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California Department of Water Resources

Groundwater Data for Selected Wells within the Eastern San Joaquin Groundwater Subbasin, California, 2003–8

Data Series 696

U.S. Department of the Interior
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Cover: Photograph of U.S. Geological Survey drill rig used to install wells 001N006E04J003M, and –04J004M at multiple-well monitoring site STK–4 in Victory Park, Stockton, California, September 12, 2005. Photograph taken by Rhett Everett, U.S. Geological Survey, 2005.

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By Dennis A. Clark, John A. Izbicki, Loren F. Metzger, Rhett R. Everett, Gregory A. Smith, David O'Leary, Nicholas F. Teague, and Matthew K. Burgess

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KEN SALAZAR, Secretary

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Conversion Factors

Inch/Pound to SI

Multiply	By	To obtain
	Length	
inch (in.)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
square mile (mi^2)	259.0	hectare (ha)
square mile (mi^2)	2.590	square kilometer (km^2)
	Volume	
gallon (gal)	3.785	liter (L)
acre-foot (acre-ft)	1,233	cubic meter (m^3)
acre-foot (acre-ft)	0.001233	cubic hectometer (hm^3)
	Flow rate	
acre-foot per year (acre-ft/yr)	1,233	cubic meter per year (m^3/yr)
acre-foot per year (acre-ft/yr)	0.001233	cubic hectometer per year (hm^3/yr)
foot per minute (ft/min)	0.3048	meter per minute (m/min)

SI to Inch/Pound

Multiply	By	To obtain
	Length	
centimeter (cm)	0.3937	inch (in.)
millimeter (mm)	0.03937	inch (in.)
	Volume	
liter (L)	0.2642	gallon (gal)
liter (L)	61.02	cubic inch (in^3)
	Mass	
gram (g)	0.03527	ounce, avoirdupois (oz)

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

$$°F=(1.8×°C)+32$$

Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD 88).

Altitude, as used in this report, refers to distance above or below the vertical datum.

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (µS/cm at 25 °C).

Concentrations of chemical constituents in water are given either in milligrams per liter (mg/L) or micrograms per liter (µg/L). Radioactivity in water is given in picocuries per liter (pCi/L).

Abbreviations and Acronyms

Abbreviations and Acronyms

ADAPS	Automated Data Processing System
DWR	California Department of Water Resources
EM	electromagnetic
GAMA	Groundwater Ambient Monitoring and Assessment
GOES	Geostationary Operational Environmental Satellite
HDP	heat dissipation probes
LYS	lysimeters
NESJGBA	Northeastern San Joaquin Ground Water Banking Authority
NWIS	National Water Information System
NWISWeb	National Water Information System Web page
ODEX	Overburden Drilling and Exploration
PES	polyethersulfone
PVC	polyvinyl chloride
SMCL	Secondary Maximum Contaminant Level
SP	spontaneous potential
USGS	U.S. Geological Survey

Groundwater Data for Selected Wells within the Eastern San Joaquin Groundwater Subbasin, California, 2003–8

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Abstract

Data were collected by the U.S. Geological Survey from 2003 through 2008 in the Eastern San Joaquin Groundwater Subbasin, 80 miles east of San Francisco, California, as part of a study of the increasing chloride concentrations in groundwater processes. Data collected include geologic, geophysical, chemical, and hydrologic data collected during and after the installation of five multiple-well monitoring sites, from three existing multiple-well sites, and from 79 selected public-supply, irrigation, and domestic wells. Each multiple-well monitoring site installed as part of this study contained three to five 2-inch diameter polyvinyl chloride (PVC)-cased wells ranging in depth from 68 to 880 feet below land surface. Continuous water-level data were collected from the 19 wells installed at these 5 sites and from 10 existing monitoring wells at 3 additional multiple-well sites in the study area. Thirty-one electromagnetic logs were collected seasonally from the deepest PVC-cased monitoring well at seven multiple-well sites. About 200 water samples were collected from 79 wells in the study area. Coupled well-bore flow data and depth-dependent water-quality data were collected from 12 production wells under pumped conditions, and well-bore flow data were collected from 10 additional wells under unpumped conditions.

Introduction

Coincident with groundwater pumping and subsequent declines in water levels, chloride concentrations have increased in water from wells in the Eastern San Joaquin Groundwater Subbasin (fig. 1), about 80 miles east of San Francisco, California (Montgomery Watson, Inc., 2000; CDM, Inc., 2001; Northeastern San Joaquin County Groundwater Banking Authority, 2004; Izbicki and others, 2006). Water samples from a number of public-supply, agricultural, and domestic wells in the western part of the subbasin adjacent to the San Joaquin Delta exceed the U.S. Environmental Protection Agency Secondary Maximum Contaminant Level (SMCL) for chloride of 250 milligrams per liter (mg/L) (U.S. Environmental Protection Agency, 2006). Some of these wells have been removed from service.

The areal extent of high-chloride water in the subbasin has been mapped in previous studies (Montgomery Watson, Inc., 2000; CDM, Inc., 2001; Izbicki and others, 2006). However, the vertical distribution of this high-chloride water and its movement through the freshwater aquifers to wells is not known. Potential sources of high-chloride water include surface water from the Sacramento-San Joaquin Delta, porewater within Delta sediments, water from saline aquifers that underlie freshwater aquifers, and irrigation return water. In addition to high-chloride concentrations, some wells in the study area yield water having arsenic (Izbicki, Stamos, and others, 2008) or nitrate concentrations that exceed the Maximum Contaminant Level for these constituents (Northeastern San Joaquin County Groundwater Banking Authority, 2004). Other regional water-quality issues include the presence of organic compounds contributed by anthropogenic sources (Bennett and others, 2006).

The Northeastern San Joaquin Ground Water Banking Authority (NESJGBA) and the California Department of Water Resources (DWR) undertook a study in cooperation with the U.S. Geological Survey (USGS) to better understand the areal and vertical distribution and source of high-chloride water to wells within the Eastern San Joaquin Groundwater Subbasin. Data collection for the study began in August 2003 and ended in September 2008. Data collection included test drilling and multiple-well monitoring site installation; water-level measurements; borehole geophysical data collection, including electromagnetic logging and coupled well-bore flow and depth-dependent sample collection; and water-quality sample collection and analysis.

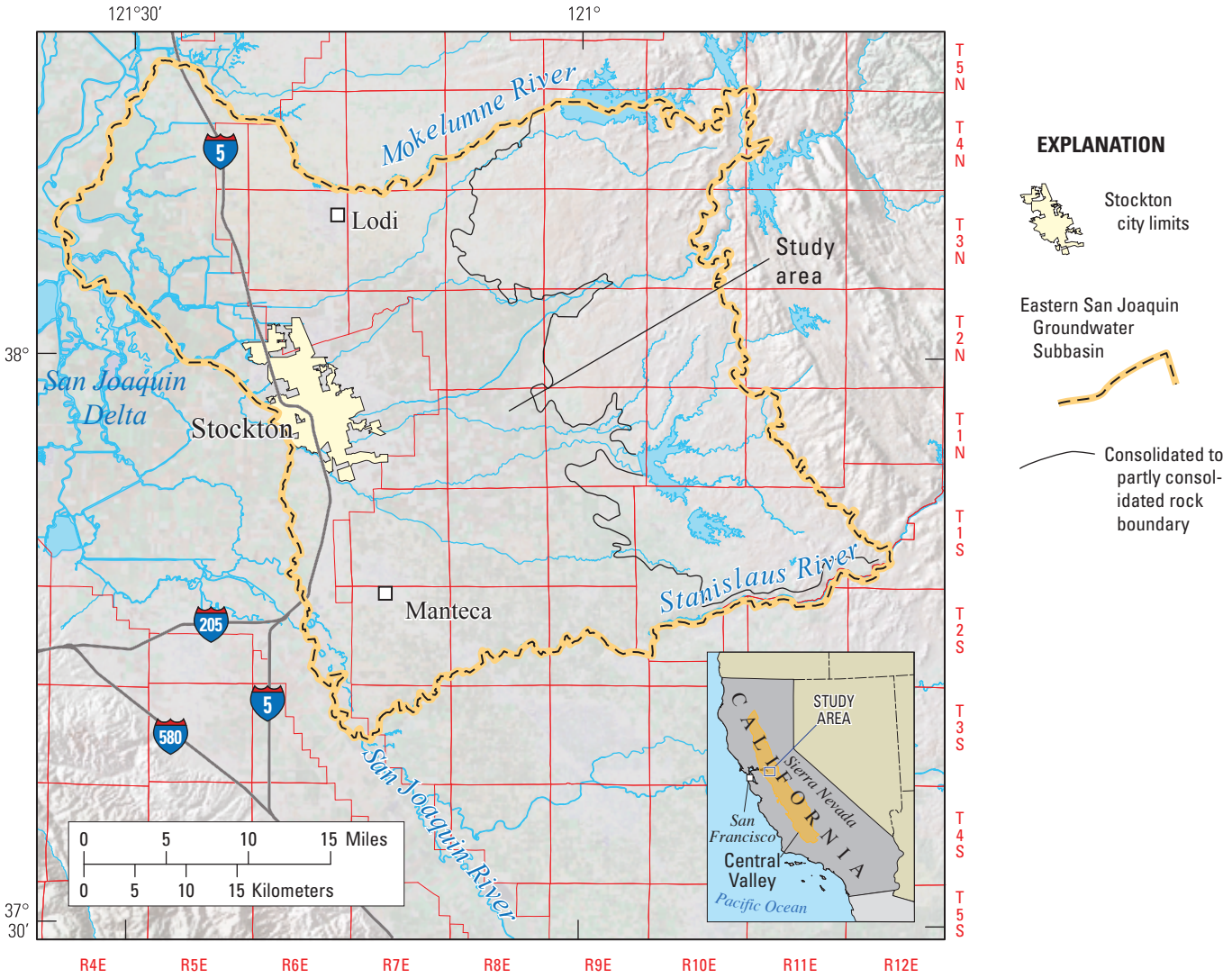


Figure 1. Location of study area, Eastern San Joaquin Groundwater Subbasin, California.

Hydrogeologic Setting

The study area is the Eastern San Joaquin Groundwater Subbasin near Stockton, Calif. (fig. 1), about 80 miles east of San Francisco. The groundwater subbasin is about 1,100 square miles (California Department of Water Resources, 2006) and is part of the larger San Joaquin Groundwater Basin that occupies the southern two-thirds of the Central Valley of California. The climate of the area is characterized by hot, dry summers and cool, moist winters. Average annual precipitation ranges from 10 to 18 inches (Soil Conservation Service, 1992). Precipitation is greater in the Sierra Nevada to the east of the study area. Runoff from the Sierra Nevada, primarily as snowmelt, helps sustain flow in rivers and streams that cross the study area. The largest of these, the Mokelumne and Stanislaus Rivers, bound the study area to the north and south, respectively. The San Joaquin River, which drains the San Joaquin Valley from the south, bounds the study area to the west, and the foothills of the Sierra Nevada form the eastern boundary (fig. 1). In 2000, the population within the study area was about 580,000. The population is expected to increase to more than 1.2 million by 2040 (CDM, Inc., 2001).

The study area is underlain by several thousand feet (ft) of consolidated, partly consolidated, and unconsolidated deposits (California Department of Water Resources, 1967). The deeper, more consolidated deposits are of marine origin. Water in these deposits is saline (Mendenhall, 1908) and is not extensively used for water supply. However, these deeper deposits have been explored for oil and gas and for the potential storage of waste. These deeper marine deposits are separated from the overlying alluvial-fan and delta deposits of the San Joaquin River and tributaries by volcanic deposits.

Volcanic sands within the Mehrten and Valley Springs Formations are the oldest fresh water-bearing deposits commonly pumped for water supply in the study area. These consolidated to partly consolidated sands crop out on the east side of the subbasin and are an important source of supply in that area (California Department of Water Resources, 1967). The Mehrten Formation also contains low-permeability pyroclastic deposits, lahars, and debris flows (Curtis, 1954). Alluvium eroded from the volcanic sands blankets these low-permeability volcanic deposits that form the effective base of freshwater in the study area, about 800 to 1,000 ft below land surface near Stockton (California Department of Water Resources, 1967).

The overlying alluvial deposits are composed of varying amounts of sand, silt, clay, and gravel—eroded from crystalline rock in the Sierra Nevada. These deposits include recent alluvium along stream and river channels, the Victor Formation (California Department of Water resources, 1967) and Arroyo Seco Gravel of Pleistocene age, and older alluvial-fan deposits of the Modesto (California Department of Water resources, 1967), Riverbank, and Laguna Formations (California Department of Water Resources, 2003). The Modesto, Riverbank and Laguna Formations were largely eroded from the same source material, have similar lithology, and are almost indistinguishable on the basis of test drilling data (Piper and others, 1939), except where characteristic soil horizons have developed during long periods when deposition was not occurring (Burow and others, 1997; Jurgens and others, 2008). The contacts between the formations represent the surfaces of different alluvial fans established by uplift and changing climatic conditions in the Sierra Nevada. The surfaces of the fans have been dissected and backfilled by alluvial deposits from subsequent fan building. Buried stream-channel deposits produced in this manner often yield large quantities of water to wells (Burow and others, 1997). The degree of consolidation increases with age and depth of the deposits; their water-yielding properties generally decrease with increasing depth and consolidation (Piper and others, 1939).

Deposits underlying the present floodplain and Delta of the San Joaquin River are fine-grained and rich in organic material. These deposits interfinger with the alluvial deposits in the study area. Since Tertiary time, deposition in the Delta area has been controlled in part by uplift in the Sierra Nevada and Coastal Ranges and subsequent deepening of the California Trough along the axis of the Central Valley (Mendenhall, 1908; Piper and others, 1939). The fine-grained delta deposits yield only small amounts of water to wells, and in places water from wells is saline.

Under predevelopment conditions, groundwater movement in the alluvial deposits was from the base of the Sierra Nevada, northwest to the groundwater discharge area near the eastern edge of the Delta (Mendenhall, 1908). Groundwater that discharged to surface water, springs, and seeps in this area was fresh and low in dissolved minerals (Mendenhall, 1908). Surface water also infiltrated from the upper reaches of rivers and streams into underlying alluvial deposits and discharged along the lower reaches of these streams, sustaining baseflow during dry periods (Piper and others, 1939). Along the western margin of the study area, groundwater movement was from southeast to northwest along the axis of the San Joaquin Valley. This water also discharged to the Delta. (Mendenhall, 1908).

Groundwater in deep wells in the western part of the study area was artesian. Water from most deep artesian wells near Stockton was saline (Mendenhall, 1908); as a consequence, this water was not commonly used for agricultural or public supply. Saline water extracted during natural gas production from marine deposits in the Stockton area was discharged at land surface and "allowed to waste" (Mendenhall, 1908), or was used for recreational purposes because of its warm temperature.

The alluvial deposits currently are pumped extensively for water supply by using large capacity wells as deep as 780 ft, with an average depth of about 350 ft (California Department of Water Resources, 2006). Groundwater pumping in excess of recharge caused water levels in the alluvial deposits east of the Delta to decline below sea level beginning in the late 1940s (California Department of Water Resources, 1967). The resulting cone of depression in the water table expanded and shifted eastward in recent years as pumping shifted eastward with population growth and with increasing chloride concentrations in the alluvial deposits near the Delta. With the exception of drought years in the late 1980s and early 1990s, the minimum altitude of the pumping depression has increased in recent years as pumping for public supply has been distributed farther from the center of Stockton, and the size (volume) of the pumping depression expanded during this period. Groundwater recharge to the alluvial deposits within the study area is about 900,000 acre-feet per year (acre-ft/yr); in 2004, the total estimated overdraft was about 150,000 acre-feet. (CDM, Inc., 2001).

Purpose and Scope

The purpose of this report is to present data collected from 2003 through 2008 in the Eastern San Joaquin Groundwater Subbasin as part of a study to better understand the increasing chloride concentrations and to estimate groundwater recharge in the area. Data in this report include geologic, geophysical, water chemistry, and hydrologic data collected at multiple-well monitoring sites installed as part of this study, geophysical data collected from existing wells in the study area, and water-chemistry data from pre-existing multiple-well monitoring sites and from public-supply, irrigation, and domestic wells sampled as part of this study.

Drilling and Well Installation

Five multiple-well monitoring sites, containing three to five 2-inch diameter polyvinyl chloride (PVC) monitoring wells in a single borehole, were installed as part of this study (table 1, fig. 2). These multiple-well sites included 001N006E04J003M–04J005M (1N/6E–4J3–5, Victory Park, STK–4), 002N005E01A002M–01A006M (2N/5E–1A2–6, Oak Grove Park, STK–1), 002N006E08N001M–08N003M (2N/6E–8N1–3, Sandman Park, STK–5), 002N006E29H001M–29H003M (2N/6E–29H1–3, Atherton Park, STK–6), and 002N006E11H004M–11H007M (2N/6E–11H4–7, Morada Lane, STK–2). The five sites were drilled by the USGS Western Research Drilling Operation team to depths ranging from about 600 to 966 ft by using the hydraulic mud-rotary method (fig. 3). The diameter of the boreholes ranged from 12.25 inches in the upper part of some boreholes to 5.25 inches in the lower part of some boreholes. Drill cuttings were collected at 20-ft intervals from the mud discharge at land surface using a #120 sieve and from the screen on the shaker tank during drilling. Additional cuttings were collected where lithologic changes were observed during drilling. Drill cores also were collected from selected depths in selected boreholes. Geophysical logs were collected in open boreholes after drilling was completed and before wells were installed. Field descriptions of drill cuttings and geophysical logs were used to guide well design and installation.

An additional borehole 002N006E11H008M (STK–3) containing one 2-inch diameter PVC monitoring well, three lysimeters (LYS), and three heat dissipation probes (HDPs) was drilled adjacent to the 11H4–7 multiple-well site to provide data near the water table (fig. 2). HDP data are not presented in this report; however, the data are stored in San Diego USGS California Water Science Center. The borehole was drilled by a USGS drill rig and crew using the ODEX (Overburden Drilling and Exploration) air-hammer method, also known as the under-reamer method (Driscoll, 1986; Hammermeister and others, 1986). When this technique is used, mud is not used as a drilling fluid and disturbance to the aquifer material near the borehole is minimized. During drilling, the borehole is stabilized by the emplacement of steel casing in the hole as the drill bit advances into the ground. Drill depth was 120 ft and the borehole diameter was 8.75 inches. Cuttings were collected at 1-ft intervals from the cyclone discharge during drilling.

Lithologic Data

Cuttings collected during test drilling were initially described in the field during drilling, and more detailed descriptions were done in the office after drilling. The cuttings are archived at the USGS office in San Diego, Calif. Detailed lithologic logs were compiled from descriptions of drill cuttings, core material, and observations recorded during drilling in the field and in the office (tables 2–7). The textures of drill cuttings and core material were determined by using a method developed by Folk (1954; fig. 4), and the particle-size distributions were described by using the National Research Council (1947) classification. This approach allows general grain-size descriptions (such as sand) to be correlated to size limits in millimeters or inches. Color, determined on moist cuttings from the hydraulic rotary boreholes and on dry cuttings from the ODEX borehole, was described according to numerical designations in the Munsell Soil Color Chart (Munsell Color, 1975, 1994).

Table 1. Multiple-well monitoring sites, Eastern San Joaquin Groundwater Subbasin, California.

[Site locations are shown in figure 2. Depths are below land surface. State well number, see well-numbering diagram in text. Well names beginning with STK were drilled by the U.S. Geological Survey. **Abbreviations**: ft, feet; HDP, heat-dissipation probe; LSD, land surface datum; LYS, suction-cup lysimeter; NAVD88, North American Vertical Datum of 1988; USGS ID, U.S. Geological Survey identification number: the unique number for each site in USGS National Water Information System (NWIS) database]

State well number	USGS ID	Altitude of land surface (feet above NAVD 88)	Descriptive name (number is depth below LSD)	Description of instrumentation (number is depth below LSD)
001N006E04J003M	375735121184901	8	STK–4 WELL at 560 ft	Well, perforated from 540 to 560 ft.
001N006E04J004M	375735121184902	8	STK–4 WELL at 360 ft	Well, perforated from 340 to 360 ft.
001N006E04J005M	375735121184903	8	STK–4 WELL at 220 ft	Well, perforated from 200 to 220 ft.
001N006E36C003M	375349121160901	15	MW1–DEEP	Well, perforated from 440 to 460 ft.
001N006E36C004M	375349121160902	15	MW2–MIDDLE	Well, perforated from 262 to 282, 302 to 312 ft.
001N006E36C005M	375349121160903	15	MW3–SHALLOW	Well, perforated from 114 to 124 ft.
002N005E01A002M	380316121221501	4	STK–1 WELL at 880 ft	Well, perforated from 860 to 880 ft.
002N005E01A003M	380316121221502	4	STK–1 WELL at 540 ft	Well, perforated from 520 to 540 ft.
002N005E01A004M	380316121221503	4	STK–1 WELL at 380 ft	Well, perforated from 360 to 380 ft.
002N005E01A005M	380316121221504	4	STK–1 WELL at 240 ft	Well, perforated from 220 to 240 ft.
002N005E01A006M	380316121221505	4	STK–1 WELL at 68 ft	Well, perforated from 58 to 68 ft.
002N006E08N001M	380147121205001	3	STK–5 WELL at 580 ft	Well, perforated from 560 to 580 ft.
002N006E08N002M	380147121205002	3	STK–5 WELL at 430 ft	Well, perforated from 410 to 430 ft.
002N006E08N003M	380147121205003	3	STK–5 WELL at 230 ft	Well, perforated from 210 to 230 ft.
002N006E11H004M	380209121164101	27	STK–2 WELL at 635 ft	Well, perforated from 615 to 635 ft.
002N006E11H005M	380209121164102	27	STK–2 WELL at 540 ft	Well, perforated from 520 to 540 ft.
002N006E11H006M	380209121164103	27	STK–2 WELL at 300 ft	Well, perforated from 280 to 300 ft.
002N006E11H007M	380209121164104	27	STK–2 WELL at 220 ft	Well, perforated from 200 to 220 ft.
002N006E11H008M	380207121164101	27	STK–3 WELL at 114 ft	Well, perforated from 109 to 114 ft.
002N006E11H009MLYS	380207121164102	27	STK–3 LYS at 68 ft	Lysimeter at 68 ft.
002N006E11H010MLYS	380207121164103	27	STK–3 LYS at 47 ft	Lysimeter at 47 ft.
002N006E11H011MHDP	380207121164104	27	STK–3 HDP at 45 ft	Heat dissipation probe at 45 ft.
002N006E11H012MLYS	380207121164105	27	STK–3 LYS at 38 ft	Lysimeter at 38 ft.
002N006E11H013MHDP	380207121164106	27	STK–3 HDP at 36 ft	Heat dissipation probe at 36 ft.
002N006E11H014MHDP	380207121164107	27	STK–3 HDP at 22 ft	Heat dissipation probe at 22 ft.
002N006E12H002M	380216121154001	33	MW1–DEEP	Well, perforated from 380 to 390 ft.
002N006E12H003M	380216121154002	33	MW2–SHALLOW	Well, perforated from 280 to 290 ft.
002N006E20E001M	380026121204401	4	MW1–DEEP	Well, perforated from 482 TO 502 ft.
002N006E20E002M	380026121204402	4	MW2–MIDDLE	Well, perforated from 294 TO 314 ft.
002N006E20E003M	380026121204403	4	MW3–SHALLOW	Well, perforated from 194 TO 204 ft.
002N006E24P001M	380004121160601	25	MW1–DEEP	Well, perforated from 500 TO 520 ft.
002N006E24P002M	380004121160602	25	MW2–MIDDLE	Well, perforated from 400 TO 450 ft.
002N006E24P003M	380004121160603	25	MW3–SHALLOW	Well, perforated from 195 TO 215 ft.
002N006E29H001M	375944121200501	5	STK–6 WELL at 560 ft	Well, perforated from 540 to 560 ft.
002N006E29H002M	375944121200502	5	STK–6 WELL at 470 ft	Well, perforated from 450 to 470 ft.
002N006E29H003M	375944121200503	5	STK–6 WELL at 260 ft	Well, perforated from 240 to 260 ft.
002N007E07K006M	380207121145701	37	MW1–DEEP	Well, perforated from 442 TO 452 ft.
002N007E07K007M	380207121145702	37	MW2–SHALLOW	Well, perforated from 215 TO 225 ft.

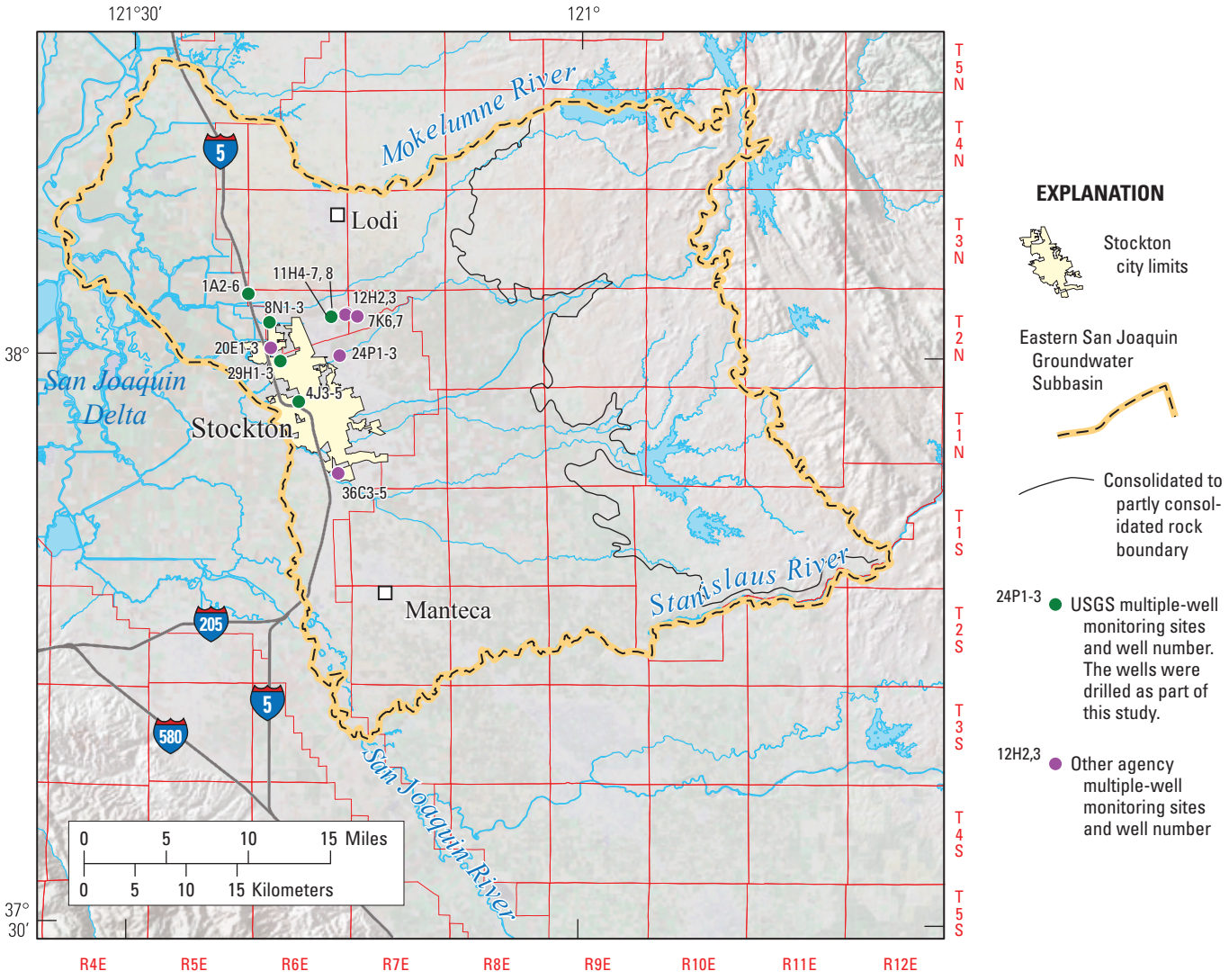


Figure 2. Location of the multiple-well monitoring sites, Eastern San Joaquin Groundwater Subbasin, California.

