12.14	8-04-92	12.24
1-31-91	11.93	8-30-91	11.39	3-06-92	11.76	9-09-92	12.34
3-08-91	11.85	10-08-91	11.66	4-03-92	11.40	10-01-92	12.43
4-08-91	11.78	11-05-91	12.01	4-30-92	11.14	12-01-92	12.75
5-02-91	11.72	12-02-91	12.23	6-03-92	11.20	12-24-92	12.73
5-30-91	11.52	1-02-92	12.14	7-01-92	11.73	2-05-93	12.43
7-02-91	11.61						
			Well 29P-204				
8-08-90	77.69	7-24-91	78.61	1-31-92	78.88	8-04-92	78.90
1-31-91	76.21	8-30-91	80.04	3-06-92	78.44	9-09-92	78.88
3-08-91	77.41	10-08-91	80.04	4-03-92	78.22	10-01-92	78.70
4-08-91	76.93	11-05-91	80.27	4-30-92	78.16	12-01-92	78.09
5-02-91	77.06	12-02-91	79.58	6-03-92	78.06	12-24-92	77.82
5-30-91	77.94	1-02-92	78.84	7-01-92	78.58	2-05-93	77.07
7-02-91	77.98						