Photograph by Rhett Everett, U.S. Geological Survey, 2005

Figure 3. U.S. Geological Survey drill rig used to install wells 001N006E04J003M, and –04J004M at multiple-well monitoring site STK–4 in Victory Park, Stockton, California, September 12, 2005.

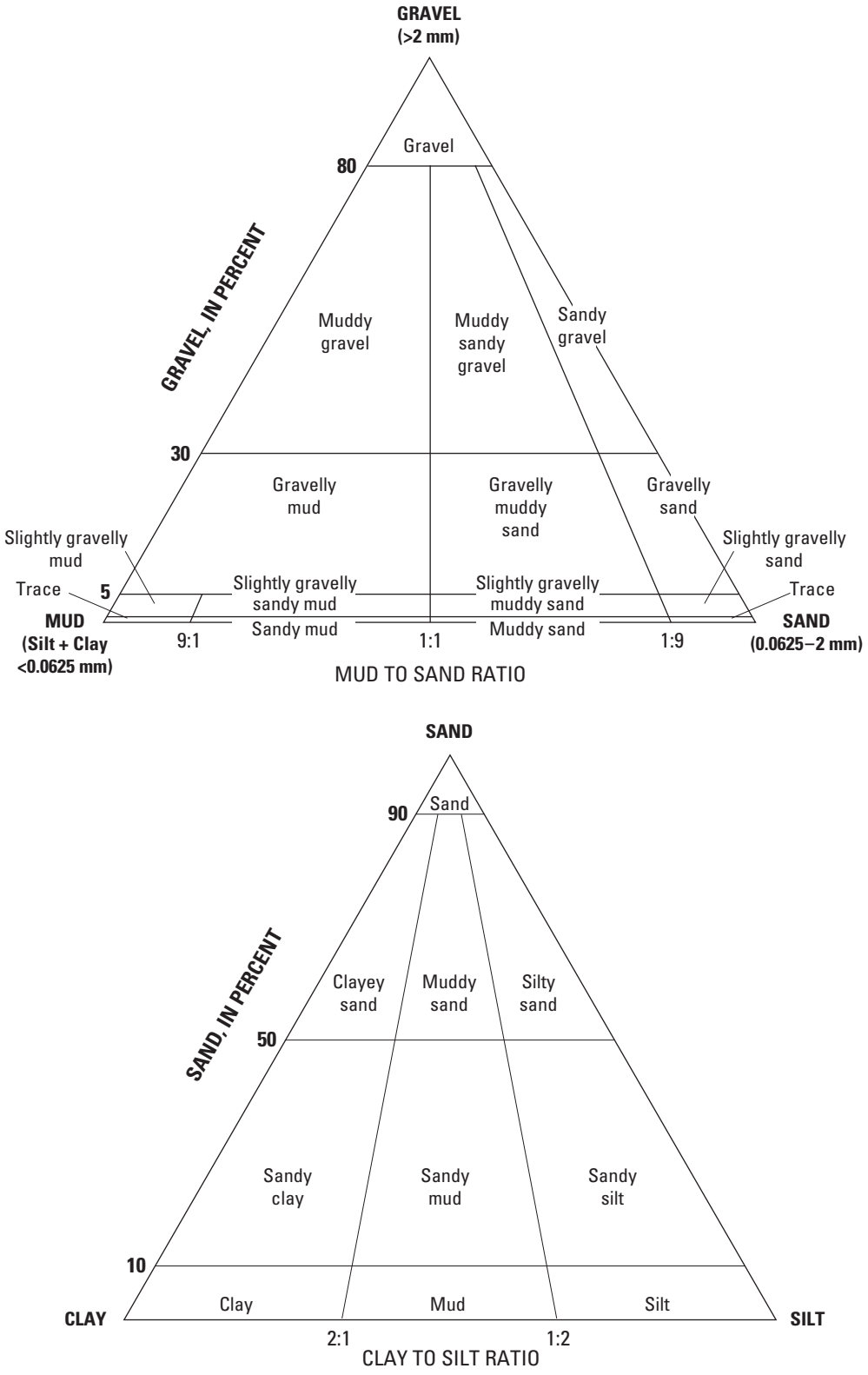


Figure 4. Piper diagrams of rock-type nomenclature used for description of texture in lithologic logs. Modified from Folk, 1954.

Table 2. Lithologic log for multiple-well monitoring site STK–4 (wells 001N006E04J003M, –04J004M, and –04J005M) near Stockton, Eastern San Joaquin Groundwater Subbasin, California, September 2005.

[Altitude of land surface, approximately 8 feet. Depth in feet below land surface. Soil and rock color notation, indicated in parentheses after each description, from Munsell Color (1994). Drilled by U.S. Geological Survey Western Region Research Drilling Unit using hydraulic rotary method, September 2005. Total depth drilled: 600 feet. Screen intervals: 540–560, 340–360, and 200–220 feet. **Abbreviations**: mm, millimeters]

Depth (feet)		Description
From	To	
0	20	Clayey sandy silt (sM); silt and clay with very fine to medium sand; moderately sorted; dark gray (2.5Y 4/1)
20	40	Silty sand (zS); very fine to very coarse sand with silt; subangular; poorly sorted; very dark grayish brown (2.5Y 3/2)
40	60	Silty sand (zS); very fine to very coarse sand with silt; subangular; poorly sorted; very dark grayish brown (2.5Y 3/2)
60	80	Silty sand (zS); very fine to very coarse sand with silt and granules; subangular; poorly sorted; very dark gray (10YR 3/1)
80	100	Silty sand (zS); medium to very coarse sand with silt, granules and mafic pebbles and occasional fine sand; subangular to subrounded; very poorly sorted; pebbles are less than 7 millimeters in diameter; dark gray (10YR 4/1)
100	120	Sandy silt (sZ); silt with very fine to medium sand; poorly sorted; very dark gray (10YR 3/1)
120	140	Sand (S); fine to coarse sand with occasional aggregated silt to granule-size; subangular; moderately sorted; very dark gray (10YR 3/1)
140	160	Sand (S); very fine to very coarse sand; subangular; poorly sorted; very dark grayish brown (2.5Y 3/2)
160	180	Sand (S); very fine to very coarse sand; subangular; poorly sorted; very dark grayish brown (2.5Y 3/2)
180	200	Silty sand (zS); fine to coarse sand with silt and some very fine and very coarse sand; subangular; poorly sorted; very dark grayish brown (2.5Y 3/2)
200	220	Sand (S); very fine to very coarse sand; subangular; very poorly sorted; very dark grayish brown (2.5Y 3/2)
220	240	Slightly silty sand (zS); medium to very coarse sand with some silt; subangular; poorly sorted; dark grayish brown (2.5Y 4/2)
240	260	Slightly silty gravelly sand (gS); fine to very coarse sand with some silt and granules; subangular; very poorly sorted; very dark grayish brown (2.5Y 3/2)
260	280	Silty sand (zS); medium to very coarse sand with silt; subangular; poorly sorted; very dark grayish brown (2.5Y 3/2)
280	300	Silty sand (zS); medium to very coarse sand with silt; subangular; poorly sorted; very dark grayish brown (2.5Y 3/2)
300	320	Slightly silty sand (zS); fine to coarse sand with some silt; subangular; moderately sorted; very dark grayish brown (2.5Y 3/2)
320	340	Slightly silty sand (zS); fine to coarse sand with some silt; subangular; moderately sorted; very dark grayish brown (2.5Y 3/2)
340	360	Sand (S); fine to very coarse sand; subrounded to subangular; poorly sorted; very dark gray (2.5Y 3/1)
360	380	Slightly gravelly sand ((g)S); very fine to very coarse sand with granules; subrounded to subangular; poorly sorted; very dark gray (2.5Y 3/1)
380	400	Slightly silty sand (zS); fine to very coarse sand with some silt; subangular; poorly sorted; very dark grayish brown (2.5Y 3/2)
400	420	Slightly silty sand (zS); fine to very coarse sand with some silt; subangular; poorly sorted; very dark grayish brown (2.5Y 3/2)
420	440	Silty sand (zS); fine to very coarse sand with silt; subangular; poorly sorted; very dark grayish brown (2.5Y 3/2)
440	460	Sand (S); medium to very coarse sand; subangular; moderately sorted; very dark grayish brown (2.5Y 3/2)
460	480	Sand (S); fine to very coarse sand; subangular; poorly sorted; very dark grayish brown (2.5Y 3/2)
480	500	Sandy silt (sZ); silt with fine to very coarse sand; poorly sorted; grayish green (5G 4/2)
500	520	Silty sand (zS); very fine to very coarse sand with silt and occasional granules; subangular; very poorly sorted; very dark grayish brown (2.5Y 3/2)
520	540	Silty sand (zS); very fine to very coarse sand with silt and occasional granules; subangular; very poorly sorted; very dark grayish brown (2.5Y 3/2)
540	560	Gravelly sand (gS); medium to very coarse sand with granules; subangular to subrounded; very poorly sorted; very dark grayish brown (2.5Y 3/2)
560	580	Silty sand (zS); very fine to very coarse sand with silt; subangular; very poorly sorted; very dark grayish brown (2.5Y 3/2)
580	600	Slightly silty sand (zS); medium to very coarse sand with some silt; subangular; moderately sorted; very dark grayish brown (2.5Y 3/2)

Table 3. Lithologic log for multiple-well monitoring site STK–1 (wells 002N005E01A002M, –01A003M, –01A004M, –01A005M, and –01A006M) near Stockton, Eastern San Joaquin Groundwater Subbasin, California, April–May 2005.

[Altitude of land surface, approximately 4 feet. Depth in feet below land surface. Soil and rock color notation, indicated in parentheses after each description, from Munsell Color (1994). Drilled by U.S. Geological Survey Western Region Research Drilling Unit using hydraulic rotary method, April–May 2005. Total depth drilled: 966 feet. Screen intervals: 860–880, 520–540, 360–380, 220–240, and 58–68 feet. **Abbreviations:** mm, millimeters; <, less than; >, greater than; %, percent]

Depth (feet)		Description
To	From	
0	20	Clayey silty sand (mS); coarse to very coarse sand with silt and some very fine to fine sand; subangular to subrounded; very poorly sorted; brown (10YR 4/3)
20	40	Sand (S); medium to very coarse sand with some very fine sand and few silts cemented to larger grains; subangular; moderately sorted; brown (10YR 4/3)
40	60	Clayey silty sand (mS); medium to very coarse sand with some very fine sand and <15% silt; subangular to subrounded; poorly sorted; olive brown (2.5Y 4/3)
60	80	Sandy silty clay (sM); clay with medium to very coarse sand and some very fine sand and <10% silt; poorly sorted; olive brown (2.5Y 4/3)
80	100	Sandy silty clay (sM); clay and some very fine sand and <10% silt; poorly sorted; olive brown (2.5Y 4/3)
100	120	Sandy silty clay (sM); clay and silt with medium to coarse sand and some finer sand and occasional very coarse sand; moderately sorted; brown (10YR 4/3)
120	140	Sandy silty clay (sM); clay and silt with coarse sand and some finer sand; subangular to subrounded; poorly sorted; olive brown (2.5Y 4/3)
140	160	Sand (S); coarse to very coarse sand with some silt; subangular; moderately sorted; dark grayish brown (2.5Y 4/2)
160	180	Clayey silty sand (mS); very fine to coarse sand with some silt; subangular; moderately sorted; dark gray (10YR 4/1)
180	200	Clayey silty sand (mS); very fine to very coarse sand with some silt; subangular; poorly sorted; dark greenish gray (10Y 3/1)
200	220	Clayey silty sand (mS); fine to medium sand with silt and occasional coarse sand; subangular; poorly sorted; dark olive gray (5Y 3/2)
220	240	Sandy silty clay (sM); clay and silt with fine to medium sand and occasional coarse gravel; poorly sorted; very dark gray (5Y 3/1)
240	260	Gravelly sand (gS); coarse to very coarse sand with pebbles and some fine-grained sand and silt; subangular to subrounded; very poorly sorted; pebbles are <10 mm in diameter; dark gray (2.5Y 4/1)
260	280	Gravelly silty sand (gmS); medium to very coarse sand with silt and occasional pebbles; subangular; very poorly sorted; pebbles are <15 mm in diameter; dark gray (2.5Y 4/1)
280	300	Clayey silty sand (mS); medium to coarse sand with silt cemented to larger grains and some fine-grained sand; subangular; poorly sorted; very dark gray (5Y 3/1)
300	320	Clayey silty sand (mS); fine to coarse sand with silt; subangular; moderately sorted; very dark gray (5Y 3/1)
320	340	Clayey silty sand (mS); very fine to medium sand with silt and occasional coarse grains; subangular; moderately sorted; very dark gray (5Y 3/1)
340	360	Sandy silty clay (sM); clay with fine to medium sand; well sorted; dark greenish gray (10Y 4/1)
360	380	Sand (S); medium sand with some fine and coarse sand; subangular; poorly sorted; dark olive gray (5Y 3/2)
380	400	Clayey silty sand (mS); medium to coarse sand with <25% silt and some fine and coarse sand; subangular; moderately sorted; olive gray (5Y 4/2)
400	420	Clayey silty sand (mS); medium to coarse sand with <25% silt and some fine and coarse sand; subangular; moderately sorted; olive gray (5Y 4/2)
420	440	Clayey silty sand (mS); coarse to very coarse sand with silt cemented to larger grains; subangular; moderately sorted; olive gray (5Y 4/2)
440	460	Clayey silty sand (mS); medium to coarse sand with silt; subangular; very poorly sorted; olive gray (5Y 4/2)
460	480	Clayey silty sand (mS); medium to coarse sand with silt; subangular; very poorly sorted; olive gray (5Y 4/2)
480	500	Clayey silty sand (mS); medium to very coarse sand with clay; subangular; moderately sorted; olive gray (5Y 4/2)
500	520	Clayey silty sand (mS); medium to very coarse sand with clay and silt; subangular; poorly sorted; olive (5Y 4/3)
520	540	Clayey silty sand (mS); medium to very coarse sand with silt cemented to larger grains; subangular; moderately sorted; olive gray (5Y 4/2)
540	560	Clayey silty sand (mS); medium sand with silt cemented to larger grains and some coarse to very coarse sand; subangular; moderately sorted; dark olive gray (5Y 3/2)
560	580	Clayey silty sand (mS); fine to medium sand with silt and some coarse to very coarse sand; subangular; very poorly sorted; dark greenish gray (10Y 4/1)
580	600	Clayey silty sand (mS); coarse to very coarse sand with silt and some fine to medium sand; subangular; poorly sorted; dark greenish gray (10Y 4/1)
600	620	Clayey silty sand (mS); medium sand with silt and some coarse to very coarse sand; subangular; poorly sorted; olive gray (5Y 4/2)
620	640	Clayey silty sand (mS); coarse to very coarse sand with silt and some fine to medium grains; subangular; poorly sorted; very dark grayish brown (2.5Y 3/2)

Table 3. Lithologic log for multiple-well monitoring site STK–1 (wells 002N005E01A002M, –01A003M, –01A004M, –01A005M, and –01A006M) near Stockton, Eastern San Joaquin Groundwater Subbasin, California, April–May 2005.—Continued

[Altitude of land surface, approximately 4 feet. Depth in feet below land surface. Soil and rock color notation, indicated in parentheses after each description, from Munsell Color (1994). Drilled by U.S. Geological Survey Western Region Research Drilling Unit using hydraulic rotary method, April–May 2005. Total depth drilled: 966 feet. Screen intervals: 860–880, 520–540, 360–380, 220–240, and 58–68 feet. **Abbreviations:** mm, millimeters; <, less than; >, greater than; %, percent]

Depth (feet)		Description
To	From	
640	660	Clayey silty sand (mS); medium to very coarse sand with silt; subangular; poorly sorted; very dark grayish brown (2.5Y 3/2)
660	680	Clayey silty sand (mS); medium to very coarse sand with silt; subangular; poorly sorted; very dark grayish brown (2.5Y 3/2)
680	700	Sandy silty clay (sM); silt and clay with coarse to very coarse sand; poorly sorted; dark grayish brown (2.5Y 4/2)
700	720	Clayey silty sand (mS); medium to very coarse sand with silt cemented to larger grains; subangular; poorly sorted; very dark grayish brown (2.5Y 3/2)
720	740	Sandy silty clay (sM); clay and silt with coarse to very coarse sand; very poorly sorted; dark gray (10YR 4/1)
740	760	Sandy silty clay (sM); clay and silt with medium sand; moderately sorted; dark gray (10YR 4/1)
760	780	Sandy silty clay (sM); clay and silt >70% with some medium to coarse sand; moderately sorted; dark grayish brown (10YR 4/2)
780	800	Sandy silty clay (sM); clay and silt >70% with some medium sand; moderately sorted; olive brown (2.5Y 4/3)
800	820	Clayey silty sand (mS); fine to very coarse sand with silt cemented to larger grains; subangular; poorly sorted; very dark grayish brown (2.5Y 3/2)
820	840	Clayey silty sand (mS); medium to very coarse sand with silt cemented to larger grains; subangular; poorly sorted; dark grayish brown (2.5Y 4/2)
840	860	Clayey silty sand (mS); medium to very coarse sand with silt cemented to larger grains; subangular; poorly sorted; olive brown (2.5Y 4/3)
860	880	Clayey silty sand (mS); fine to very coarse sand with silt cemented to larger grains; subangular; poorly sorted; some iron oxidation on individual grains; dark grayish brown (2.5Y 4/2)
880	900	Clayey silty sand (mS); fine to very coarse sand with silt cemented to larger grains; subangular to angular; poorly sorted; olive brown (2.5Y 4/3)
900	920	Clayey silty sand (mS); fine to coarse sand with silt and clay; subangular; moderately sorted; olive brown (2.5Y 4/3)
920	940	Clayey silty sand (mS); fine to very coarse sand with silt; subangular to angular; poorly sorted; dark grayish brown (2.5Y 4/2)
940	960	Clayey silty sand (mS); fine to medium sand with silt and some coarse grains; subangular; poorly sorted; very dark grayish brown (2.5Y 3/2)
960	966	No sample collected

Table 4. Lithologic log for multiple-well monitoring site STK–5 (wells 002N006E08N001M, –08N002M, and –08N003M) near Stockton, Eastern San Joaquin Groundwater Subbasin, California, May 2006.

[Altitude of land surface, approximately 3 feet. Depth in feet below land surface. Soil and rock color notation, indicated in parentheses after each description, from Munsell Color (1994). Drilled by U.S. Geological Survey Western Region Research Drilling Unit using hydraulic rotary method, May 2006. Total depth drilled: 613 feet. Screen intervals: 560–580, 410–430, and 210–230 feet. **Abbreviations:** mm, millimeters; <, less than; %, percent]

Depth (feet)		Description
To	From	
0	20	No sample collected
20	40	Gravelly sand (gS); very fine to very coarse sand with some granule- to pebble-sized gravel; very poorly sorted; angular to rounded; pebbles are <8 mm in diameter; 40% mafics; yellowish red (5YR 5/6)
40	60	Sand (S); very fine to medium sand with occasional coarse to very coarse sand; well sorted; angular to subangular; 60% quartz with some micas and mafics; reddish brown (2.5YR 4/4)
60	80	Sand (S); fine to coarse sand with occasional very coarse sand; well sorted; angular to subangular; 60% quartz with some micas and mafics; reddish brown (2.5YR 4/4)
80	100	Slightly clayey silty sand (zS); medium to coarse sand with some fine and very coarse sand and with some silt and clay; moderately sorted; subangular to subrounded; slightly sticky; dark greenish gray (5GY 4/1)
100	120	Slightly clayey sandy silt (sM); silt with some medium to coarse sand and with slight clay; well sorted; slightly sticky; dark greenish gray (5GY 4/1)
120	140	Silty sand (zS); very fine to very coarse sand with some silt; poorly sorted; subangular to subrounded; 60% quartz with some micas and mafics; brown (7.5YR 4/2)
140	160	Silty sand (zS); very fine to very coarse sand with some silt; poorly sorted; subangular; 60% quartz with some micas and mafics; brown (7.5YR 4/2)
160	180	Clayey silt (M); silt with some clay and with minor medium to very coarse sand and granules; well sorted; moderately sticky; greenish gray (5GY 5/1)
180	200	Slightly sandy clayey silt (sZ); silt with some clay and with rarely some medium to coarse sand; well sorted; moderately sticky; greenish gray (5GY 5/1)
200	220	Sandy clayey silt (sM); silt with some clay and with occasional medium to coarse sand; well sorted; slightly sticky; greenish gray (5GY 5/1)
220	240	Silty sand (zS); very fine to very coarse sand with some silt and with rarely pebble-sized gravel; poorly sorted; angular to subangular; pebbles are <5 mm in diameter; 60% quartz with some micas and mafics; dark greenish gray (10GY 3/1)
240	260	Silty sand (zS); very fine to medium sand with some silt and with occasional coarse sand; well sorted; angular to subangular; 60% quartz with some micas and mafics; dark greenish gray (10GY 3/1)
260	280	Silty sand (zS); very fine to very coarse sand with some silt and with occasional granule-sized gravel; poorly sorted; subangular to subrounded; 60% quartz with some micas and mafics; dark greenish gray (10GY 3/1)
280	300	Silty sand (zS); fine to coarse sand with some silt and with occasional very coarse sand; well sorted; subangular to subrounded; 40% quartz with micas and mafics; dark greenish gray (10GY 3/1)
300	320	Silty sand (zS); very fine to medium sand with some silt and with occasional coarse sand and with rarely very coarse sand; well sorted; subrounded; 60% quartz with some micas and mafics; dark greenish gray (10GY 3/1)
320	340	Silty sand (zS); very fine to medium sand with some silt and with occasional coarse to very coarse sand; moderately sorted; subangular to subrounded; 60% quartz with some micas and mafics; dark greenish gray (10GY 3/1)
340	360	Slightly clayey sandy silt (sM); silt with some medium sand and with slight clay; well sorted; slightly sticky; dark greenish gray (5GY 4/1)
360	380	Silty sand (zS); very fine to very coarse sand with some silt; poorly sorted; subangular to subrounded; 60% quartz with some micas and mafics; dark greenish gray (5GY 4/1)
380	400	Sandy silt (sZ); silt with very fine to medium sand; well sorted; 40% quartz with micas and mafics; dark greenish gray (5GY 4/1)
400	420	Sandy clayey silt (sM); silt with some clay and with some medium to large sand; well sorted; slightly sticky; dark greenish gray (5GY 4/1)

Table 4. Lithologic log for multiple-well monitoring site STK–5 (wells 002N006E08N001M, –08N002M, and –08N003M) near Stockton, Eastern San Joaquin Groundwater Subbasin, California, May 2006.—Continued

[Altitude of land surface, approximately 3 feet. Depth in feet below land surface. Soil and rock color notation, indicated in parentheses after each description, from Munsell Color (1994). Drilled by U.S. Geological Survey Western Region Research Drilling Unit using hydraulic rotary method, May 2006. Total depth drilled: 613 feet. Screen intervals: 560–580, 410–430, and 210–230 feet. **Abbreviations:** mm, millimeters; <, less than; %, percent]

Depth (feet)		Description
To	From	
420	440	Slightly clayey sandy silt (sM); silt with very fine to medium sand and with occasional coarse to very coarse sand and with slight clay; moderately sorted; slightly sticky; dark greenish gray (5GY 4/1)
440	460	Sandy silt (sZ); silt with very fine to medium sand; well sorted; 70% quartz with micas; dark greenish gray (5GY 4/1)
460	480	Silty sand (zS); very fine to coarse sand with silt; moderately sorted; angular to subangular; 70% quartz with micas; dark greenish gray (5GY 4/1)
480	500	Silty sand (zS); very fine to medium sand with silt; well sorted; angular to subangular; 70% quartz with micas; dark greenish gray (5GY 4/1)
500	520	Silty sand (zS); medium to coarse sand with silt and with occasional very coarse sand to granules; moderately sorted; subangular to subrounded; 70% quartz with micas; dark greenish gray (5GY 4/1)
520	540	Silty sand (zS); very fine to very coarse sand, skewed toward medium, with silt; moderately sorted; subangular; 70% quartz with micas; dark greenish gray (5GY 4/1)
540	560	Slightly clayey sandy silt (sM); silt with medium sand and with slight clay; well sorted; slightly sticky; dark greenish gray (5GY 4/1)
560	580	Silty sand (zS); very fine to coarse sand, skewed toward medium, with silt; moderately sorted; subangular to subrounded; 70% quartz with micas; dark greenish gray (10GY 3/1)
580	600	Silty sand (zS); very fine to coarse sand, skewed toward medium, with silt; moderately sorted; subangular to subrounded; 70% quartz with micas; dark greenish gray (10GY 3/1)
600	613	No sample collected

Table 5. Lithologic log for multiple-well monitoring site STK–2 (wells 200N006E11H004M, –11H005M, –11H006M, and –11H007M) near Stockton, Eastern San Joaquin Groundwater Subbasin, California, May 2005.

[Altitude of land surface, approximately 27 feet. Depth in feet below land surface. Soil and rock color notation, indicated in parentheses after each description, from Munsell Color (1994). Drilled by U.S. Geological Survey Western Region Research Drilling Unit using hydraulic rotary method, May 2005. Total depth drilled: 643 feet. Screen intervals: 615–635, 520–540, 280–300, and 200–220 feet. **Abbreviations:** mm, millimeters; <, less than; %, percent]

Depth (feet)		Description
To	From	
0	20	Sandy silty clay (sM); clay and silt with <50% fine to very coarse sand; poorly sorted; very dark grayish brown (10YR 3/2)
20	40	Clayey silty sand (mS); fine to coarse sand with <30% silt; subangular; moderately sorted; brown (10YR 4/3); some caliche
40	60	Clayey silty sand (mS); fine to medium sand with silt and occasional coarse to very coarse sand; subangular; moderately sorted; brown (10YR 5/3)
60	80	Clayey silty sand (mS); medium sand with silt and some fine to coarse sand; subangular; moderately sorted; yellowish brown (10YR 5/4)
80	100	Clayey silty sand (mS); very fine sand with silt and some medium to coarse sand; subangular; poorly sorted; yellowish brown (10YR 5/4)
100	120	Sandy silty clay (sM); clay and silt with <50% medium to coarse sand; poorly sorted; yellowish brown (10YR 5/4)
120	140	Sandy silty clay (sM); clay and silt with <50% medium to coarse sand; poorly sorted; dark yellowish brown (10YR 4/4)
140	160	Clayey silty sand (mS); fine to medium sand with some coarse to very coarse sand, silt and occasional pebbles; subangular; poorly sorted; pebbles are <10 mm in diameter; brown (10YR 5/3)
160	180	Clayey silty sand (mS); medium to very coarse sand with silt; subangular; poorly sorted; dark yellowish brown (10YR 4/4)
180	200	Sandy silty clay (sM); clay and silt with <50% fine to coarse sand; poorly sorted; brown (10YR 4/3)
200	220	Slightly gravelly sand ((g)S); medium to very coarse sand with a few pebbles <10 mm in diameter and some silt; subrounded to subangular; poorly sorted; pebbles are <10 mm in diameter; dark grayish brown (10YR 4/2)
220	240	Clayey silty sand (mS); medium to very coarse sand with <30% silt; subangular; poorly sorted; brown (10YR 4/3)
240	260	Sandy silty clay (sM); clay and silt with <50% medium to coarse sand; poorly sorted; brown (10YR 4/3)
260	280	Sand (S); medium to very coarse sand with some silt cemented to larger grains; subangular; poorly sorted; dark yellowish brown (10YR 3/6)
280	300	Sand (S); medium to very coarse sand with few granules and silt cemented to larger grains; subangular; moderately sorted; brown (10YR 4/3)
300	320	Clayey silty sand (mS); fine to coarse sand with <40% silt and occasional very coarse sand; subangular; poorly sorted; dark yellowish brown (10YR 4/4)
320	340	Sand (S); medium to coarse sand with some very coarse sand and silt cemented to larger grains; subangular; moderately sorted; brown (10YR 4/3)
340	360	Sand (S); fine to coarse sand with silt cemented to larger grains; subangular; moderately sorted; brown (10YR 5/3)
360	380	Clayey silty sand (mS); medium to coarse sand with <30% silt; subangular; poorly sorted; brown (10YR 4/3)
380	400	Sandy silty clay (sM); clay and silt with <50% medium to coarse sand; moderately sorted; dark yellowish brown (10YR 3/4)
400	410	Clayey silty sand (mS); fine to very coarse sand with <10% silt cemented to larger grains; subangular; poorly sorted; dark yellowish brown (10YR 3/4)
410	420	Clayey silty sand (mS); fine to very coarse sand with <20% silt; subangular; poorly sorted; dark yellowish brown (10YR 3/4)
420	440	Clayey silty sand (mS); fine to coarse sand with silt cemented to coarser grains; subangular; moderately sorted; yellowish brown (10YR 5/4)
440	460	Clayey silty sand (mS); fine to coarse sand with silt; subangular; poorly sorted; dark yellowish brown (10YR 3/6)
460	480	Clayey silty sand (mS); medium sand with fine to coarse sand and some silt cemented to larger grains; subangular; moderately sorted; brown (7.5YR 4/3)
480	500	Clayey silty sand (mS); medium to coarse sand with silt; subangular; poorly sorted; brown (10YR 4/3)
500	520	Sand (S); medium to very coarse sand with some silt cemented to larger grains; subangular; very poorly sorted; dark grayish brown (10YR 4/2)
520	540	Sand (S); medium to very coarse sand with some silt cemented to larger grains; subangular; very poorly sorted; dark grayish brown (10YR 4/2)
540	560	Sand (S); medium to coarse sand with some very coarse sand and silt cemented to larger grains; subangular; poorly sorted; dark grayish brown (10YR 4/2)
560	580	Sand (S); medium to coarse sand with some finer-grained sand and occasional coarse sand; subangular; moderately sorted; dark grayish brown (10YR 4/2)
580	600	Sand (S); medium to very coarse sand with silt cemented to larger grains; subangular; poorly sorted; dark gray (10YR 4/1)
600	620	Clayey silty sand (mS); medium to very coarse sand with silt; subangular; very poorly sorted; dark gray (10YR 4/1)
620	640	Sand (S); medium sand with some coarse to very coarse sand and silt cemented to larger grains; subangular; poorly sorted; dark gray (10YR 4/1)
640	643	No sample collected

Table 6. Lithologic log for unsaturated-zone monitoring site STK–3 (002N006E11H008M) near Stockton, Eastern San Joaquin Groundwater Subbasin, California, September 2005.

[Altitude of land surface, approximately 27 feet. Depth in feet below land surface. Soil and rock color notation from, indicated in parentheses after each description, Munsell Color (1994). Drilled by U.S. Geological Survey Western Region Research Drilling Unit using ODEX (overburden drilling and exploration) method, September 2005. Total depth drilled: 120 feet. Screen intervals: 615–635, 520–540, 280–300, and 200–220 feet. **Abbreviations:** mm, millimeters; >, greater than; <, less than; %, percent]

Depth (feet)		Description
To	From	
0	1	Silty clayey sand (mS); very fine to medium sand with silt and fine-grained sand cemented together, resulting in very coarse sand-size to pebble-size conglomerates, and occasional granules of dark rock; poorly sorted; subangular to rounded; pebbles are <8 mm in diameter; brown (7.5YR 5/3)
1	2	Slightly gravelly silty clayey sand ((g)mS); coarse to very coarse sand with pebbles and silt to fine sand with silt cemented to coarser grains; very poorly sorted; subrounded to subangular; pebbles are <15 mm in diameter; brown (7.5YR 5/2)
2	3	Slightly gravelly silty clayey sand ((g)mS); very fine to medium gravels with silt and occasional pebbles and silt to fine-grained sand cemented together resulting in medium sand-size to granule-size conglomerates; moderately sorted; subangular; pebbles are <9 mm in diameter; light brown (7.5YR 6/3)
3	4	Sand (S); fine to medium sand cemented together resulting in medium sand-size to very coarse sand-size conglomerates and some pebble-size conglomerates; moderately sorted; subangular; pebbles are <10 mm in diameter; brown (7.5YR 5/3)
4	5	Sand (S); very fine to medium sand cemented together, resulting in medium sand-size to coarse sand-size conglomerates with occasional very coarse conglomerates; moderately sorted; subangular; pale brown (10YR 6/3)
5	6	Sand (S); very fine to medium sand, cemented to medium coarse granule-size conglomerates; moderately sorted; subangular; pale brown (10YR 6/3)
6	7	Silty clayey sand (mS); very fine to medium sand with clay and silt, cemented to medium to very coarse granule-size conglomerates; moderately sorted; subangular; gray (10YR 6/1)
7	8	Silty clayey sand (mS); very fine to medium sand with some clay and silt, cemented to medium to coarse sand; moderately sorted; subangular; pale brown (10YR 6/3)
8	9	Silty clayey sand (mS); very fine to medium sand with some clay and silt, cemented to medium to coarse sand; moderately sorted; subangular; pale brown (10YR 6/3)
9	10	Silty clayey sand (mS); fine sand with clay and silt and medium sand and some very fine to fine sand cemented to each other and larger grains and occasional very coarse-size conglomerates; well sorted; subangular; pebbles are <8 mm in diameter; pale brown (10YR 6/3)
10	11	Silty clayey sand (mS); fine sand with clay and silt and medium sand and some very fine to fine sand cemented to each other and larger grains and occasional very coarse-size conglomerates; well sorted; subangular; pale brown (10YR 6/3)
11	12	Slightly gravelly clayey silty sand ((g)mS); very fine to medium sand with some clayey silt and some very fine to fine sand cemented to each other and larger grains and many very coarse conglomerates; poorly sorted; pebbles are <15 mm in diameter; light brownish gray (10YR 6/2)
12	13	Gravelly clayey sand (gmS); very fine to medium sand with clay and some very fine to fine sand cemented to each other and larger grains and many very coarse conglomerates with large fraction granules and pebbles; poorly sorted; pebbles are <15 mm in diameter; brown (10YR 5/3)
13	14	Gravelly clayey sand (gmS); fine sand with some medium sand, some clay and silt; poorly sorted; subangular to subrounded; silt and fine sand cemented into very coarse sand; pebbles are <20 mm in diameter; brown (10YR 5/3)
14	15	Gravelly clayey sand (gmS); fine sand with some medium sand and clay; poorly sorted; subangular to subrounded; silt and fine sand cemented into very coarse sand; pebbles are <20 mm in diameter; brown (10YR 5/3)
15	16	Gravelly clayey sand (gmS); fine sand with some medium sand with some clay; poorly sorted; subangular to subrounded; silt and fine sand cemented into very coarse sand; pebbles are <20 mm in diameter; brown (10YR 5/3)
16	17	Gravelly clayey sand (gmS); fine sand with some medium sand and some clay and silt; poorly sorted; subangular to subrounded; silt and fine sand cemented into very coarse sand; pebbles are <20 mm in diameter; brown (10YR 5/3)
17	18	Gravelly clayey sand (gmS); fine sand with some medium sand and some silt; poorly sorted; subangular to subrounded; silt and fine sand cemented into very coarse sand; pebbles are <20 mm in diameter; 40% of material is caliche; white (10YR 8/1)
18	19	Sand (S); very fine to medium sand with occasional coarse sand and some finer grains cemented together to very coarse to pebble-size; moderately sorted; subangular; pebbles are <5 mm in diameter; grayish brown (10YR 5/2)

Table 6. Lithologic log for unsaturated-zone monitoring site STK–3 (002N006E11H008M) near Stockton, Eastern San Joaquin Groundwater Subbasin, California, September 2005.—Continued

[Altitude of land surface, approximately 27 feet. Depth in feet below land surface. Soil and rock color notation from, indicated in parentheses after each description, Munsell Color (1994). Drilled by U.S. Geological Survey Western Region Research Drilling Unit using ODEX (overburden drilling and exploration) method, September 2005. Total depth drilled: 120 feet. Screen intervals: 615–635, 520–540, 280–300, and 200–220 feet. **Abbreviations:** mm, millimeters; >, greater than; <, less than; %, percent]

Depth (feet)		Description
To	From	
19	20	Sand (S); very fine to coarse sand and many finer grains cemented together or to larger grains forming coarse and occasionally very coarse to granule-size conglomerates; well sorted; subrounded to angular; grayish brown (10YR 5/2)
20	21	Sand (S); very fine to coarse sand and many finer grains cemented together or to larger grains forming coarse; well sorted; subrounded to angular; grayish brown (10YR 5/2)
21	22	Sand (S); medium to coarse sand with silt to fine grains cemented to larger grains and occasional mineral granule- and pebble-size conglomerates; moderately sorted; subangular; pebbles are <6 mm in diameter; brown (10YR 5/3)
22	23	Sand (S); medium coarse sand with silt to fine grained sand cemented to larger grains and each other and occasional granule-size conglomerates; subrounded to subangular; moderately sorted; yellowish brown (10YR 5/4)
23	24	Sand (S); coarse sand with silt to fine sand cemented to larger grains and occasional very coarse sand; moderately sorted; subangular; yellowish brown (10YR 5/4)
24	25	Sand (S); medium to very coarse sand with silt cemented to larger grains and occasional very coarse to granules of cemented sand; poorly sorted; subangular; pale brown (10YR 6/3)
25	26	Sand (S); very fine to very coarse sand with silt cemented to larger grains; poorly sorted; subrounded to subangular; pale brown (10YR 6/3)
26	27	Sand (S); very fine to very coarse sand with silt cemented to larger grains; poorly sorted; subrounded to subangular; pale brown (10YR 6/3)
27	28	Sand (S); very fine to very coarse sand with silt cemented to larger grains; poorly sorted; subrounded to subangular; pale brown (10YR 6/3)
28	29	Sand (S); very fine to very coarse sand with silt cemented to larger grains and occasional fine-grained material cemented together resulting in very coarse conglomerates; poorly sorted; subrounded to subangular; pale brown (10YR 6/3)
29	30	Sand (S); very fine to coarse sand with silt cemented to larger grains and occasional very coarse sand and few fine-grained sand cemented together to form coarse grain-size conglomerates; moderately sorted; subangular; light brownish gray (10YR 6/2)
30	31	Sand (S); medium to very coarse sand with some fine sand with silt cemented to larger grains and occasional pebbles; moderately sorted; subangular; pebbles are <5 mm in diameter; very fine magnetite grains; pale brown (10YR 6/3)
31	32	Sand (S); very fine to very coarse sand with silt cemented to larger grains with occasional granules cemented together to fine-grained to larger granule-size; poorly sorted; subangular; very fine magnetite grains in sediment; brown (10YR 5/3)
32	33	Sand (S); very fine to very coarse sand and silt with less silt cemented to larger grains; poorly sorted; subangular; brown (10YR 5/3)
33	34	Gravelly sand (gS); medium to very coarse sand with some fine grains and silt to very fine grains cemented to larger grains, poorly sorted; subrounded to subangular; pebbles are <13 mm in diameter; light brownish gray (10YR 6/2)
34	35	Slightly gravelly sand ((g)S); coarse to very coarse sand with silt to very fine grains cemented to larger grains, and fine grained material cemented together forming conglomerate granules; moderately sorted; subangular; pale brown (10YR 6/3)
35	36	Sandy gravel (sG); very fine to very coarse sand with silt cemented to larger grains; poorly sorted; subrounded to subangular; pebbles are <20 mm in diameter; pale brown (10YR 6/3)
36	37	Sandy gravel (sG); very fine to very coarse sand with silt cemented to larger grains; poorly sorted; subangular to subrounded; pebbles are <20 mm in diameter; pebbles include quartzite clasts; pale brown (10YR 6/3)
37	38	Silty clayey sand (mS); medium to very coarse sand with some finer grained material and silt cemented to larger grains and fragments of consolidated clays; moderately sorted; angular; pebbles are <20 mm in diameter; pale brown (10YR 6/3)
38	39	Gravelly sand (gS); medium to very coarse sand with silt cemented to larger grains and some fine grained sand cemented together to very coarse granule-size; moderately sorted; subangular; pale brown (10YR 6/3)

Table 6. Lithologic log for unsaturated-zone monitoring site STK–3 (002N006E11H008M) near Stockton, Eastern San Joaquin Groundwater Subbasin, California, September 2005.—Continued

[Altitude of land surface, approximately 27 feet. Depth in feet below land surface. Soil and rock color notation from, indicated in parentheses after each description, Munsell Color (1994). Drilled by U.S. Geological Survey Western Region Research Drilling Unit using ODEX (overburden drilling and exploration) method, September 2005. Total depth drilled: 120 feet. Screen intervals: 615–635, 520–540, 280–300, and 200–220 feet. **Abbreviations:** mm, millimeters; >, greater than; <, less than; %, percent]

Depth (feet)		Description
To	From	
39	40	Slightly gravelly sand ((g)S); medium to very coarse sand with some fine grained sand and pebbles; moderately sorted; subangular; pebbles are <12 mm in diameter; light brownish gray (10YR 6/2)
40	41	Sand (S); medium to very coarse sand with silt cemented to larger grains and some fine grained sand and some finer grained material cemented together to make larger-size particles; poorly sorted; subangular; light brownish gray (10YR 6/2)
41	42	Slightly gravelly sand ((g)S); medium to very coarse sand with silt cemented to larger grains and some fine grained sand and pebbles and some finer grained material cemented together to make larger-size particles; poorly sorted; subangular; pebbles are <18 mm in diameter; light brownish gray (10YR 6/2)
42	43	Sand (S); coarse to very coarse sand with some finer grained sand and silt cemented to larger grains; moderately sorted; subangular; light brownish gray (10YR 6/2)
43	44	Slightly gravelly sand ((g)S); coarse to very coarse sand with some finer grained sand and pebbles and silt cemented to larger grains; moderately sorted; subangular; pebbles are <25 mm in diameter; light brownish gray (10YR 6/2)
44	45	Sand (S); coarse to very coarse sand with some finer grained sand and silt cemented to larger grains; moderately sorted; subangular; light brownish gray (10YR 6/2)
45	46	Sand (S); medium to very coarse sand with silt cemented to larger grains and some finer grained material cemented to make larger-size particles up to granules; moderately sorted; subangular; light brownish gray (10YR 6/2)
46	47	Gravelly sand (gS); coarse to very coarse sand with some finer grained sand and pebbles and silt cemented to larger grains and some finer grained material cemented to make larger-size particles up to granules; pebbles are <17 mm in diameter; moderately sorted; subangular; light brownish gray (10YR 6/2)
47	48	Sand (S); medium to very coarse sand with considerable amount of silt cemented to larger grains; moderately sorted; subangular; light brownish gray (10YR 6/2)
48	49	Sand (S); medium to coarse sand with silt cemented to larger grains; well sorted; subangular; light brownish gray (10YR 6/2)
49	50	Sand (S); coarse to very coarse sand with some finer grained fraction and silt cemented to larger grains; moderately sorted; subangular; light brownish gray (10YR 6/2)
50	51	Clayey silty sand (mS); medium to very coarse sand with >10% silt and many silts cemented to larger grains; poorly sorted; subangular; light brownish gray (10YR 6/2)
51	52	Gravelly clayey sand (gmS); very fine to very coarse sand with >10% silt and pebbles and many silts cemented to larger grains; very poorly sorted; subangular; pebbles are <16 mm in diameter; pale brown (10YR 6/3)
52	53	Clayey silty sand (mS); very fine to very coarse sand with silt, and many silts cemented to larger grains; very poorly sorted; subangular; pale brown (10YR 6/3)
53	54	Clayey silty sand (mS); very fine to very coarse sand with silt, and many silts cemented to larger grains; very poorly sorted; subangular; pale brown (10YR 6/3)
54	55	Clayey silty sand (mS); very fine to very coarse sand with silt, and many silts cemented to larger grains; very poorly sorted; subangular; pale brown (10YR 6/3)
55	56	Clayey silty sand (mS); medium to very coarse sand with >30% silt and clay; very poorly sorted; subrounded; pale brown (10YR 6/3)
56	57	Sandy clayey silt (sM); silt with <50% very fine to very coarse sand; poorly sorted; subrounded; pale brown (10YR 6/3)
57	58	Clayey silty sand (mS); very fine to very coarse sand and silt; poorly sorted; subangular; pale brown (10YR 6/3)
58	59	Clayey silty sand (mS); medium to very coarse sand with silt cemented to larger grains and occasional large pebbles and particles of hardened clay, silt and fine-grained sand; poorly sorted; subangular; pale brown (10YR 6/3)
59	60	Sand (S); medium to very coarse sand with granules of silt cemented to larger grains and some fine-grained sand; poorly sorted; subangular; pale brown (10YR 6/3)
60	61	Clayey silty sand (mS); medium to very coarse sand with <10% silt and silt cemented to larger grains; poorly sorted; subangular; pale brown (10YR 6/3)
61	62	Clayey silty sand (mS); medium to very coarse sand with <10% silt and silts cemented to larger grains; poorly sorted; subangular; pale brown (10YR 6/3)

Table 6. Lithologic log for unsaturated-zone monitoring site STK–3 (002N006E11H008M) near Stockton, Eastern San Joaquin Groundwater Subbasin, California, September 2005.—Continued

[Altitude of land surface, approximately 27 feet. Depth in feet below land surface. Soil and rock color notation from, indicated in parentheses after each description, Munsell Color (1994). Drilled by U.S. Geological Survey Western Region Research Drilling Unit using ODEX (overburden drilling and exploration) method, September 2005. Total depth drilled: 120 feet. Screen intervals: 615–635, 520–540, 280–300, and 200–220 feet. **Abbreviations:** mm, millimeters; >, greater than; <, less than; %, percent]

Depth (feet)		Description
To	From	
62	63	Clayey silty sand (mS); medium to very coarse sand with <10% silt and silts cemented to larger grains; poorly sorted; subangular; pale brown (10YR 6/3)
63	64	Sandy silty clay (sM); clay and silt with <50% very fine to very coarse sand; poorly sorted; subangular; pale brown (10YR 6/3)
64	65	Sandy silty clay (sM); clay and silt with <50% very fine to very coarse sand; poorly sorted; subangular; pale brown (10YR 6/3)
65	66	Sandy silty clay (sM); clay and silt with <50% very fine to very coarse sand; poorly sorted; subangular; yellowish brown (10YR 5/4)
66	67	Sandy silty clay (sM); clay and silt with <50% very fine to very coarse sand; poorly sorted; subangular; brown (10YR 5/3)
67	68	Sandy silty clay (sM); clay and silt with <50% very fine to very coarse sand; poorly sorted; subrounded; pale brown (10YR 6/3)
68	69	Clayey silty sand (mS); medium to coarse sand with silt cemented to larger grains and many fine-grained particles cemented together forming very coarse to granule-size particles; moderately sorted; subangular; brown (10YR 5/3)
69	70	Clayey silty sand (mS); fine to coarse sand with >30% silt; poorly sorted; subrounded; caliche <10%; pale brown (10YR 6/3)
70	71	Sandy silty clay (sM); fine to coarse sand with >30% silt; poorly sorted; subrounded; caliche <10%; pale brown (10YR 6/3)
71	72	Sandy silty clay (sM); clay and silt with >25% fine to medium sand; moderately sorted; subangular; caliche <10%; light brownish gray (10YR 6/2)
72	73	Clayey silty sand (mS); fine sand with silt and clay; moderately sorted; subangular; pale brown (10YR 6/3)
73	74	Clayey silty sand (mS); fine to medium sand with silt and clay; moderately sorted; subangular; pale brown (10YR 6/3)
74	75	Sandy clayey silt (sM); silt with fine to coarse sand and clay; well sorted; subangular; very pale brown (10YR 7/3)
75	76	Sandy clayey silt (sM); silt with fine to coarse sand and clay; well sorted; subangular; very pale brown (10YR 7/3)
76	77	Sandy clayey silt (sM); silt with fine to coarse sand and clay; well sorted; subangular; some caliche; pale brown (10YR 6/3)
77	78	Sandy clayey silt (sM); silt with fine to medium sand; moderately sorted; subangular; pale brown (10YR 6/3)
78	79	Sandy clayey silt (sM); silt with fine to coarse sand; moderately sorted; subangular; pale brown (10YR 6/3)
79	80	Clayey silty sand (mS); very fine to medium sand with silt; well sorted; subangular; dark yellowish brown (10YR 4/4)
80	81	Sand (S); fine to medium sand; well sorted; subrounded to subangular; dark yellowish brown (10YR 3/4)
81	82	Sand (S); fine to medium sand; well sorted; subrounded to subangular; dark yellowish brown (10YR 3/4)
82	83	Sand (S); fine to medium sand; well sorted; subrounded to subangular; dark yellowish brown (10YR 3/4)
83	84	Clayey silty sand (mS); medium to coarse sand with some silt; well sorted; subangular; yellowish brown (10YR 5/4)
84	85	Clayey silty sand (mS); very fine to coarse sand with silt; poorly sorted; subangular; yellowish brown (10YR 5/4)
85	86	Clayey silty sand (mS); very fine to coarse sand with silt and clay; poorly sorted; subangular; yellowish brown (10YR 5/4)
86	87	Clayey silty sand (mS); very fine to very coarse sand with silt and clay; poorly sorted; subangular; yellowish brown (10YR 5/4)
87	88	Clayey silty sand (mS); very fine to medium sand with some silt and clay; moderately sorted; subangular; yellowish brown (10YR 5/4)
88	89	Clayey silty sand (mS); very fine to coarse sand with some silt and clay; moderately sorted; subangular; yellowish brown (10YR 5/4)
89	90	Clayey silty sand (mS); fine to coarse sand with silt and some clay; poorly sorted; subangular; yellowish brown (10YR 5/4)
90	91	Silty sand (S); medium to coarse sand with silt cemented to larger grains; well sorted; subangular; pale brown (10YR 6/3)
91	92	Sandy silty clay (sM); clay and silt with some fine to coarse sand; poorly sorted; subangular; pale brown (10YR 6/3)
92	93	Sandy silty clay (sM); clay and silt with medium to very coarse sand and some finer sand; moderately sorted; subangular; pale brown (10YR 6/3)
93	94	Sandy silty clay (sM); clay and silt with fine to coarse sand; poorly sorted; subangular; pale brown (10YR 6/3)
94	95	Sandy silty clay (sM); clay and silt with some medium sand; moderately sorted; subangular; pale brown (10YR 6/3)
95	96	Sandy silty clay (sM); clay and silt with some medium sand and caliche; moderately sorted; subangular; pale brown (10YR 6/3)
96	97	Sandy silty clay (sM); clay and silt with very fine to very coarse sand and some caliche; poorly sorted; subangular; pale brown (10YR 6/3)

Table 6. Lithologic log for unsaturated-zone monitoring site STK–3 (002N006E11H008M) near Stockton, Eastern San Joaquin Groundwater Subbasin, California, September 2005.—Continued

[Altitude of land surface, approximately 27 feet. Depth in feet below land surface. Soil and rock color notation from, indicated in parentheses after each description, Munsell Color (1994). Drilled by U.S. Geological Survey Western Region Research Drilling Unit using ODEX (overburden drilling and exploration) method, September 2005. Total depth drilled: 120 feet. Screen intervals: 615–635, 520–540, 280–300, and 200–220 feet. **Abbreviations:** mm, millimeters; >, greater than; <, less than; %, percent]

Depth (feet)		Description
To	From	
97	98	Sandy silty clay (sM); clay with silt and some fine to very coarse sand; caliche balls to <15 mm; very poorly sorted; subangular; pale brown (10YR 6/3)
98	99	Sandy silty clay (sM); clay and silt with very fine to medium sand and some coarse sand; poorly sorted; subangular; pale brown (10YR 6/3)
99	100	Sandy silty clay (sM); clay and silt with very fine to very coarse sand; poorly sorted; subangular; pale brown (10YR 6/3)
100	101	Sandy silty clay (sM); clay with silt and some fine to medium sand; moderately sorted; subangular; grayish brown (10YR 5/2)
101	102	Sandy silty clay (sM); clay with silt and occasional coarse sand; some caliche, moderately sorted; subangular; light brownish gray (10YR6/2)
102	103	Sandy silty clay (sM); clay with silt and occasional medium to very coarse sand; some caliche; moderately sorted; subangular; light brownish gray (10YR 6/2)
103	104	Sandy silty clay (sM); clay with silt and some medium sand; moderately sorted; subangular; light brownish gray (10YR 6/2)
104	105	Sandy silty clay (sM); clay and silt with some fine to medium sand; moderately sorted; subangular; light brownish gray (10YR 6/2)
105	106	Sandy silty clay (sM); clay and silt with some very fine to medium sand; moderately sorted; subangular; light brownish gray (10YR 6/2)
106	107	Clayey silty sand (mS); fine to medium sand with and silt and clay; moderately sorted; subrounded; dark yellowish brown (10YR 4/4)
107	108	Sand (S); very fine to medium sand; moderately sorted; subangular; dark brown (10YR 3/3)
108	109	Clayey silty sand (mS); very fine to coarse sand with silt; poorly sorted; subangular; pale brown (10YR 6/3)
109	110	Sand (S); very fine to very coarse sand; poorly sorted; subangular; brown (10YR 4/3)
110	111	Clayey silty sand (mS); very fine to coarse sand with silt; poorly sorted; subangular; yellowish brown (10YR 5/4)
111	112	Sand (S); very fine to medium sand; well sorted; subangular; yellowish brown (10YR 5/4)
112	113	Clayey silty sand (mS); very fine to coarse sand with silt; poorly sorted; subangular; yellowish brown (10YR 5/4)
113	114	Clayey silty sand (mS); very fine to fine sand with silt; well sorted; subangular; yellowish brown (10YR 5/4)
114	115	Clayey silty sand (mS); very fine to very coarse sand with silt and clay; poorly sorted; subangular; light yellowish brown (10YR 6/4)
115	116	Sandy silty clay (sM); clay and silt with very fine to fine sand; moderately sorted; subangular; light yellowish brown (10YR 6/4)
116	117	Sandy silty clay (sM); clay and silt with some very fine to medium sand; well sorted; subangular; light yellowish brown (10YR 6/4)
117	119	No sample collected
119	120	Sandy silty clay (sM); clay with some silt and medium to coarse sand; poorly sorted; subangular; light yellowish brown (10YR 6/4)

Table 7. Lithologic log for multiple-well monitoring site STK–6 (wells 002006E29H001M, –29H002M, and –29H003M) near Stockton, Eastern San Joaquin Groundwater Subbasin, California, May 2006.

[Altitude of land surface, approximately 5 feet. Depth in feet below land surface. Soil and rock color notation, indicated in parentheses after each description, from Munsell Color (1994). Drilled by U.S. Geological Survey Western Region Research Drilling Unit using hydraulic rotary method, May 2006. Total depth drilled: 618 feet. Screen intervals: 540–560, 450–470, and 240–260 feet. **Abbreviations:** mm, millimeters; %, percent]

Depth (feet)		Description
To	From	
0	20	No data
20	39	Sand (S); medium sand with some fine and coarse sand and with occasional very coarse sand; well sorted; subangular to subrounded; 35% mafics; yellowish red (5YR 4/6)
39	59	Sand (S); medium sand with some fine sand; very well sorted; subrounded to rounded; 35% mafics; reddish brown (5YR 4/4)
59	62	No sample collected
62	80	Silty sand (zS); very fine to coarse sand with some silt; moderately sorted; subangular to subrounded; 35% mafics; very dark grayish brown (10YR 3/2)
80	100	Sand (S); very fine to coarse sand, skewed toward medium, with slight silt; well sorted; subangular to subrounded; 35% mafics; very dark grayish brown (10YR 3/2)
100	120	Silty sand (zS); very fine to medium sand with some silt; well sorted; subangular; 35% mafics; very dark grayish brown (10YR 3/2)
120	140	Sandy silty clay (sM); clay with silt and with occasional very fine to coarse sand; well sorted; slightly sticky; dark greenish gray (5GY 4/1)
140	160	Gravelly silty sand (gmS); medium to very coarse sand with some finer sand and silt and with occasional granules to 3 mm; poorly sorted; subangular to subrounded; 30% mafics; dark greenish gray (5GY 4/1)
160	180	Silty sand (zS); fine to medium sand with silt and with occasional coarse sand; well sorted; subangular to rounded; 50% mafics; very dark grayish brown (10YR 3/2)
180	200	Sandy silty clay (sM); clay with silt and with some fine to medium sand; well sorted; slightly sticky; dark grayish brown (10YR 4/2)
200	220	Silty clay (M); clay with some silt and with rarely some medium sand; very well sorted; slightly sticky; grayish brown (10YR 5/2)
220	240	Silty clay (M); clay with some silt and with rarely some medium sand; very well sorted; slightly sticky; grayish brown (10YR 5/2)
240	260	Silty sandy clay (sM); clay with fine to medium sand and with silt; well sorted; slightly sticky; very dark grayish brown (10YR 3/2)
260	280	Silty clay (M); clay with silt and with rarely some medium or coarse sand; very well sorted; slightly sticky; very dark grayish brown (10YR 3/2)
280	300	Sand (S); very fine to fine sand with minor silt and with rarely medium to coarse sand; very well sorted; subangular to subrounded; 40% mafics, especially biotite; very dark grayish brown (10YR 3/2)
300	320	Silty sand (zS); very fine to fine sand with some silt and with occasional medium sand; very well sorted; subangular to subrounded; 40% mafics, especially biotite; olive brown (2.5Y 4/3)
320	340	Silty sand (zS); very fine to fine sand with some silt and with occasional medium sand; very well sorted; subangular to subrounded; 40% mafics, especially biotite; olive brown (2.5Y 4/3)
340	360	Silty sand (zS); very fine to fine sand with some silt and with occasional medium sand; very well sorted; subangular to subrounded; 40% mafics, especially biotite; olive brown (2.5Y 4/3)
360	380	Silty clay (M); clay with some silt and with rarely some medium sand; very well sorted; slightly sticky; dark grayish brown (2.5Y 4/2)

Table 7. Lithologic log for multiple-well monitoring site STK–6 (wells 002006E29H001M, –29H002M, and –29H003M) near Stockton, Eastern San Joaquin Groundwater Subbasin, California, May 2006.—Continued

[Altitude of land surface, approximately 5 feet. Depth in feet below land surface. Soil and rock color notation, indicated in parentheses after each description, from Munsell Color (1994). Drilled by U.S. Geological Survey Western Region Research Drilling Unit using hydraulic rotary method, May 2006. Total depth drilled: 618 feet. Screen intervals: 540–560, 450–470, and 240–260 feet. **Abbreviations:** mm, millimeters; %, percent]

Depth (feet)		Description
To	From	
380	400	Silty sand (zS); very fine to fine sand with some silt and with occasional medium sand; very well sorted; subangular to subrounded; 30% mafics; dark greenish gray (5GY 4/1)
400	420	Silty sand (zS); very fine to coarse sand with some silt; well sorted; subangular to rounded; 30% mafics; very dark grayish brown (10YR 3/2)
420	440	Silty sand (zS); very fine to coarse sand with some silt; well sorted; subangular to rounded; 30% mafics; very dark grayish brown (10YR 3/2)
440	458	Silty sand (zS); very fine to very coarse sand with some silt; moderately sorted; subrounded; 30% mafics; brown (7.5YR 4/2)
458	478	Sand (S); very fine to very coarse sand; moderately sorted; subangular to subrounded; 30% mafics; brown (7.5YR 4/2)
478	498	Silty sand (zS); very fine to fine sand with some silt and with occasional medium sand; very well sorted; subangular to subrounded; 30% mafics; dark reddish gray (5YR 4/2)
498	518	Silty sand (zS); very fine to fine sand with some silt and with occasional medium sand; very well sorted; subangular to subrounded; 30% mafics; dark reddish gray (5YR 4/2)
518	538	Silty sand (zS); very fine to medium sand with silt and with some very coarse sand; moderately sorted; subrounded; 30% mafics; dark reddish gray (5YR 4/2)
538	558	Silty sand (zS); very fine to medium sand with silt and with some very coarse sand; moderately sorted; subrounded; 30% mafics; dark reddish gray (5YR 4/2)
558	578	Silty sand (zS); very fine to very coarse sand with some silt; poorly sorted; subangular to subrounded; 30% mafics; very dark grayish brown (10YR 3/2)
578	598	Silty clay (M); clay with some silt and rarely with some medium sand; very well sorted; slightly sticky; dark greenish gray (5GY 4/1)
598	615	Sandy silt (sZ); silt with very fine to medium sand; well sorted; 30% mafics; dark reddish gray (5YR 4/2)
615	618	No sample collected

Geophysical Logs

Borehole geophysical logs for each multiple-well monitoring site were collected from uncased fluid-filled boreholes after drilling and prior to well installation to provide information on the lithologic units and chemical characteristics of the groundwater encountered during drilling. Geophysical logs for selected multiple-well sites are shown in figures 5–9. The geophysical logs generally included: caliper, natural gamma, spontaneous potential (SP), 16-inch and 64-inch electrical resistivity (also known as short or 16–N, and long or 64–N, normal resistivity logs, respectively), and electromagnetic (EM) resistivity logs. These logs are archived in the USGS internal data base, Logarchiver, and are available in electronic form upon request. Only the natural-gamma log could be collected through the steel pipe used to stabilize the borehole after ODEX drilling at the 11H8 site. This log is not shown in this report but is on file at the USGS office in San Diego, Calif.

The caliper tool measures the diameter of the borehole, which changed as the diameter of the drill bit was decreased with increasing drill depth. Unexpected increases in borehole diameter may indicate depths where poorly consolidated sand and (or) gravel have come loose from the sides of the borehole during drilling. These changes may commonly occur at geologic contacts between different aquifer or formation layers. Decreases in borehole diameter may indicate depths where clay has swelled into the borehole or where overlying material that has fallen into the borehole has bridged and partly closed the borehole. This information is needed for placement of well screens, backfill material around well screens, and bentonite seals between well screens during well construction.

The natural-gamma tool measures the intensity of gamma-ray emissions resulting from the decay of naturally occurring radioactive isotopes, which include potassium-40, uranium, and thorium (Schlumberger, 1972). Natural-gamma logs are used to help define lithology, geologic correlation between wells, and the thickness of aquifer layers. Clay-rich deposits and feldspar-rich gravels generally emit higher intensity gamma ray than silts or sands. Comparison of the gamma log and the lithologic log is necessary to distinguish between clay and gravel deposits that have similar gamma-ray emissions.

The SP tool measures voltage differences that exist between nonporous and porous beds. An SP log usually has a baseline that corresponds to impermeable beds such as clay or shale. Deflections to the left of this baseline correspond to the positions of permeable strata if the formation water is less resistive (more saline) than the drilling mud. Deflections to the right of the baseline correspond to the positions of permeable strata if the formation water is more resistive (less saline) than the drilling mud (Schlumberger, 1972). SP logs can be used to help determine bed thickness, chemical and physical properties, clay content, lithology, and correlation of lithologic units between wells.

The short (16–N) and long (64–N) normal electrical resistivity tools measure the apparent resistivity of a volume of rock under the direct application of an electric current (Keys and MacCary, 1983). These logs are used to determine formation and fluid resistivity and to estimate formation porosity. In an alluvial aquifer system, low resistivity generally indicates water higher in dissolved solids, or fine-grained deposits such as silt, clay, and shale, or both; whereas, high resistivity indicates water lower in dissolved solids, or coarser material, such as sand or gravel, or both. Therefore, resistivity data (coupled with lithologic data) can be used as an indicator of water quality—in general, as dissolved-solids concentration increases, resistivity decreases. For example, the presence of high dissolved-solids water in alluvial deposits could result in a low value of apparent resistivity even if the deposits are composed of sand and gravel. The difference between the short and long normal logs is the separation distance between the electrodes in the tool. As the separation distance increases the volume of aquifer material measured by the tool increases. Comparison of short- and long-normal resistivity values can provide an estimate of the extent to which drilling fluid has entered aquifer deposits during drilling, an indication of the permeability of the aquifer deposits.

The EM tool measures the apparent resistivity of a volume of rock under an induced electromagnetic field. EM logs yield information on lithology of a formation and on chemical characteristics of pore water (McNeil and others, 1990). In alluvial aquifers, EM logs can be interpreted in a manner similar to electrical resistivity logs, where high EM conductivity generally indicates water higher in dissolved solid or fine-grained deposits such as silt, clay, and shale, or both, and low EM conductivity indicates water lower in dissolved solids or coarse-grained material such as sand or gravel, or both. EM logs also can be used to identify changes in water quality in the aquifer outside PVC-cased wells. The application of EM logs for this purpose is discussed later in this manuscript.

The sonic tool, also known as the acoustic or acoustic-velocity tool, is used to measure consolidation and porosity of geologic materials. A sonic log was collected at multiple-well site 002N005E01A002M–01A006M. This log is not presented in this report but is on file at the USGS office in San Diego, California.

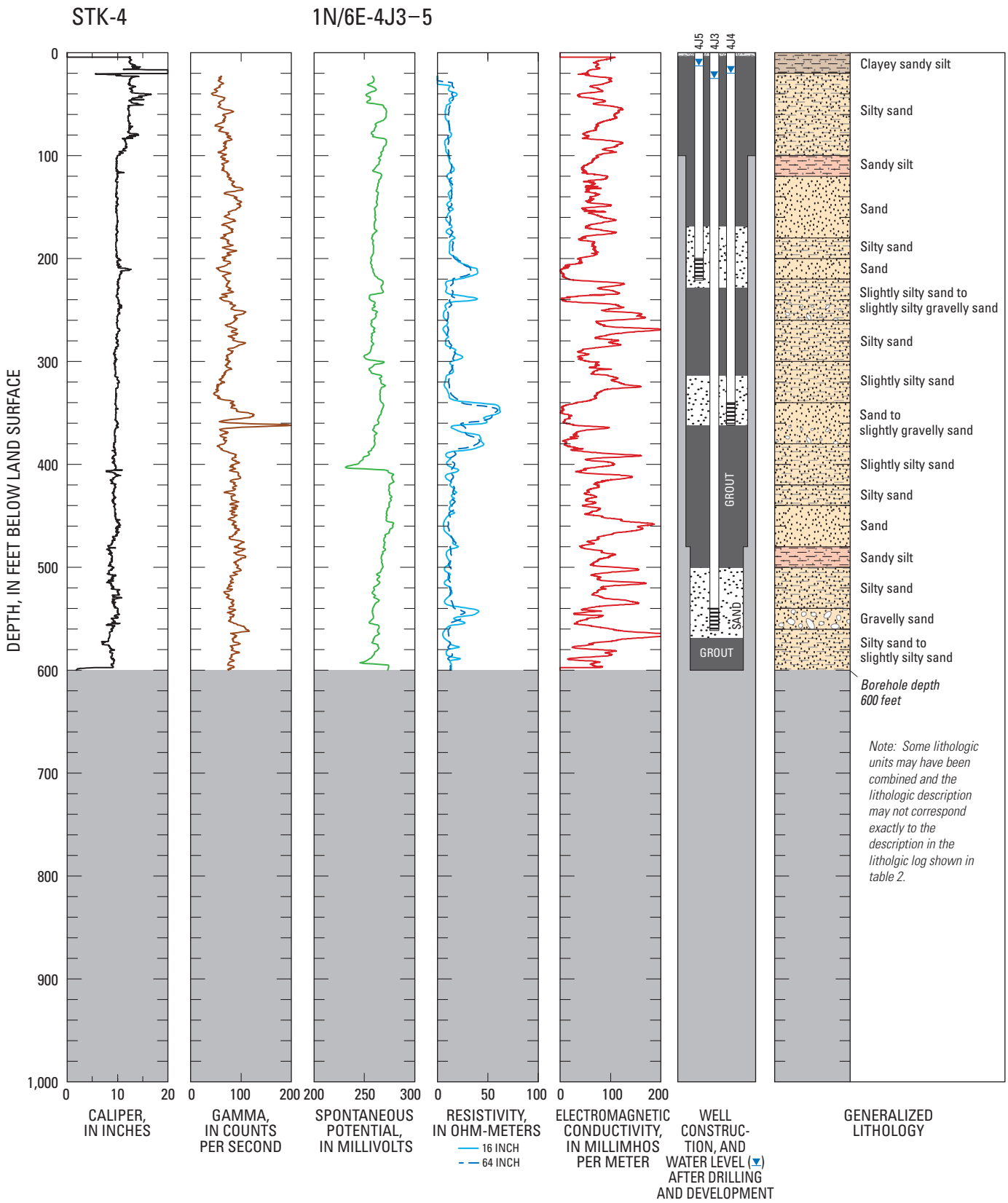


Figure 5. Geophysical logs, lithology, and construction information for multiple-well monitoring site STK–4 (wells 001N006E04J003M, –04J004M, and –04J005M), Eastern San Joaquin Groundwater Subbasin, California.

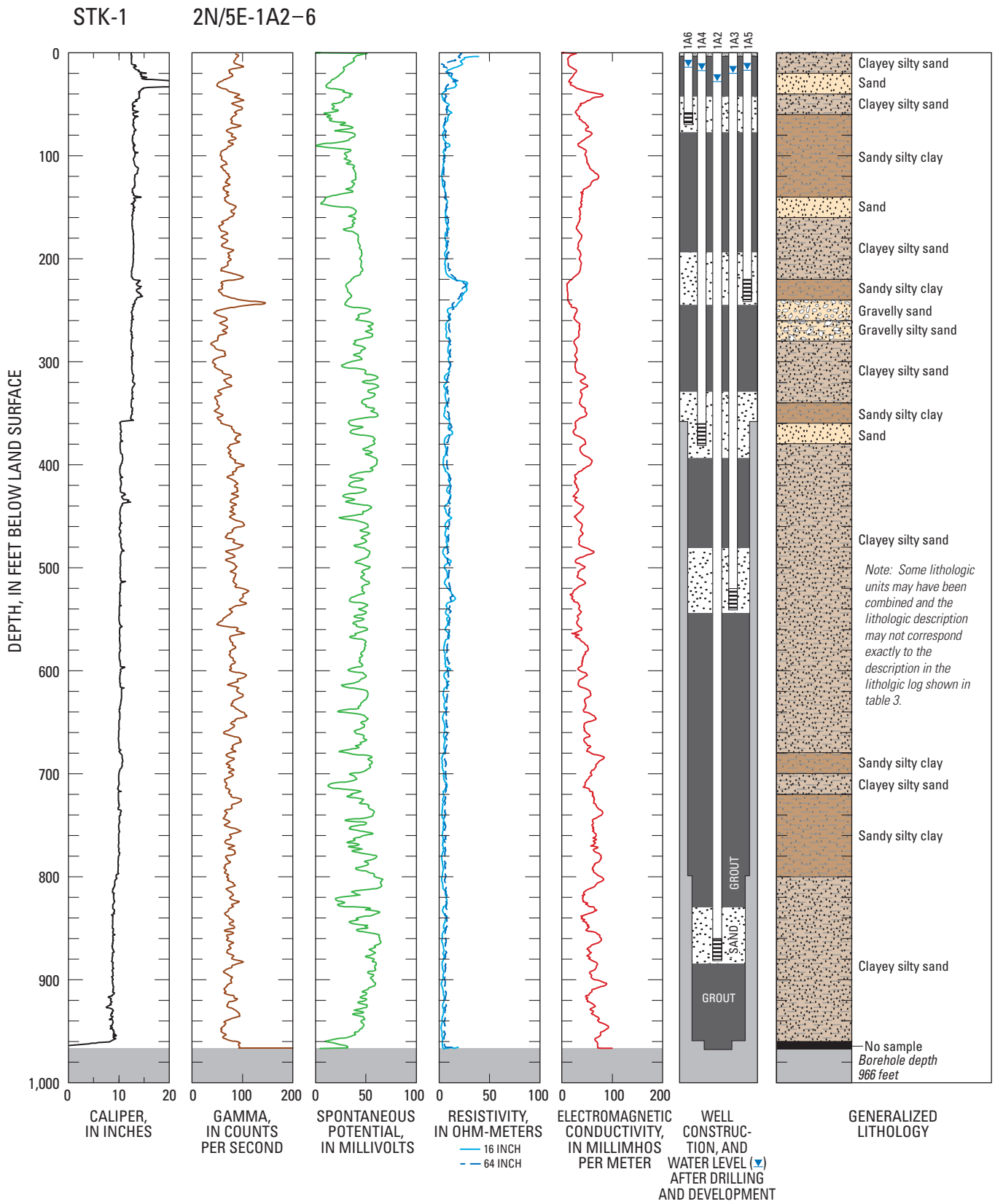


Figure 6. Geophysical logs, lithology, and construction information for multiple-well monitoring site STK–1 (wells 002N005E01A002M, –01A003M, –01A004M, –01A005M, and –01A006M), Eastern San Joaquin Groundwater Subbasin, California.

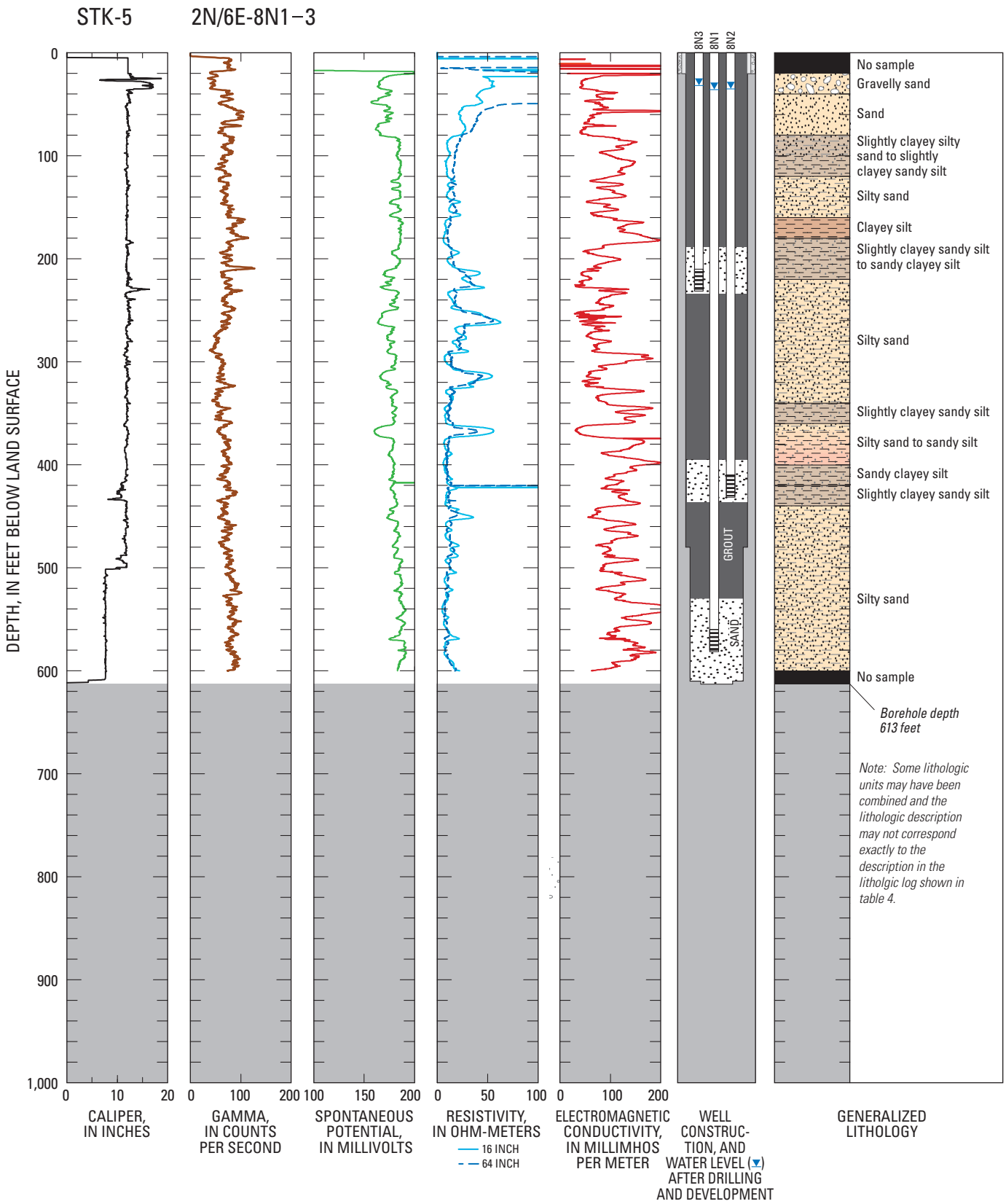


Figure 7. Geophysical logs, lithology, and construction information for multiple-well monitoring site STK–5 (wells 002N006E08N001M, –08N002M, and –08N003M), Eastern San Joaquin Groundwater Subbasin, California.

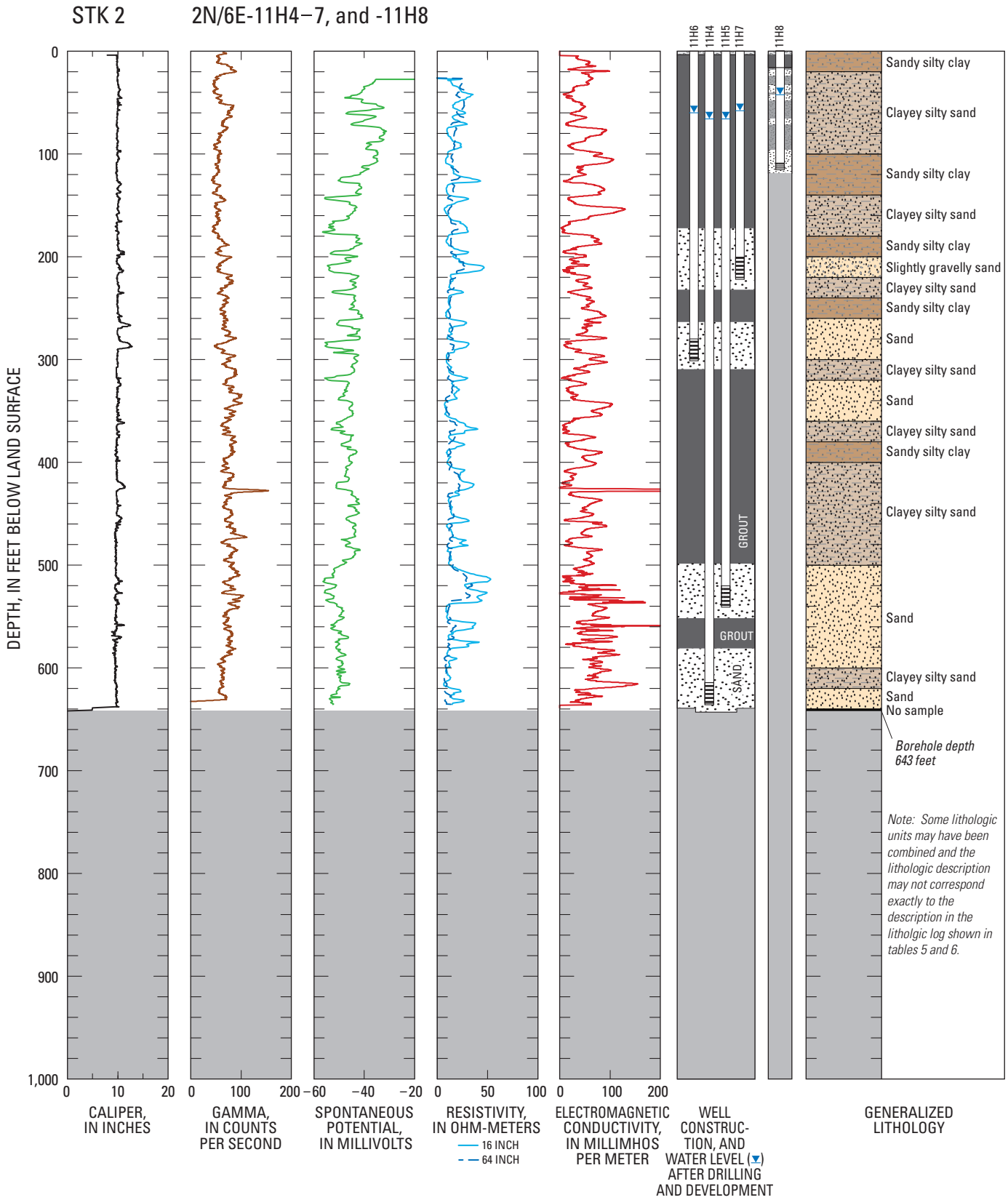


Figure 8. Geophysical logs, lithology, and construction information for multiple-well monitoring site STK–2 (wells 002N006E11H004M, –11H005M, –11H006M, –11H007M and –11H008M), Eastern San Joaquin Groundwater Subbasin, California.

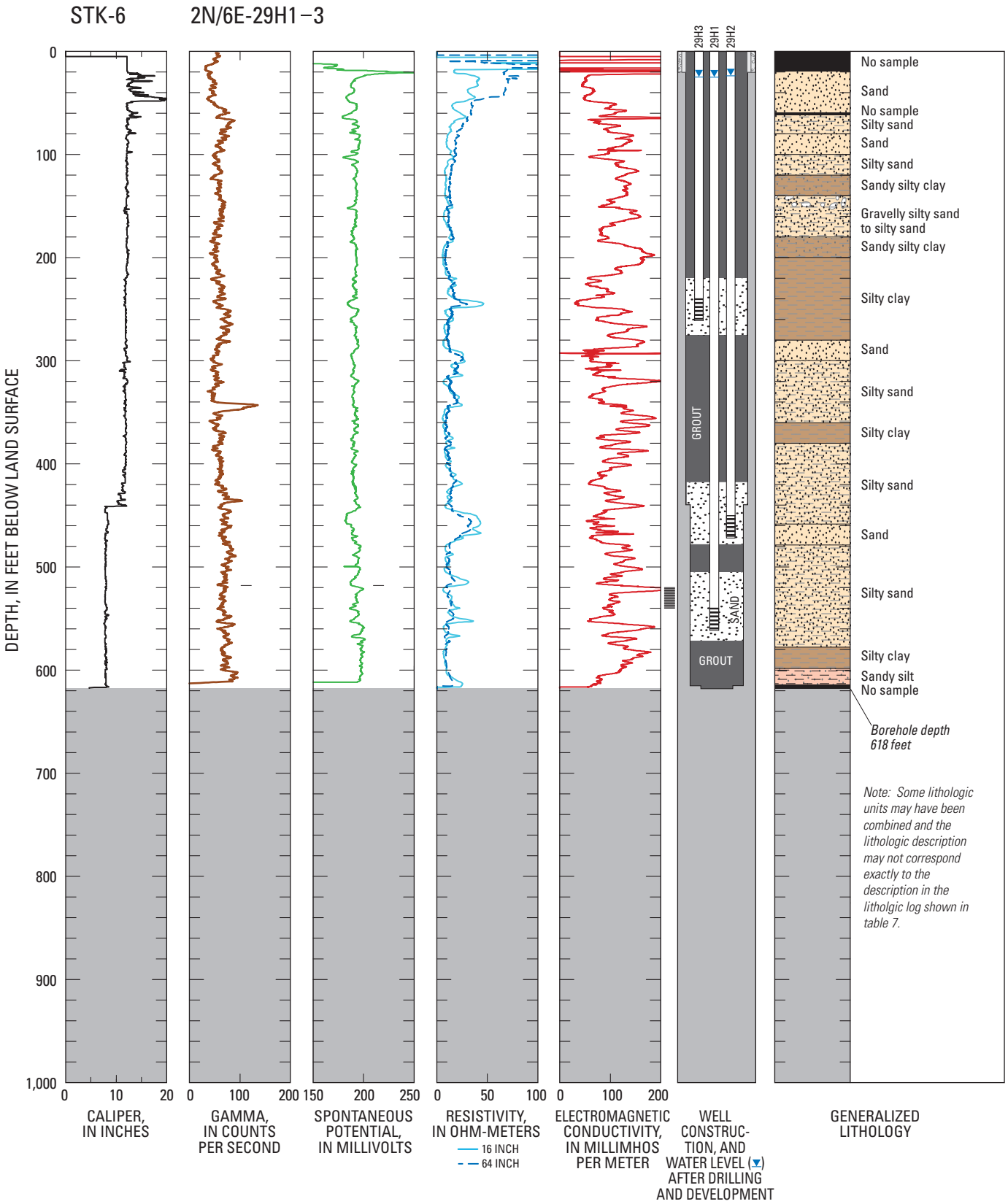


Figure 9. Geophysical logs, lithology, and construction information for multiple-well monitoring site STK–6 (wells 002N006E29H001M, –29H002M, and –29H003M), Eastern San Joaquin Groundwater Subbasin, California.

Well Construction

The design of each multiple-well site was based on field notes, inspection of cuttings in the field and office, and analysis of geophysical logs collected after drilling. Multiple-well sites were constructed by installing several 2-inch diameter PVC wells, one at a time, in a single bore-hole. The length of the screened interval of the wells ranged from 10 to 20 ft and consists of 0.02-inch slots on 0.125-inch spacing. The total open area for this 2-inch diameter well screen is 7.6 square inches per foot. Graded sand (Monterrey Sand #3) was used as the filter pack for well screens at all multiple-well sites. The filter pack was emplaced through a 1-inch diameter tremie pipe. After the filter pack was installed, bentonite grout was pumped into the borehole above the filter pack through a tremie pipe by using a grouter. The process was repeated for each well in the borehole to provide a bentonite seal between wells that prevents water movement vertically through the borehole. Following installation of the uppermost well and filter pack, the borehole was filled with bentonite grout to about 50 ft below land surface, and then the remainder of the borehole was filled with concrete to provide a sanitary seal. Centralizers were used at multiple-well sites 001N006E04J003M–04J005M, 002N006E08N001M–08N003M, and 002N006E29H001M–29H003M to ensure wells were centralized within, the borehole, and to insured that bentonite seal between individual well casings prevented vertical water movement. Wells were constructed in accordance with County of San Joaquin Public Health Department ordinances and guidelines (San Joaquin County Ordinance Code Section 9–1115.6), and all wells were inspected during drilling and at completion by a county inspector. Well-construction data for multiple-well sites installed as part of this study and for other existing multiple-well sites in the study area are provided in table 1. Well-construction diagrams for five multiple-well monitoring sites installed as part of this study are shown in figures 5–9.

After installation, the individual wells were developed by using compressed air to remove the drilling mud from the well and the aquifer surrounding the well (fig. 10). Development continued until water from the well contained no discernible drilling fluid and the specific conductance of the water had stabilized.

Water-Level Data

Groundwater levels from 28 wells at 8 selected multiple-well monitoring sites (figs. 11–18) were monitored continuously using pressure transducers at some period of time between January 2006 and August 2008. The sites included wells drilled as part of this study and as part of previous work by the DWR (2003) and by the City of Stockton. Gaps within the hydrographs indicated time periods when the pressure transducer or datalogger were not functioning (table 8).

The data show seasonal differences in water levels with depth and shorter term differences in water levels with depth in response to pumping from nearby wells. Data from multiple-well sites 001N006E04J003M–04J005M, 002N005E01A002M–01A006M, and 002N006E11H004M–11H008M were transmitted by Geostationary Operational Environmental Satellite (GOES; fig. 19) to the USGS National Water Information System (NWIS) database where they were available for near real-time public access through the USGS National Water Information System Web page (NWISWeb). Data from multiple-well sites 001N006E36C003M–36C005M, 002N006E08N001M–08N003M, 002N006E20E001M–20E003M, 002N006E24P001M–24P003M, and 002N006E29H001M–29H003M were retrieved manually during routine servicing and posted to NWIS after field collection. During routine servicing, water levels were measured to an accuracy of 0.01 ft using a calibrated steel tape or a calibrated electric tape. Measured water levels were used to check instrument accuracy and correct for instrument drift, if necessary, prior to posting of the data on NWIS.

All continuous water-level data and measurements collected during routine site servicing are stored in the U.S. Geological Survey Automated Data Processing System (ADAPS) and may be viewed via NWISWeb.

Photograph by Loren Metzger, U.S. Geological Survey, 2007.

Figure 10. Well development using an air compressor at multiple-well monitoring site 002N006E20E001M, –20E002M, and –20E003M (Swenson Park), Stockton, California, March 27, 2007.

A

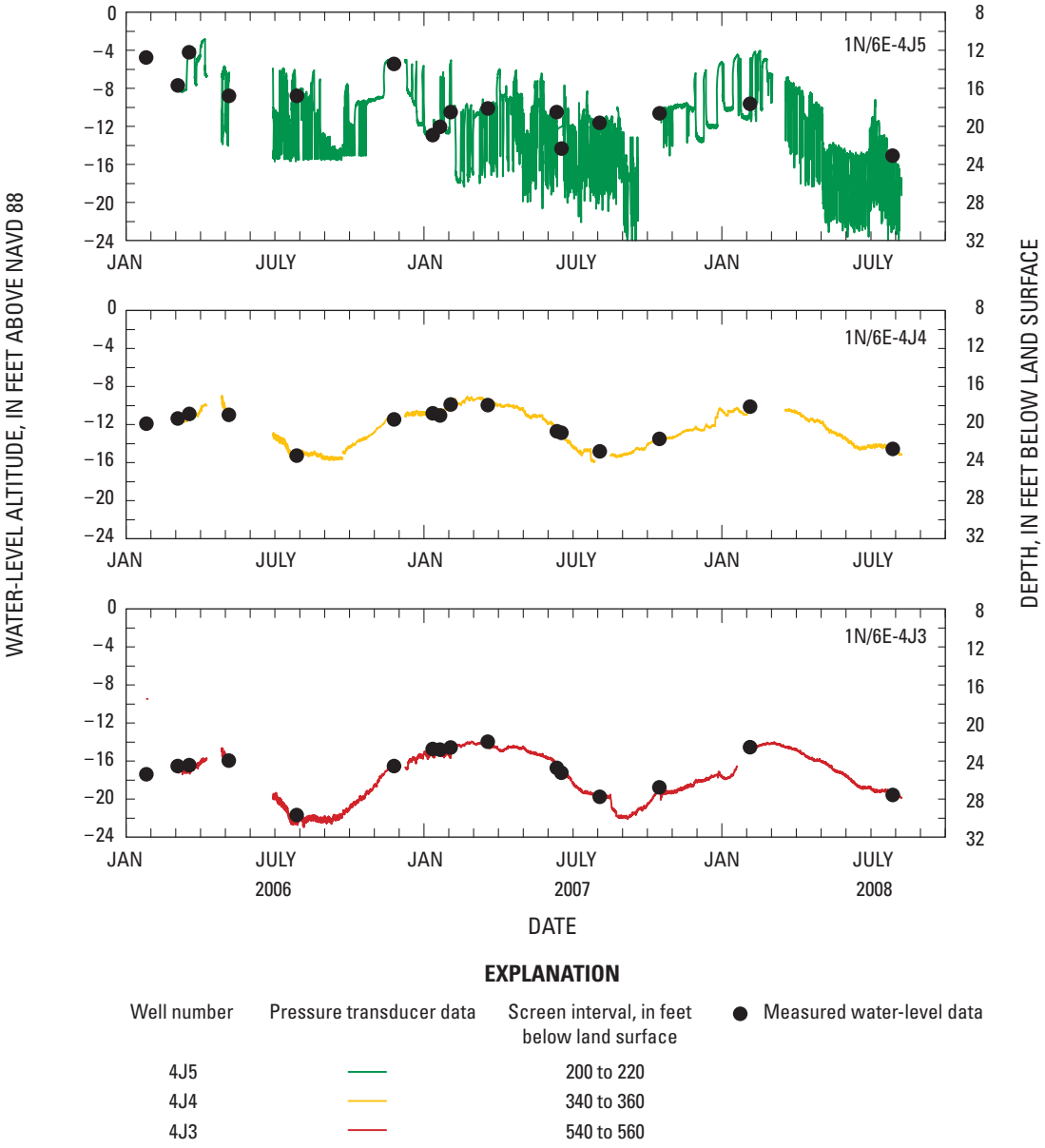


Figure 11. Water levels for multiple-well monitoring site STK–4 (001N006E04J003M, –04J004M, and –04J005M), Eastern San Joaquin Groundwater Subbasin, California, (*A*) individual wells, and (*B*) with depth (grouped on one graph).

B

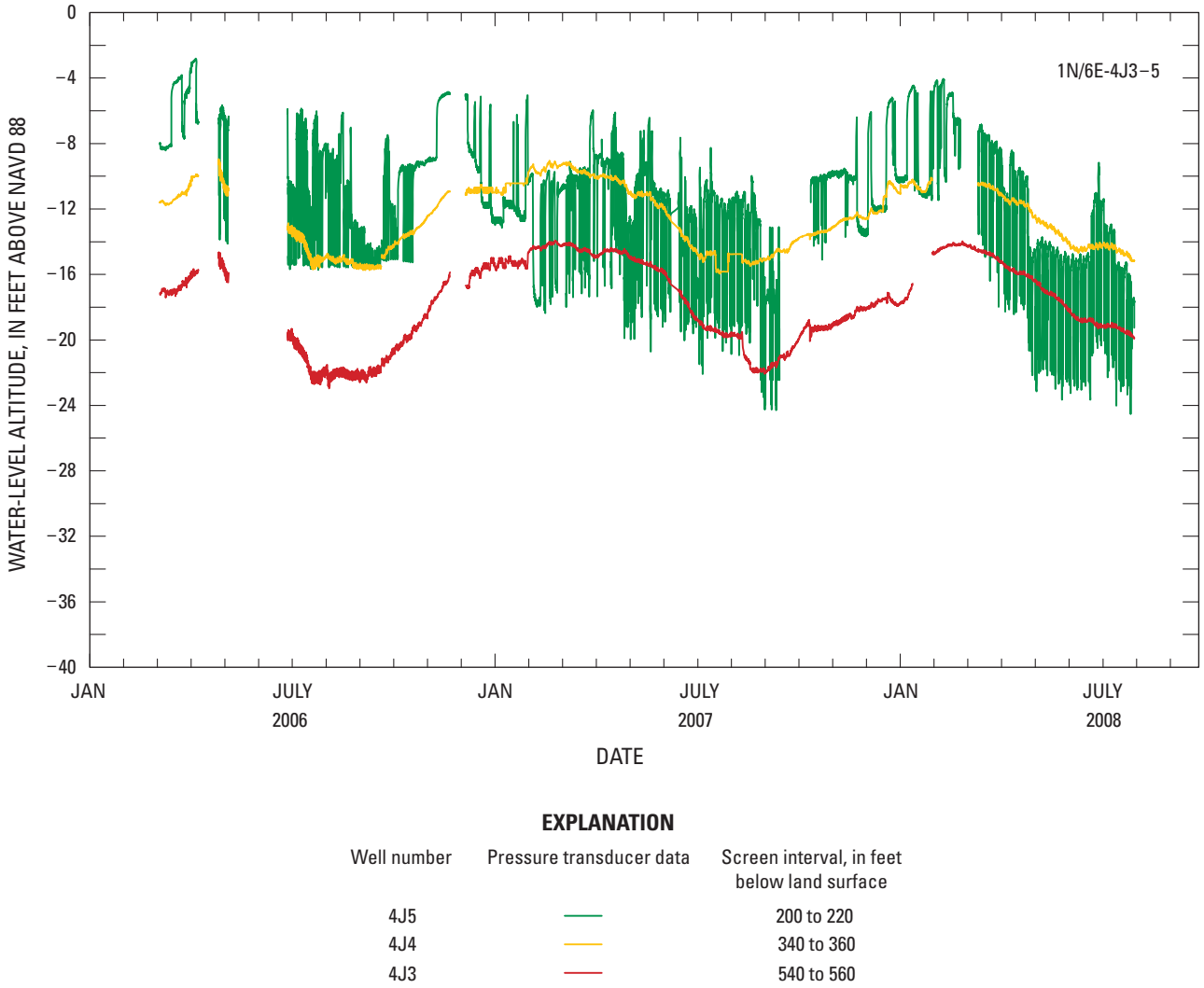


Figure 11.—Continued

A

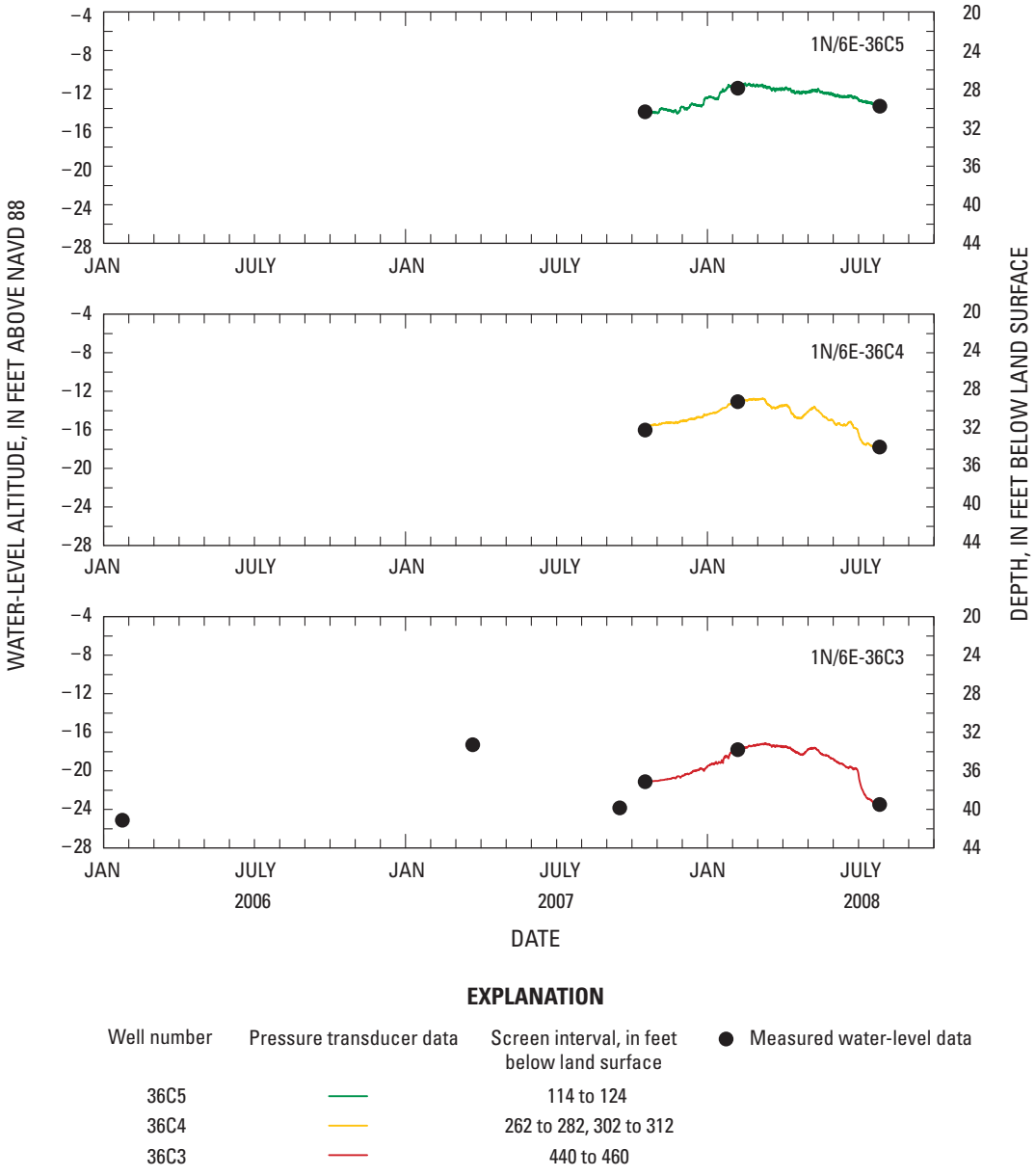
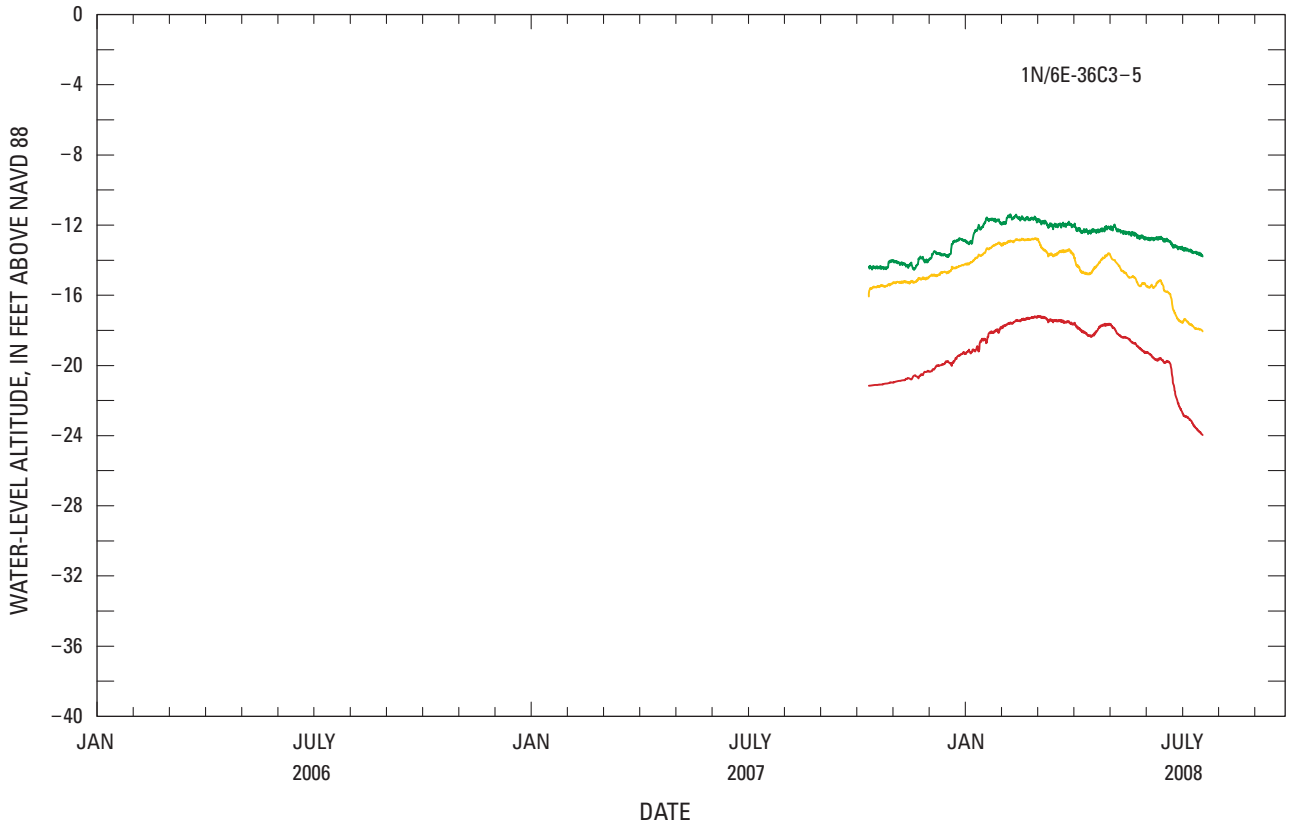


Figure 12. Water-level data for multiple-well monitoring site SPERRY ROAD (001N006E36C003M, –36C004M, and –36C005M), Eastern San Joaquin Groundwater Subbasin, California, (*A*) individual wells, and (*B*) with depth (grouped on one graph).

B



EXPLANATION

Well number	Pressure transducer data	Screen interval, in feet below land surface
36C5		114 to 124
36C4		262 to 282, 302 to 312
36C3		440 to 460

Figure 12.—Continued

A

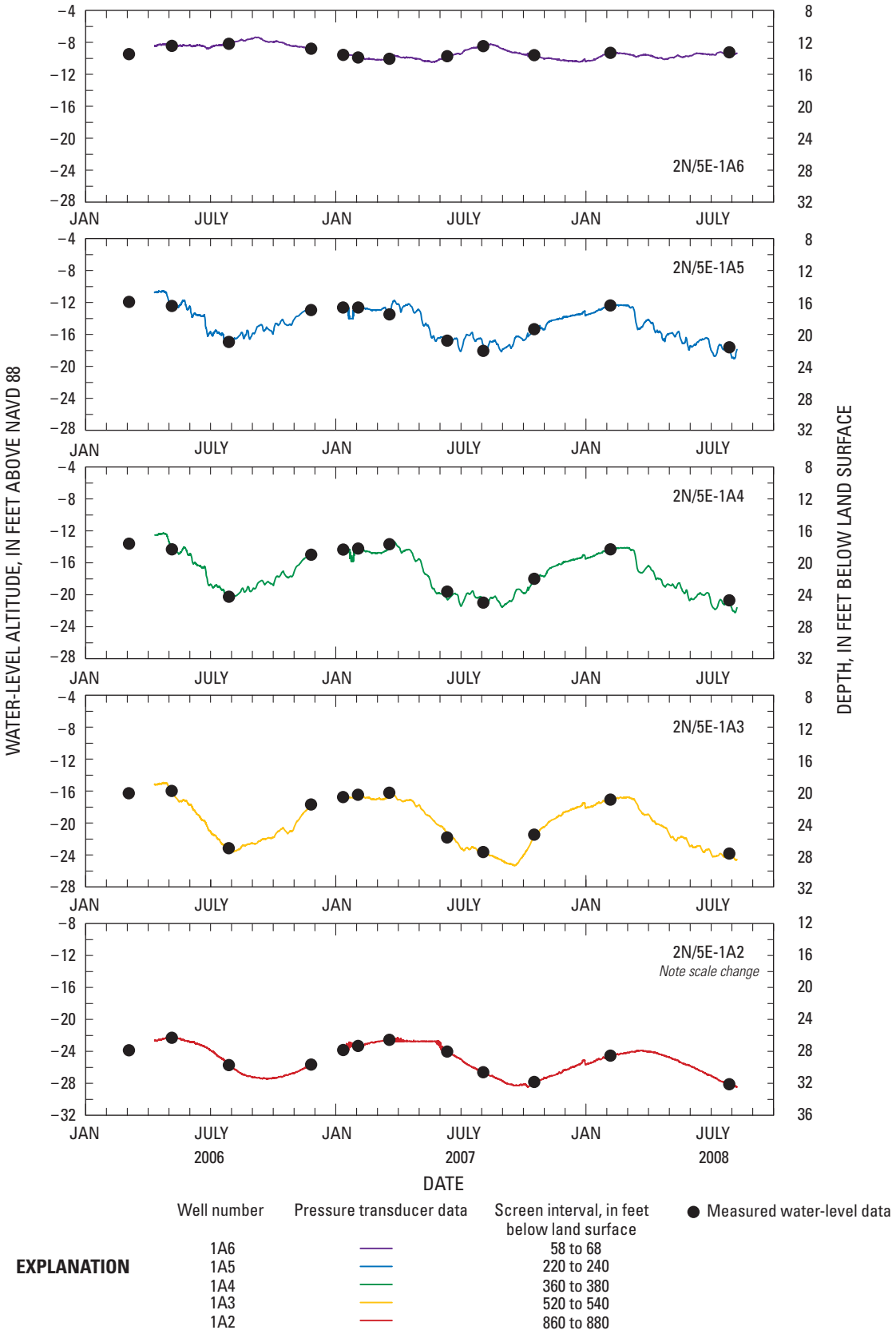
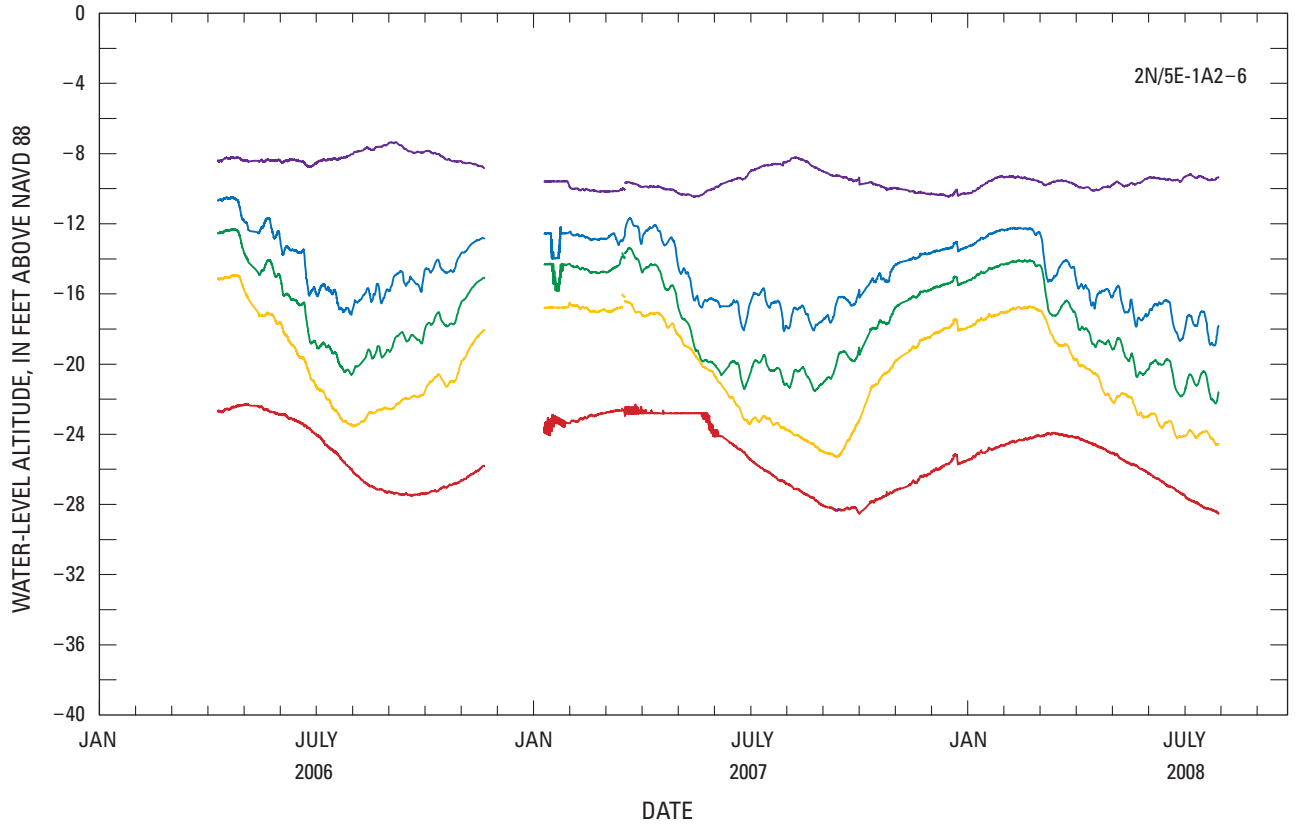


Figure 13. Water levels for multiple-well monitoring site STK–1 (002N005E01A002M, –01A003M, –01A004M, –01A005M, and -–01A006M), Eastern San Joaquin Groundwater Subbasin, California, (*A*) individual wells, and (*B*) with depth (grouped on one graph).

B



EXPLANATION

Well number	Pressure transducer data	Screen interval, in feet below land surface
1A6		58 to 68
1A5		220 to 240
1A4		360 to 380
1A3		520 to 540
1A2		860 to 880

Figure 13.—Continued

A

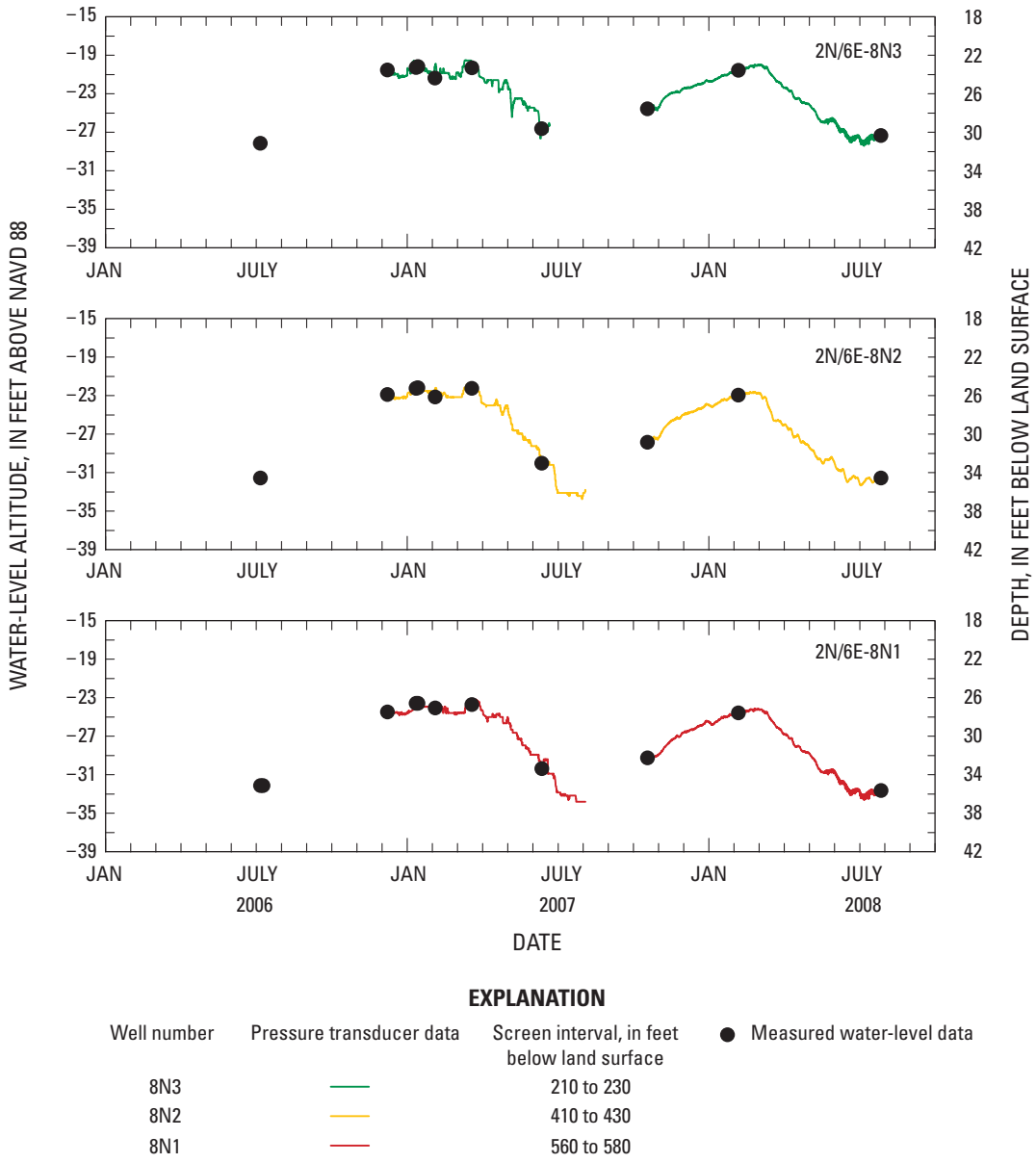
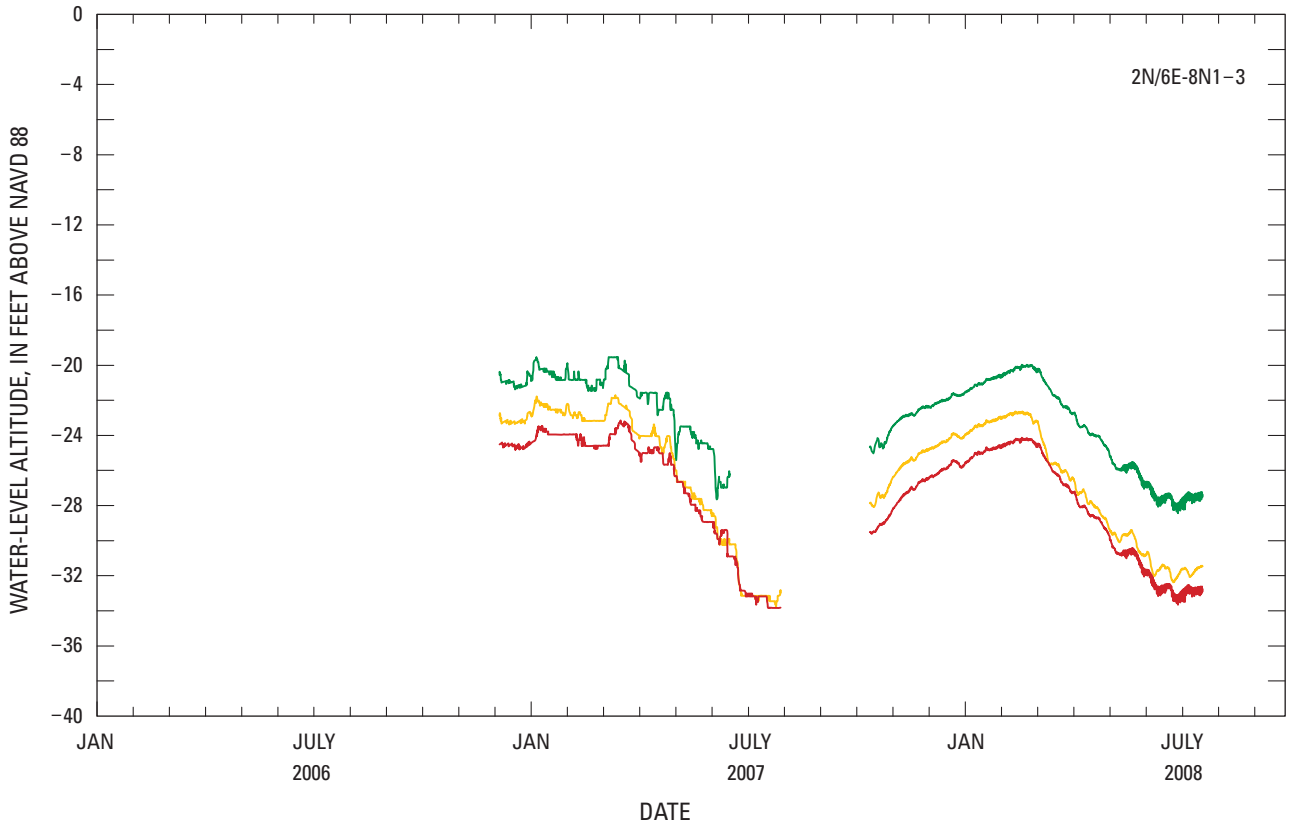


Figure 14. Water levels for multiple-well monitoring site STK–5 (002N006E08N001M, –08N002M, and –08N003M), Eastern San Joaquin Groundwater Subbasin, California, (*A*) individual wells, and (*B*) with depth (grouped on one graph).

B



EXPLANATION

Well number	Pressure transducer data	Screen interval, in feet below land surface
8N3		210 to 230
8N2		410 to 430
8N1		560 to 580

Figure 14.—Continued

A

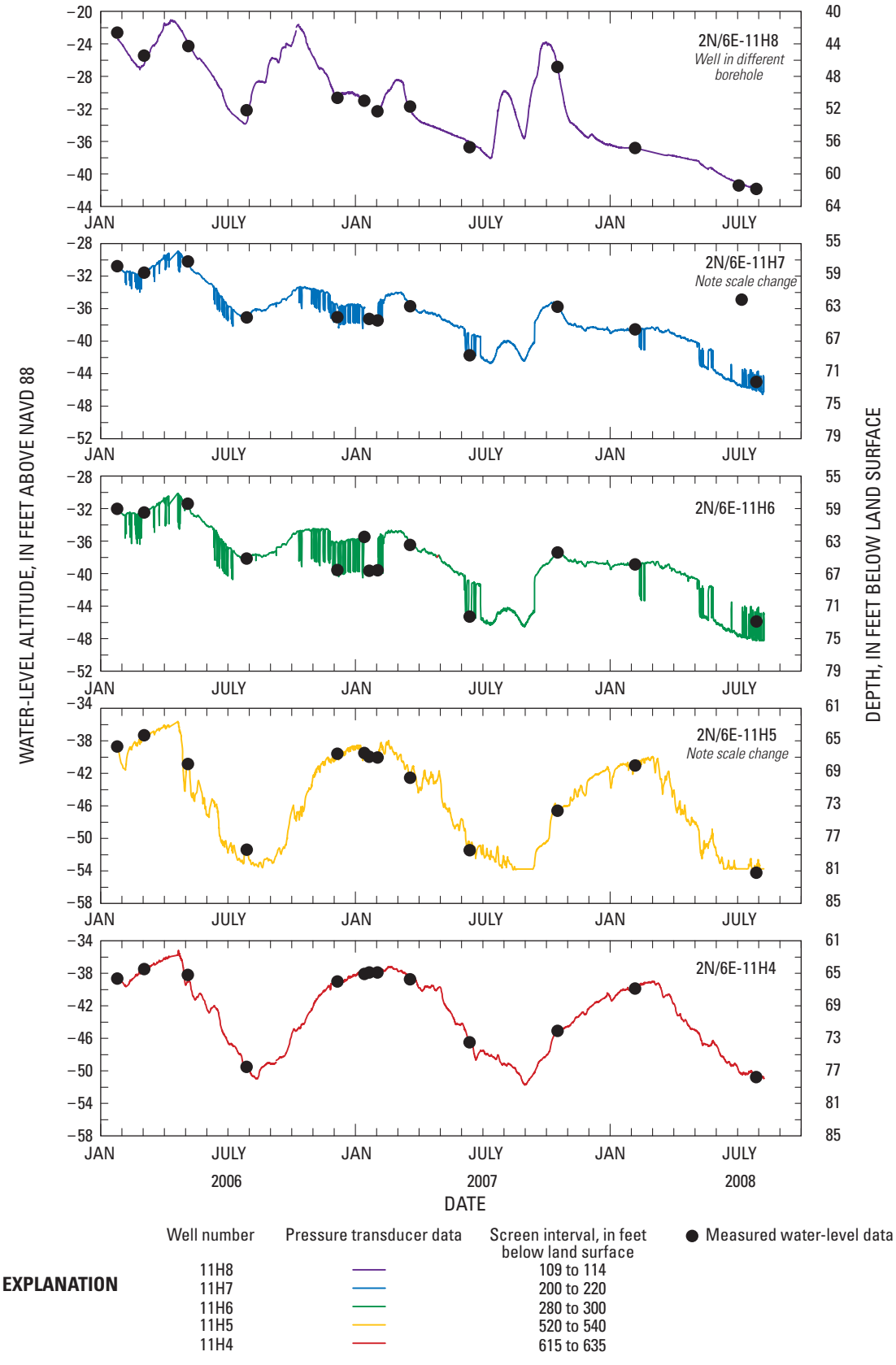
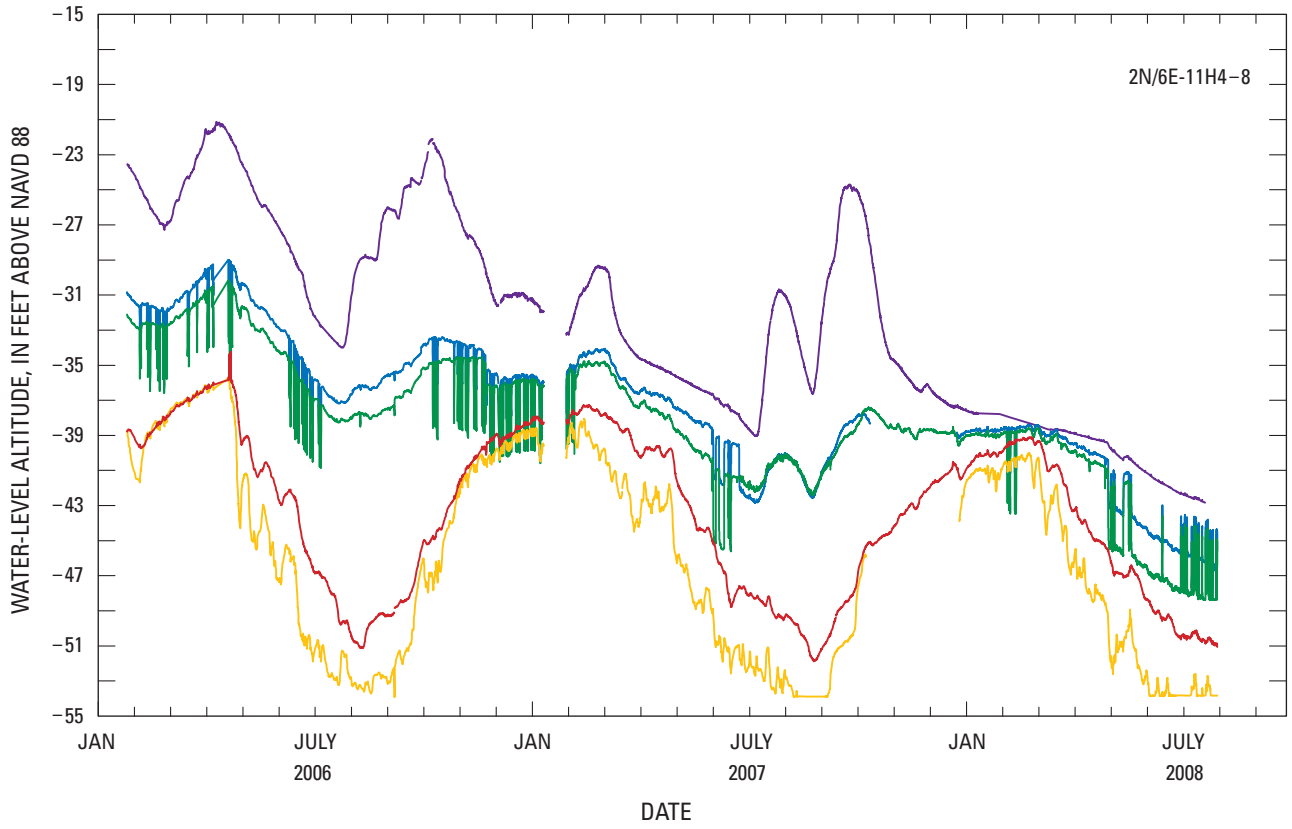


Figure 15. Water levels for multiple-well monitoring site STK–2 and STK–3 (002N006E11H004M, –11H005M, –11H006M, –11H007M and –11H008M), Eastern San Joaquin Groundwater Subbasin, California, (*A*) individual wells, and (*B*) with depth (grouped on one graph).

B



EXPLANATION

Well number	Pressure transducer data	Screen interval, in feet below land surface
11H8		109 to 114
11H7		200 to 220
11H6		280 to 300
11H5		520 to 540
11H4		615 to 635

Figure 15.—Continued

A

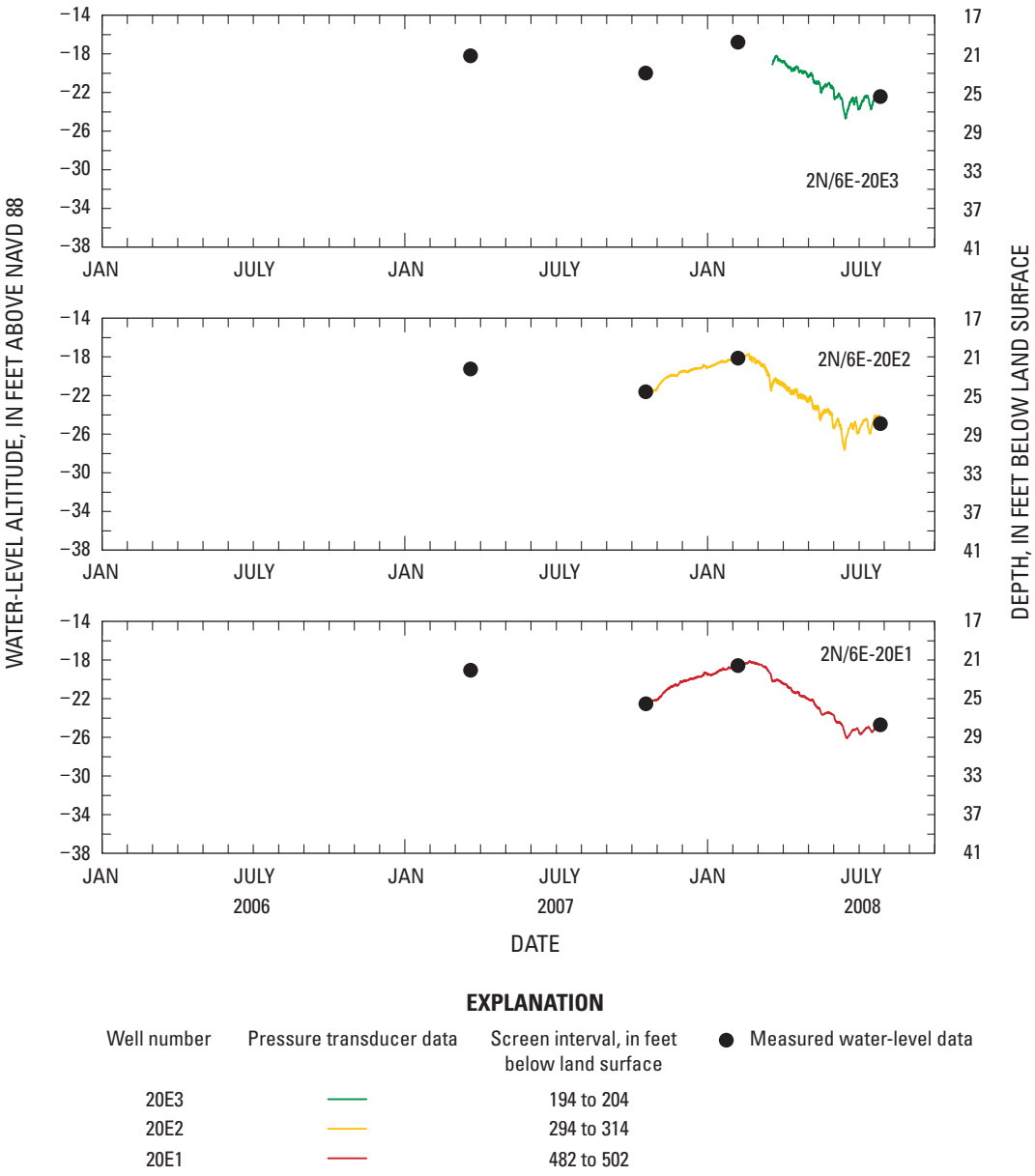
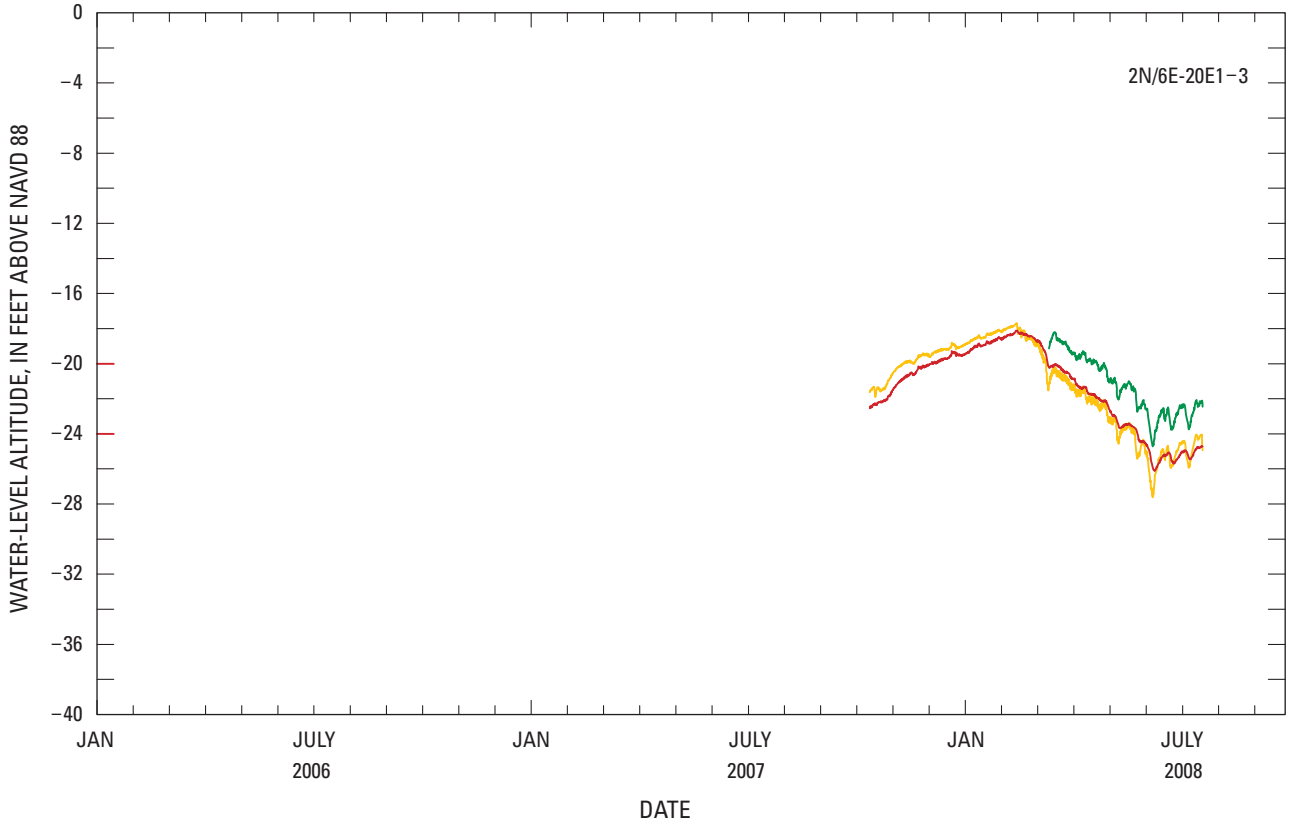


Figure 16. Water levels for multiple-well monitoring site SWENSON PARK (002N006E20E001M, –20E002M, and –20E003M), Eastern San Joaquin Groundwater Subbasin, California, (*A*) individual wells, and (*B*) with depth (grouped on one graph).

B



EXPLANATION

Well number	Pressure transducer data	Screen interval, in feet below land surface
20E3		194 to 204
20E2		294 to 314
20E1		482 to 502

Figure 16.—Continued

A

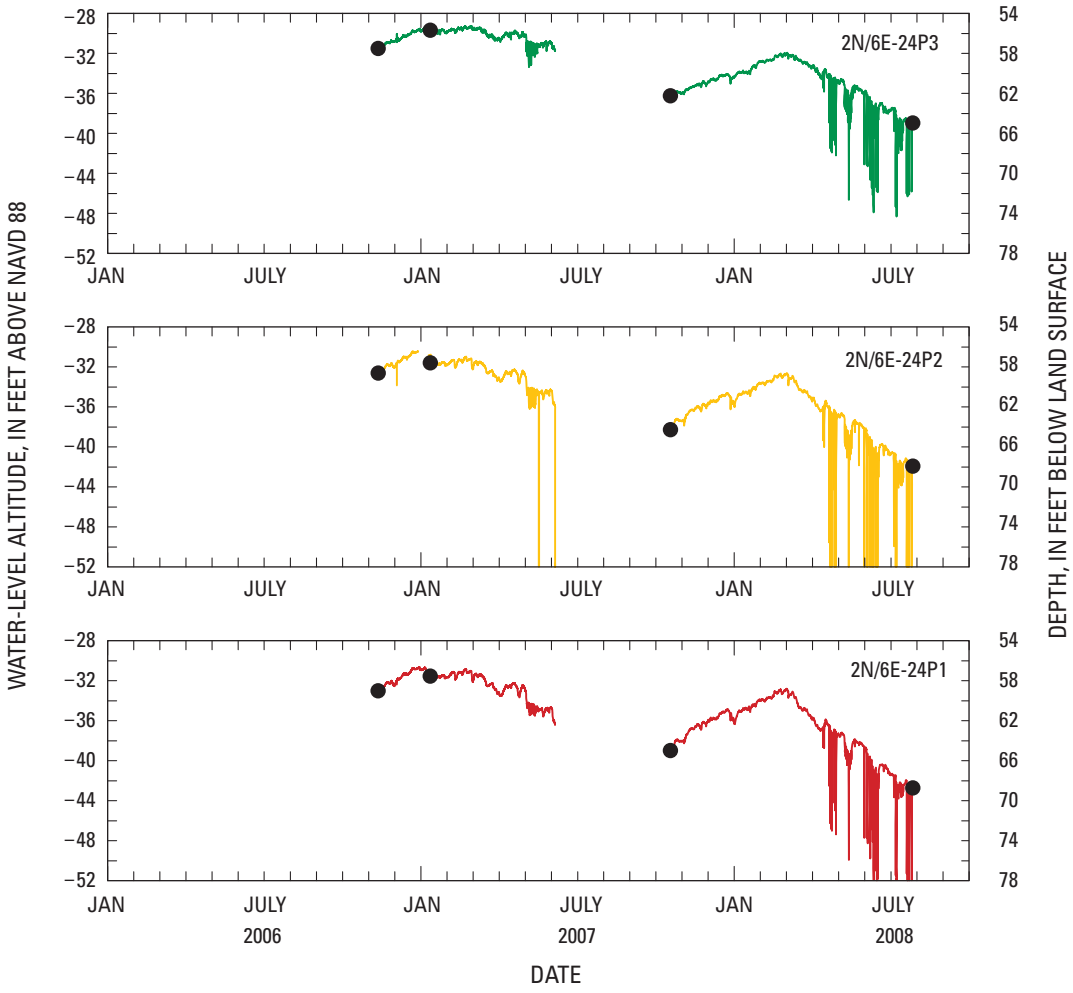
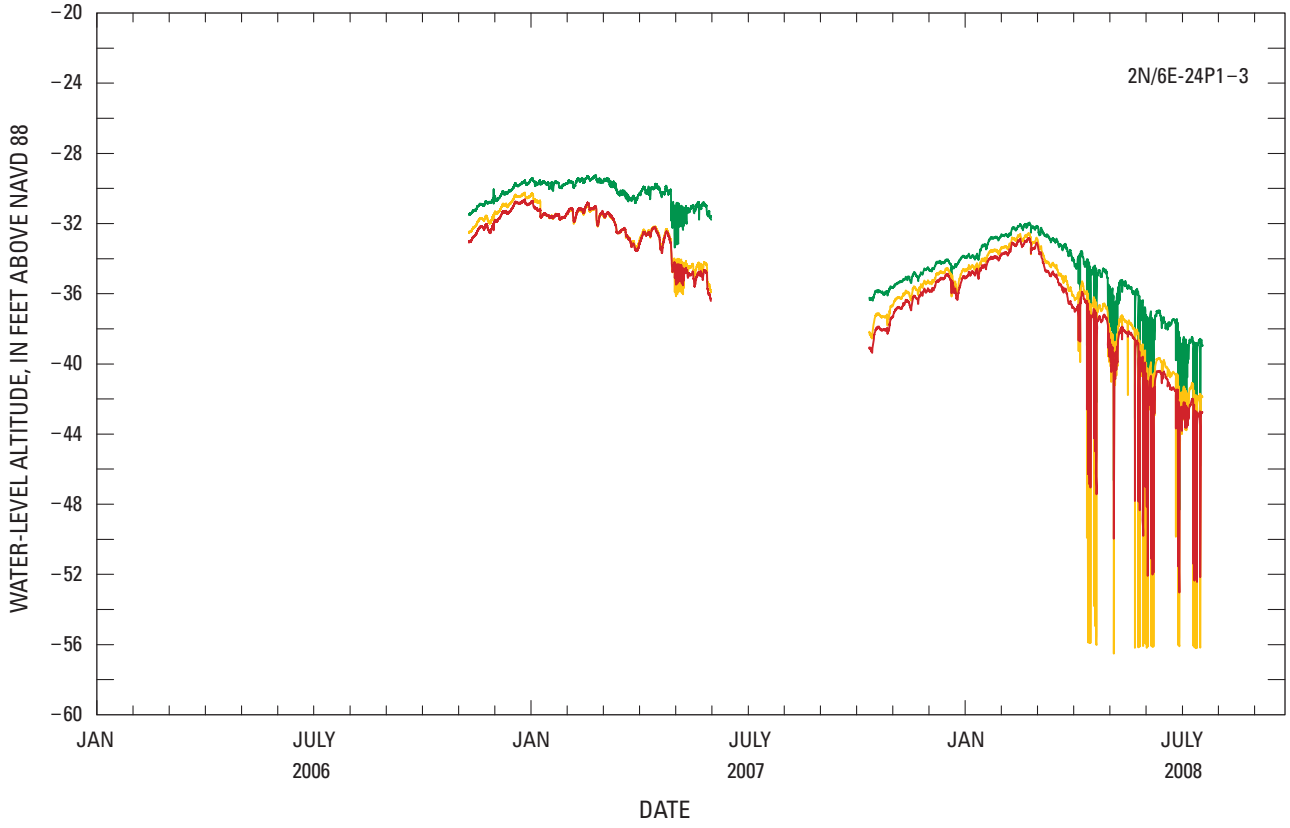


Figure 17. Water levels for multiple-well monitoring site BLOSSOM RANCH (002N006E24P001M, –24P002M, and –24P003M), Eastern San Joaquin Groundwater Subbasin, California, (*A*) individual wells, and (*B*) with depth (grouped on one graph).

B



EXPLANATION

Well number	Pressure transducer data	Screen interval, in feet below land surface
24P3		195 to 215
24P2		400 to 450
24P1		500 to 520

Figure 17.—Continued

A

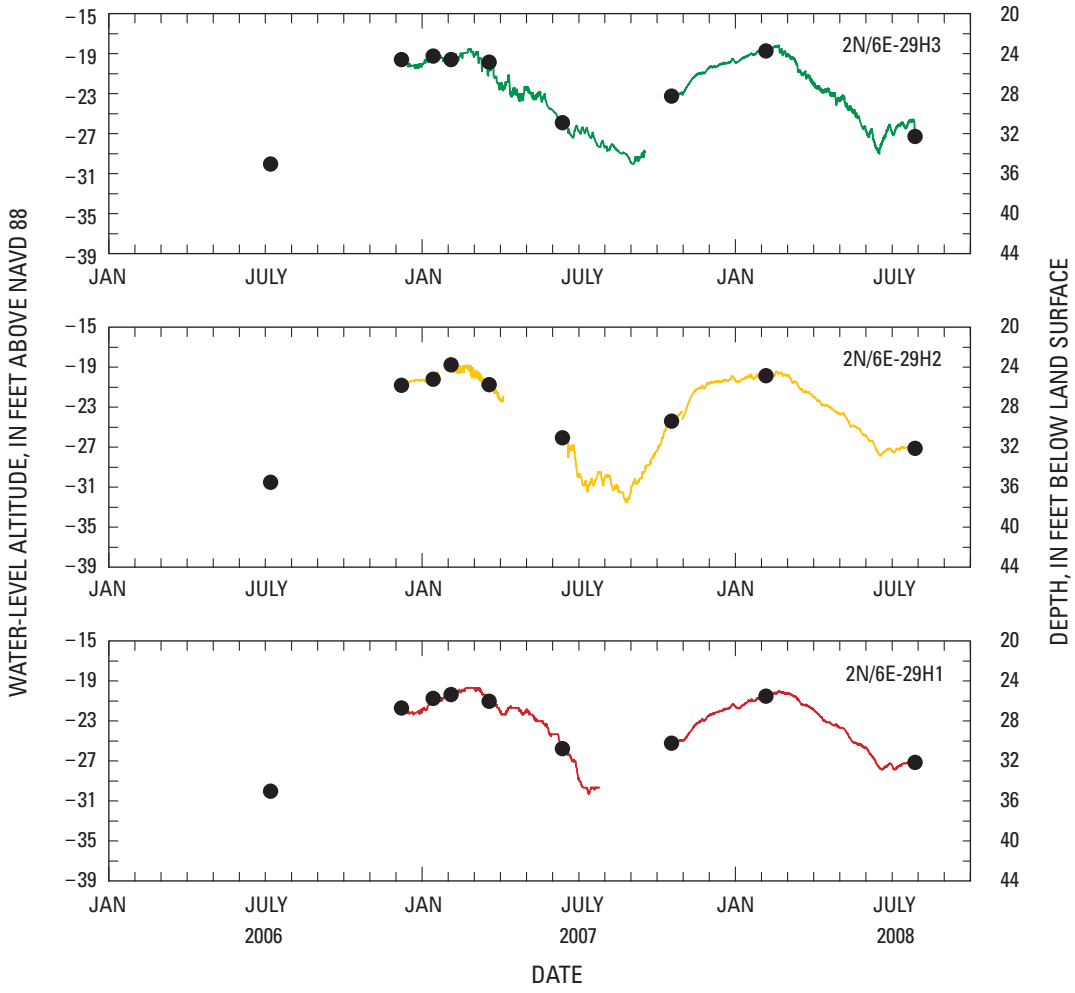
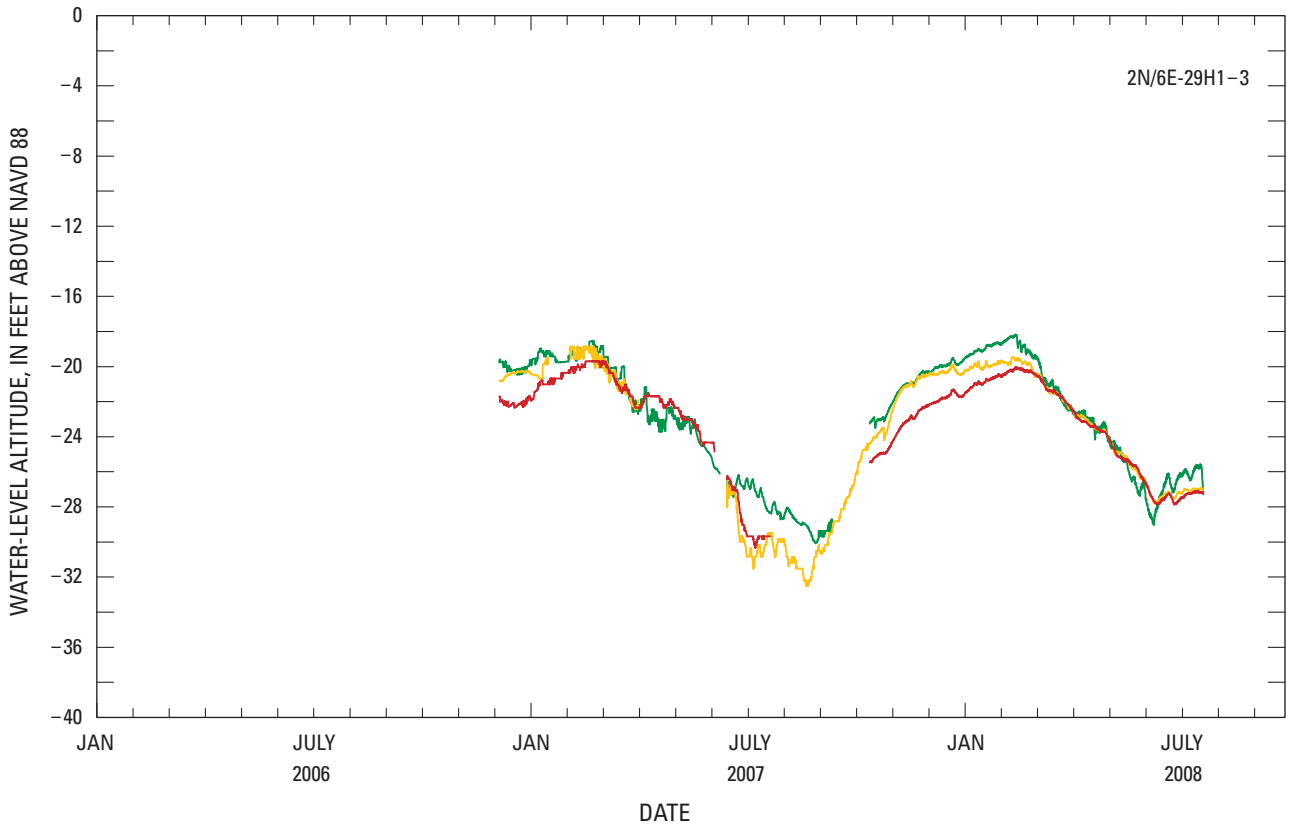


Figure 18. Water levels for multiple-well monitoring site STK–6 (002N006E29H001M, –29H002M, and –29H003M), Eastern San Joaquin Groundwater Subbasin, California, (*A*) individual wells, and (*B*) with depth (grouped on one graph).

B



EXPLANATION

Well number	Pressure transducer data	Screen interval, in feet below land surface
29H3		200 to 220
29H2		340 to 360
29H1		540 to 560

Figure 18.—Continued

Table 8. Transducer recording dates for multiple-well monitoring sites, Eastern San Joaquin Groundwater Subbasin, California.

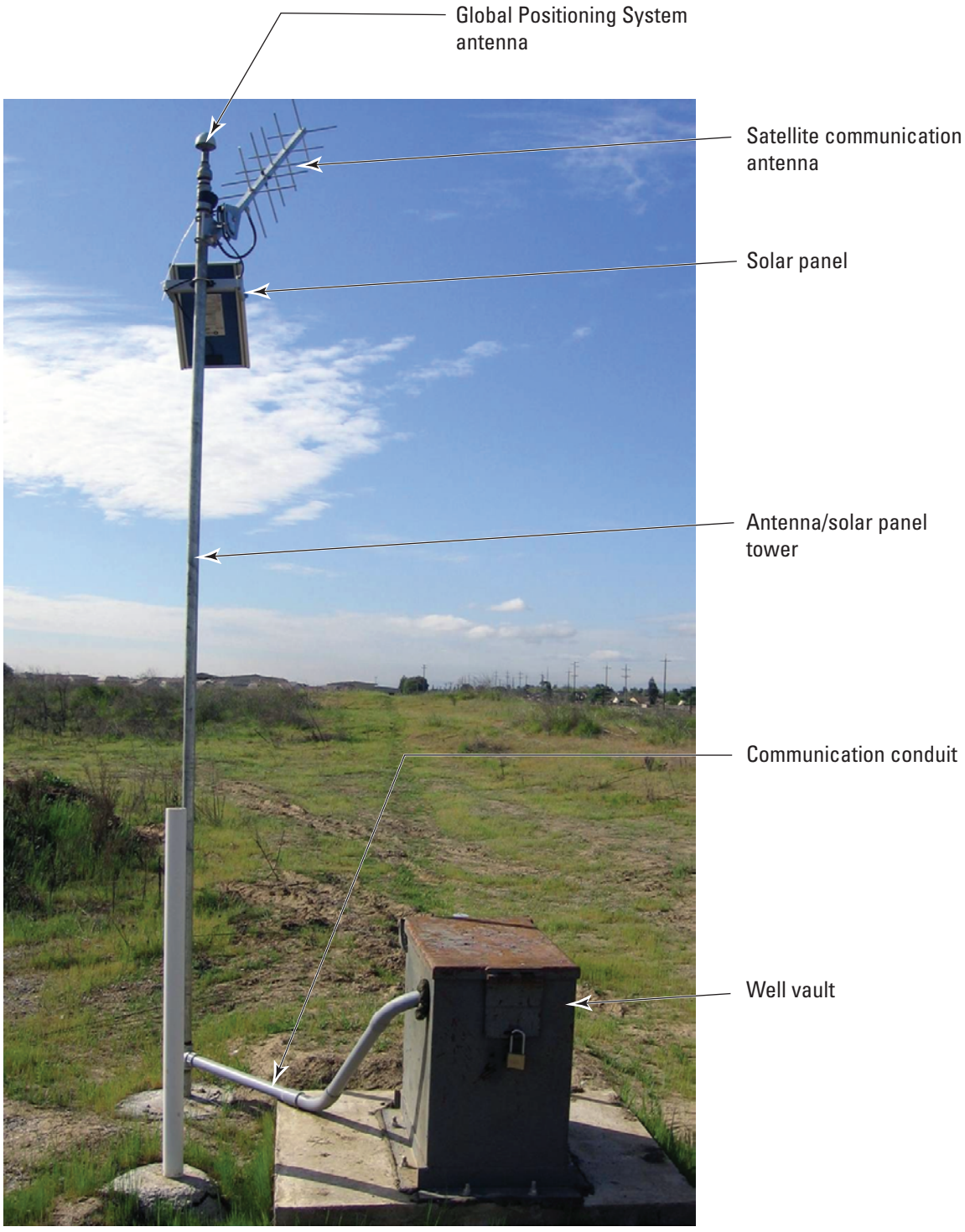
[Site locations are shown in figure 2. Depths are below land surface. State well number, see well-numbering diagram in text. Well names beginning with STK were drilled by the U.S. Geological Survey. **Abbreviations**: ft, feet; mm/dd/yy, month/day/year; USGS ID, U.S. Geological Survey identification number: the unique number for each site in USGS National Water Information System (NWIS) database]

State well number	USGS ID	Well name	Description of well-screen intervals	Transducer recording dates (mm/dd/yy)
001N006E04J003M	375735121184901	STK–4 at 560 ft	540 to 560 ft	01/28/06 to 04/12/06, 05/01/06 to 05/10/06, 07/03/06 to 11/29/06, 12 /13/06 to 01/27/08, 02/14/08 to 08/17/08
001N006E04J004M	375735121184902	STK–4 at 360 ft	340 to 360 ft	01/28/06 to 04/12/06, 05/01/06 to 05/10/06, 07/03/06 to 08/12/07, 08/24/07 to 02/13/08, 03/27/08 to 08/17/08
001N006E04J005M	375735121184903	STK–4 at 220 ft	200 to 220 ft	01/28/06 to 04/12/06, 05/01/06 to 05/10/06, 07/03/06 to 11/29/06, 12/13/06 to 09/27/07, 10/25/07 to 01/27/08, 02/14/08 to 08/17/08
001N006E36C003M	375349121160901	MW1–DEEP	440 to 460 ft	10/25/07 to 08/06/08
001N006E36C004M	375349121160902	MW2–MIDDLE	262 to 282 ft, 302 to 312 ft	10/25/07 to 08/06/08
001N006E36C005M	375349121160903	MW3–SHALLOW	114 to 124 ft	10/25/07 to 08/06/08
002N005E01A002M	380316121221501	STK–1 at 880 ft	860 to 880 ft	04/14/06 to 12/01/06, 01/17/07 to 08/17/08
002N005E01A003M	380316121221502	STK–1 at 540 ft	520 to 540 ft	04/14/06 to 12/01/06, 01/17/07 to 08/17/08
002N005E01A004M	380316121221503	STK–1 at 380 ft	360 to 380 ft	04/14/06 to 12/01/06, 01/17/07 to 08/17/08
002N005E01A005M	380316121221504	STK–1 at 240 ft	220 to 240 ft	04/14/06 to 12/01/06, 01/17/07 to 08/17/08
002N005E01A006M	380316121221505	STK–1 at 68 ft	58 to 68 ft	04/14/06 to 12/01/06, 01/17/07 to 08/17/08
002N006E08N001M	380147121205001	STK–5 at 580 ft	560 to 580 ft	12/13/06 to 08/11/07, 10/26/07 to 08/06/08

Table 8. Transducer recording dates for multiple-well monitoring sites, Eastern San Joaquin Groundwater Subbasin, California.—Continued

[Site locations are shown in figure 2. Depths are below land surface. State well number, see well-numbering diagram in text. Well names beginning with STK were drilled by the U.S. Geological Survey. **Abbreviations**: ft, feet; mm/dd/yy, month/day/year; USGS ID, U.S. Geological Survey identification number: the unique number for each site in USGS National Water Information System (NWIS) database]

State well number	USGS ID	Well name	Description of well-screen intervals	Transducer recording dates (mm/dd/yy)
002N006E08N002M	380147121205002	STK–5 at 430 ft	410 to 430 ft	12/13/06 to 08/11/07, 10/26/07 to 08/06/08
002N006E08N003M	380147121205003	STK–5 at 230 ft	210 to 230 ft	12/13/06 to 08/11/07, 10/26/07 to 08/06/08
002N006E11H004M	380209121164101	STK–2 at 635 ft	615 to 635 ft	01/27/06 to 01/19/07, 02/07/07 to 08/07/08
002N006E11H005M	380209121164102	STK–2 at 540 ft	520 to 540 ft	01/27/06 to 01/19/07, 02/07/07 to 08/07/08
002N006E11H006M	380209121164103	STK–2 at 300 ft	280 to 300 ft	01/27/06 to 01/19/07, 02/07/07 to 08/07/08
002N006E11H007M	380209121164104	STK–2 at 220 ft	200 to 220 ft	01/27/06 to 01/19/07, 02/07/07 to 08/07/08
002N006E11H008M	380207121164101	STK–3 at 114 ft	109 to 114 ft	01/27/06 to 01/19/07, 02/07/07 to 08/07/08
002N006E20E001M	380026121204401	MW1–DEEP	482 to 502 ft	10/26/07 to 08/06/08
002N006E20E002M	380026121204402	MW2–MIDDLE	294 to 314 ft	10/26/07 to 08/06/08
002N006E20E003M	380026121204403	MW3–SHALLOW	194 to 204 ft	03/28/08 to 08/16/08
002N006E24P001M	380004121160601	MW1–DEEP	500 to 520 ft	11/17/06 to 06/12/07, 10/26/07 to 08/06/08
002N006E24P002M	380004121160602	MW2–MIDDLE	400 to 450 ft	11/17/06 to 06/13/07, 10/26/07 to 08/06/08
002N006E24P003M	380004121160603	MW3–SHALLOW	195 to 215 ft	11/17/06 to 06/12/07, 10/26/07 to 08/06/08
002N006E29H001M	375944121200501	STK–6 at 560 ft	540 to 560 ft	12/13/06 to 08/02/07, 10/26/07 to 08/07/08
002N006E29H002M	375944121200502	STK–6 at 470 ft	450 to 470 ft	12/13/06 to 01/24/07, 02/11/07 to04/11/07, 06/20/07 to 08/07/07
002N006E29H003M	375944121200503	STK–6 at 260 ft	240 to 260 ft	12/13/06 to 09/24/07, 10/26/07 to 08/07/08



Photograph by David O'Leary, U.S. Geological Survey, 2007.

Figure 19. Data collection and transmission platform located at multiple-well monitoring site 002N006E11H004M, –11H005M, –11H006M, and –11H007M (STK–2), near Morada Lane, Stockton, California, March 26, 2007.

Geophysical Log Data from Wells

EM logs were collected from selected PVC-cased monitoring wells to estimate changes in groundwater chemistry at intervals not screened by monitoring wells. Fluid-velocity logs (including fluid temperature and fluid-resistivity logs) were collected from existing public-supply wells under both unpumped and pumped conditions. Fluid-velocity logs collected from wells under pumped conditions were coupled with depth-dependent water-chemistry data collected from discrete depths within the well. Coupled fluid-velocity log data and depth-dependent water-chemistry data were used to evaluate differences in water chemistry with depth.

Electromagnetic (EM) Logs

Only a limited number of wells screened over selected intervals can be installed at multiple-well monitoring sites. As a consequence, changes in water quality are not measured directly through much of the aquifer thickness. To address this issue, the deepest well at multiple-well sites was used as an access tube for repeated measurement of electromagnetic resistivity through the entire aquifer thickness penetrated by the well. EM logs collected through the PVC casings of monitoring wells are sensitive to lithology and to the resistivity of the pore fluids within the deposits of the formation (McNeil and others, 1990). Because the lithology remains constant with time, repeated EM logs differ only if the fluid resistivity changes as a result of the movement of water of differing quality at depth (Williams and others, 1993). The volume of aquifer material measured by the EM logging tool is a donut-shaped torus having an inner diameter of about 10 inches and an outer diameter of about 50 inches. As a result, the tool is relatively insensitive to borehole fill material adjacent to the well (McNeil and others, 1990). These properties make repeated EM resistivity logs from the same well collected over periods of time suitable for identifying changes in water quality, particularly changes in salinity, at depth intervals from which groundwater samples cannot be collected directly.

The range of conductivity that can be measured using the EM logging tool is 5–3000 millimhos per meter (mmho/m) with an accuracy of plus or minus 5 percent at 30 mmho/m (Century Geophysical Corp., 2008). Electromagnetic induction measurements may be affected by borehole size, washouts, and metallic minerals or well construction components such as centralizers (Century Geophysical Corp., 2008). Metal centralizers installed at approximately 29- to 59-ft intervals during construction of wells 001N006E36C003M and 002N006E20E001M created signal interference over approximately 15 percent of the depth of each well, including the bottom 29 and 20 ft, respectively. Data from these intervals were omitted prior to data processing and analysis of the EM logs.

To ensure comparability between logs collected at different times, calibration was checked at each site prior to logging by using a 2-point calibration technique. When this technique was used, the tool was suspended upside down in air, and EM resistivity values were measured using free air as the zero value and a calibration-ring sleeve, placed over the bottom end of the inverted tool, having a conductivity of 705 mmho/m. Adjustment to the tool calibration was required if the measured resistivity values exceeded 10 percent of the expected values (Century Geophysical Corp., 2008). At sites where signal interference from nearby cultural artifacts such as overhead power lines, metal fences, and underground utilities made calibration difficult, existing calibration settings from previous logs were retained.

Wells were logged at a speed of about 30 feet per minute (ft/min) in the upward direction so as to maintain tension on the draw-works cable and to reduce signal noise. The deepest well at each of the multiple-well sites was logged four to five times during the course of the study (table 9). At multiple-well site 002N006E08N001M–08N003M, an obstruction in well 002N006E08N001M necessitated the use of the second deepest well at the site (002N006E08N002M) for logs collected in May and September 2007. EM logs collected from PVC-cased wells as part of this study are archived in the USGS internal database, Logarchiver, and are available in electronic form upon request. EM logs collected from fluid-filled boreholes after completion of drilling but prior to installation of the wells were not comparable to logs collected within PVC-cased wells.

Duplicate logs collected over multiple years were collected at 001N006E04J003M in 2006 and in wells 001N006E36C003M, 002N006E08N001M, 002N006E08N002M, 002N006E20E001M, and 002N006E29H001M in 2007 to verify the repeatability of measurements (table 9). The R-squared value and coefficient of variation ranged from 0.993 to 0.997 and from 2.32 to 4.46, respectively.

Table 9. Well-construction data and dates of electromagnetic induction logging for selected multiple-well sites, Stockton, California.

[Site locations are shown in figure 2. Depths are below land surface. State well number., see well-numbering diagram in text. **Abbreviations**: ft, feet; mm/dd/yyyy, month/day/year; USGS ID, U.S. Geological Survey identification number: the unique number for each site in USGS National Water Information System (NWIS) database; –, none]

State well number	USGS ID	Descriptive name	Date drilled (mm/dd/yyyy)	Depth cased (ft)	Screened interval depths (ft)	Available electromagnetic induction data (mm/dd/yyyy)
001N006E04J003M	375735121184901	STK–4 at 560 ft	09/16/2005	560	540–560	09/13/2005, 01/26/2006, 03/30/2007, 09/24/2007
001N006E04J004M	375735121184902	STK–4 at 360 ft	–	360	340–360	–
001N006E04J005M	375735121184903	STK–4 at 220 ft	–	220	200–220	–
001N006E36C003M	375349121160901	MW1–DEEP	05/10/2002	465	440–460	05/06/2002, 07/15/2004, 01/26/2006, 03/29/2007, 09/24/2007
001N006E36C004M	375349121160902	MW2–MIDDLE	05/15/2002	317	262–282, 302–312	–
001N006E36C005M	375349121160903	MW3–SHALLOW	05/16/2002	129	114–124	–
002N005E01A002M	380316121221501	STK–1 at 880 ft	05/06/2005	880	860–880	05/03/2005, 01/24/2006, 04/10/2007, 09/25/2007
002N005E01A003M	380316121221502	STK–1 at 540 ft	–	540	520–540	–
002N005E01A004M	380316121221503	STK–1 at 380 ft	–	380	360–380	–
002N005E01A005M	380316121221504	STK–1 at 240 ft	–	240	220–240	–
002N005E01A006M	380316121221505	STK–1 at 68 ft	–	68	58–68	–
002N006E08N001M	380147121205001	STK–5 at 580 ft	05/16/2006	580	560–580	05/13/2006, 07/13/2006, 04/11/2007,
002N006E08N002M	380147121205002	STK–5 at 430 ft	–	430	410–430	05/24/2007, 09/26/2007
002N006E08N003M	380147121205003	STK–5 at 230 ft	–	230	210–230	–
002N006E11H004M	380209121164101	STK–2 at 635 ft	05/16/2005	635	615–635	05/13/2005, 01/23/2006, 4/10/2007/, 09/26/2007
002N006E11H005M	380209121164102	STK–2 at 540 ft	–	540	520–540	–
002N006E11H006M	380209121164103	STK–2 at 300 ft	–	300	280–300	–
002N006E11H007M	380209121164104	STK–2 at 220 ft	–	220	200–220	–
002N006E20E001M	380026121204401	MW1–DEEP	05/23/2002	507	482–502	05/20/2002, 07/15/2004, 01/24/2006, 03/28/2007, 09/25/2007
002N006E20E002M	380026121204402	MW2–MIDDLE	05/29/2002	319	294–314	–
002N006E20E003M	380026121204403	MW3–SHALLOW	05/29/2002	209	194–204	–
002N006E29H001M	375944121200501	STK–6 at 560 ft	05/26/2006	560	540–560	05/22/2006, 06/20/2006, 04/11/2007, 09/26/2007
002N006E29H002M	375944121200502	STK–6 at 470 ft	–	470	450–470	–
002N006E29H003M	375944121200503	STK–6 at 260 ft	–	260	240–260	–

Pumped and Unpumped Fluid-Velocity Logs

Twenty-three fluid-velocity logs were collected from 14 existing production wells (fig. 20) by using different techniques depending on access to the well. These techniques included (1) commercially available impeller or vertical-axis velocity meters (also known as a spinner tool; Hill, 1990), (2) electromagnetic (EM) velocity meters (Paillet, 2000), or (3) the tracer-pulse method for wells having limited access (Izbicki and others, 1999). Figure 21 shows a typical field setup for collection of a fluid-velocity log using an EM velocity meter. After collection of the fluid-velocity log, depth-dependent water-chemistry data were collected from selected wells under pumping conditions by using a small-diameter (less than 1 inch) gas-displacement pump (Izbicki, 2004). These data are discussed later in this report in the section titled "Depth-dependent sample collection." Wellbore flow and selected depth-dependent water-quality data was collected while individual wells were pumped and are shown in figures 22–33. Data for unpumped conditions are shown in figures 34–44. On these figures negative flow values represent downward flow within the well and positive values represent upward flow.

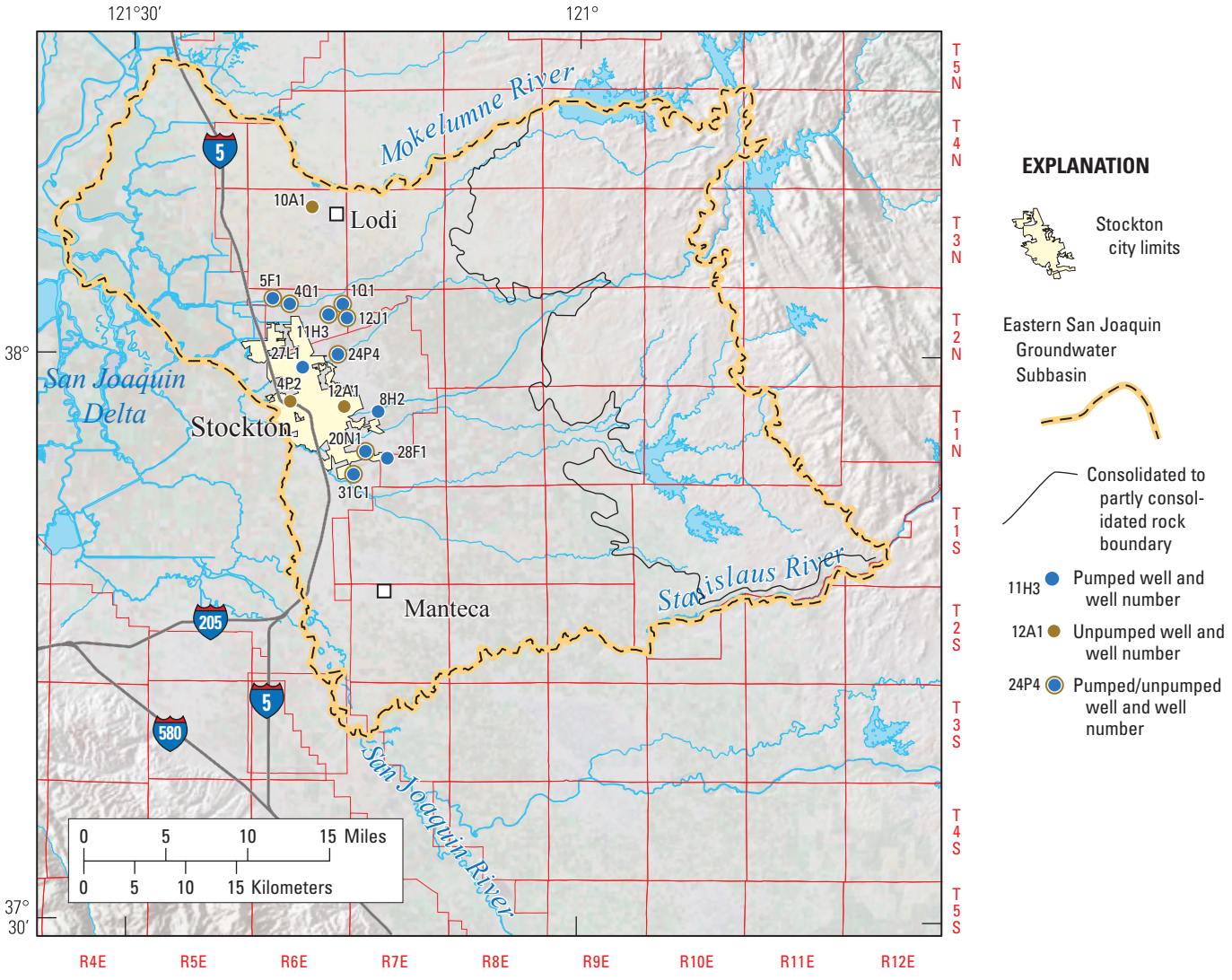
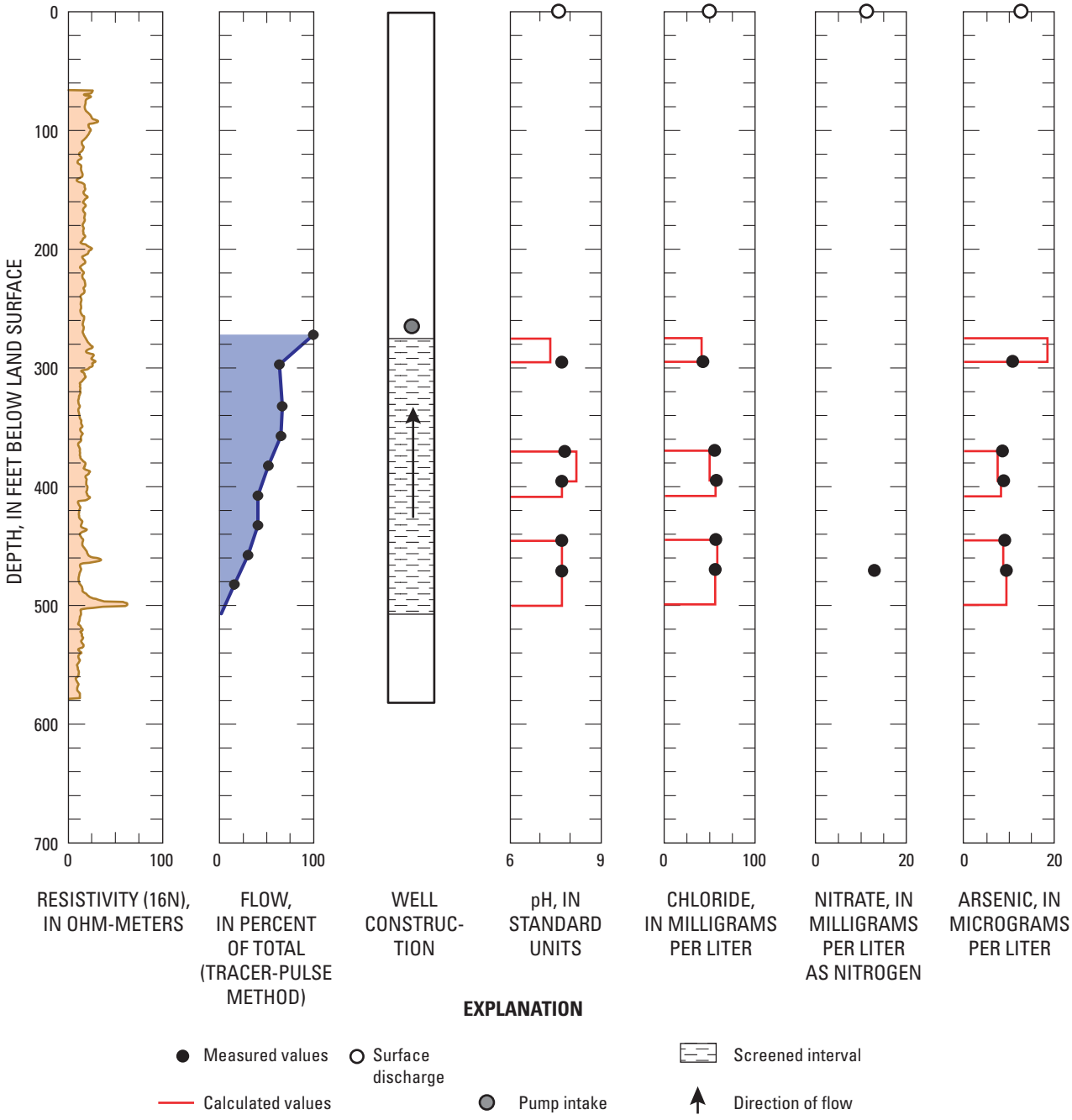


Figure 20. Locations of study area and well sampling sites for depth-dependent water chemistry coupled with pumped and unpumped fluid-velocity logs, Eastern San Joaquin Groundwater Subbasin, California.

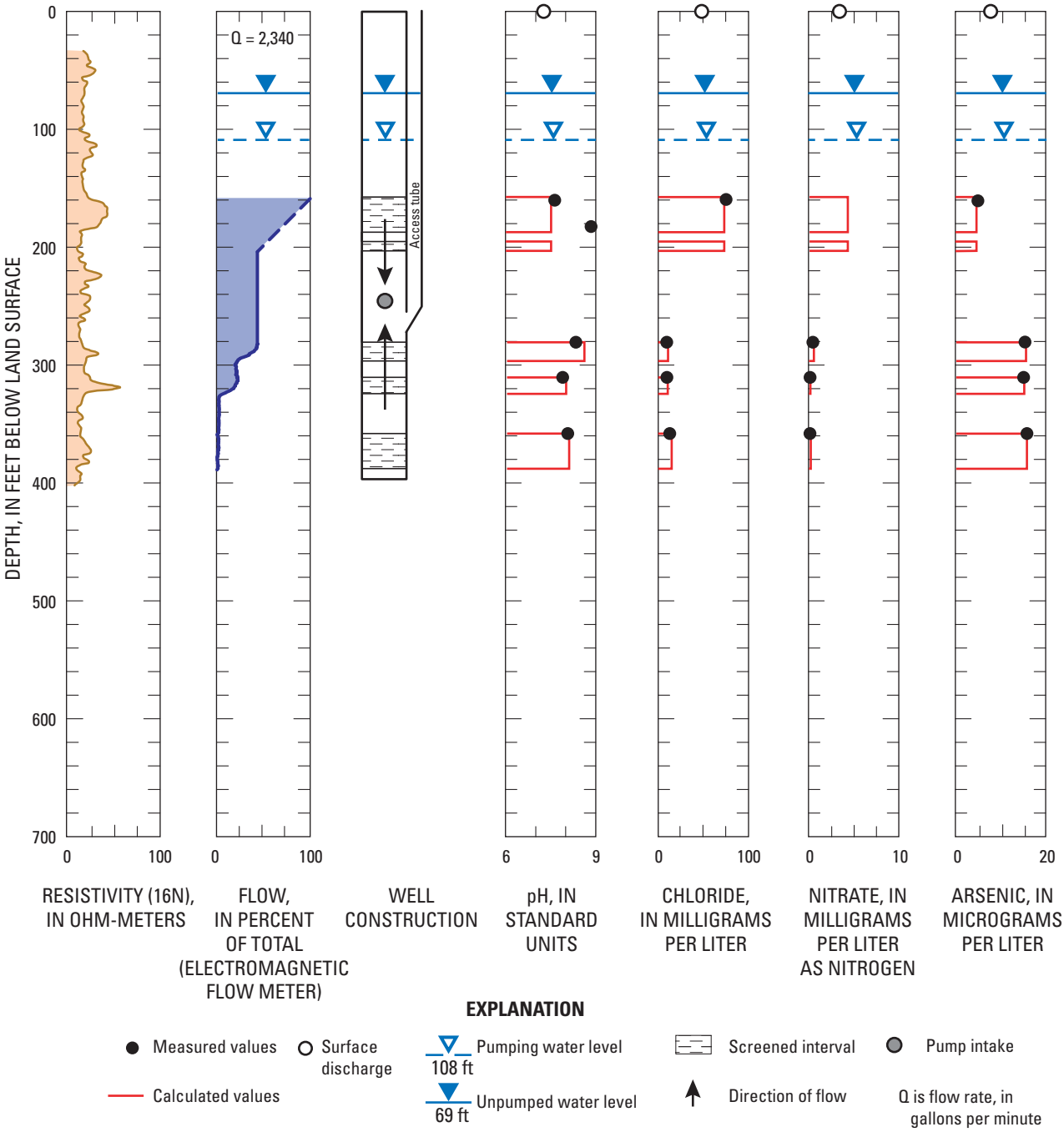
Photograph by Loren Metzger, U.S. Geological Survey, 2008.

Figure 21. Electromagnetic flowmeter logging, City of Stockton well 001N007E31C001M (SSS–5), Stockton, California, March 20, 2008.



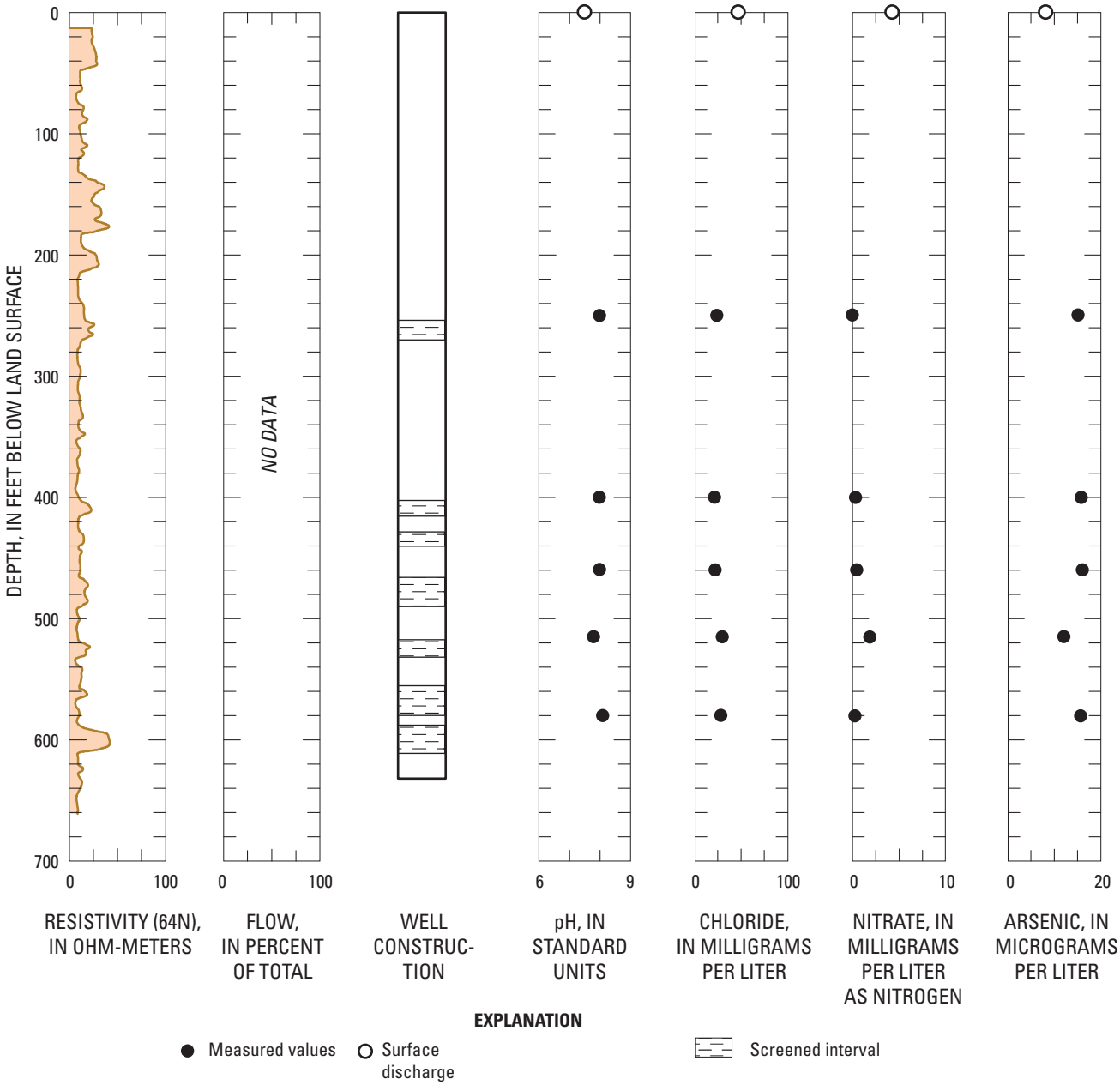
NOTE: Data for pumped and unpumped water levels not available.

Figure 22. Resistivity log, well-bore flow log, well construction, and selected depth-dependent water-quality data from well 001N007E08H002M, Eastern San Joaquin Groundwater Subbasin, California, Febuary 24, 2005.



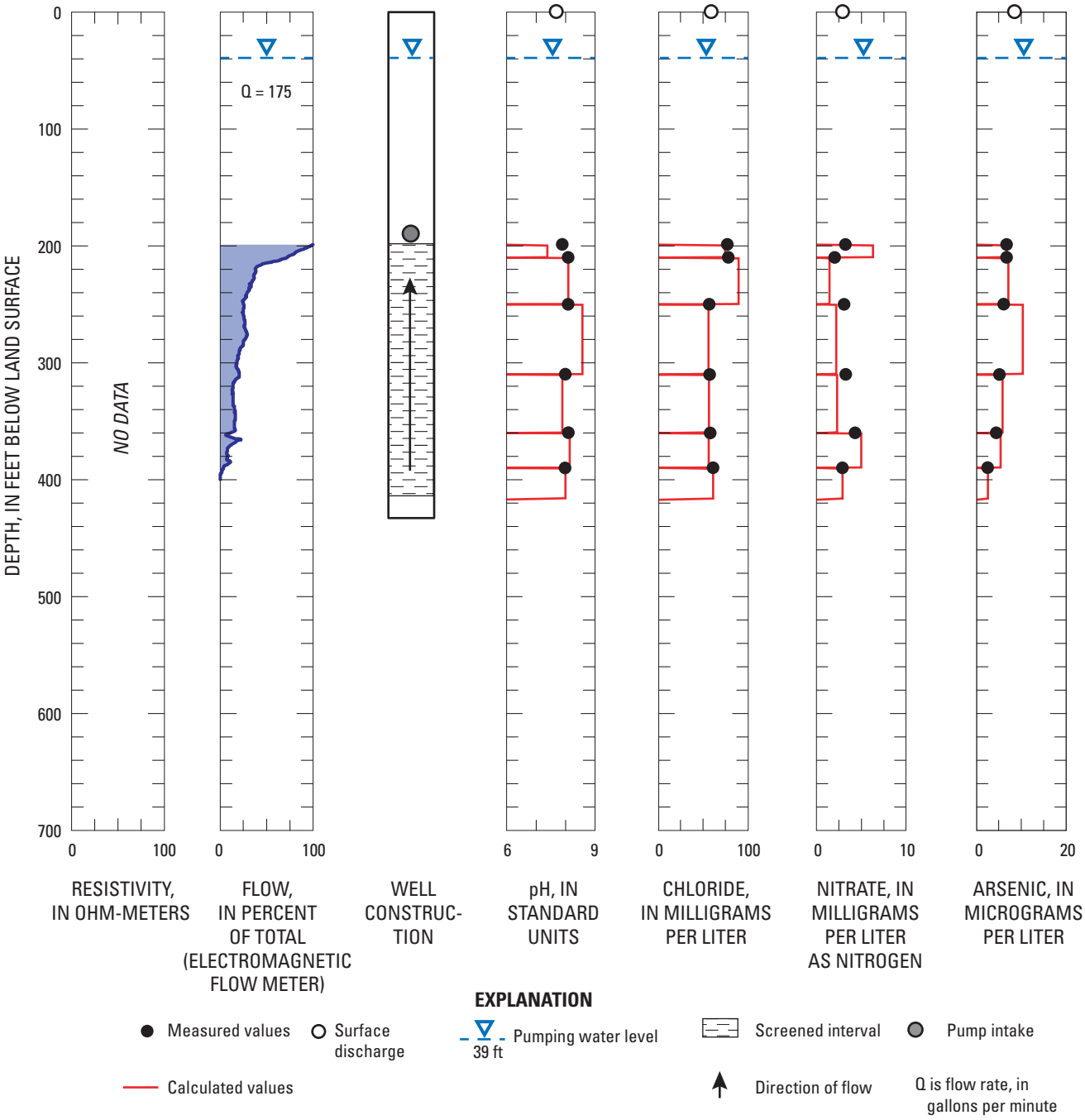
NOTE: Electromagnetic velocity log was normalized for uphole flow; the well-bore flow log was run on July 29, 2004; depth-dependent water-quality data was collected on August 4, 2004.

Figure 23. Resistivity log, well-bore flow log, well construction, and selected depth-dependent water-quality data from well 001N007E20N001M, Eastern San Joaquin Groundwater Subbasin, California, August 2, 2004.



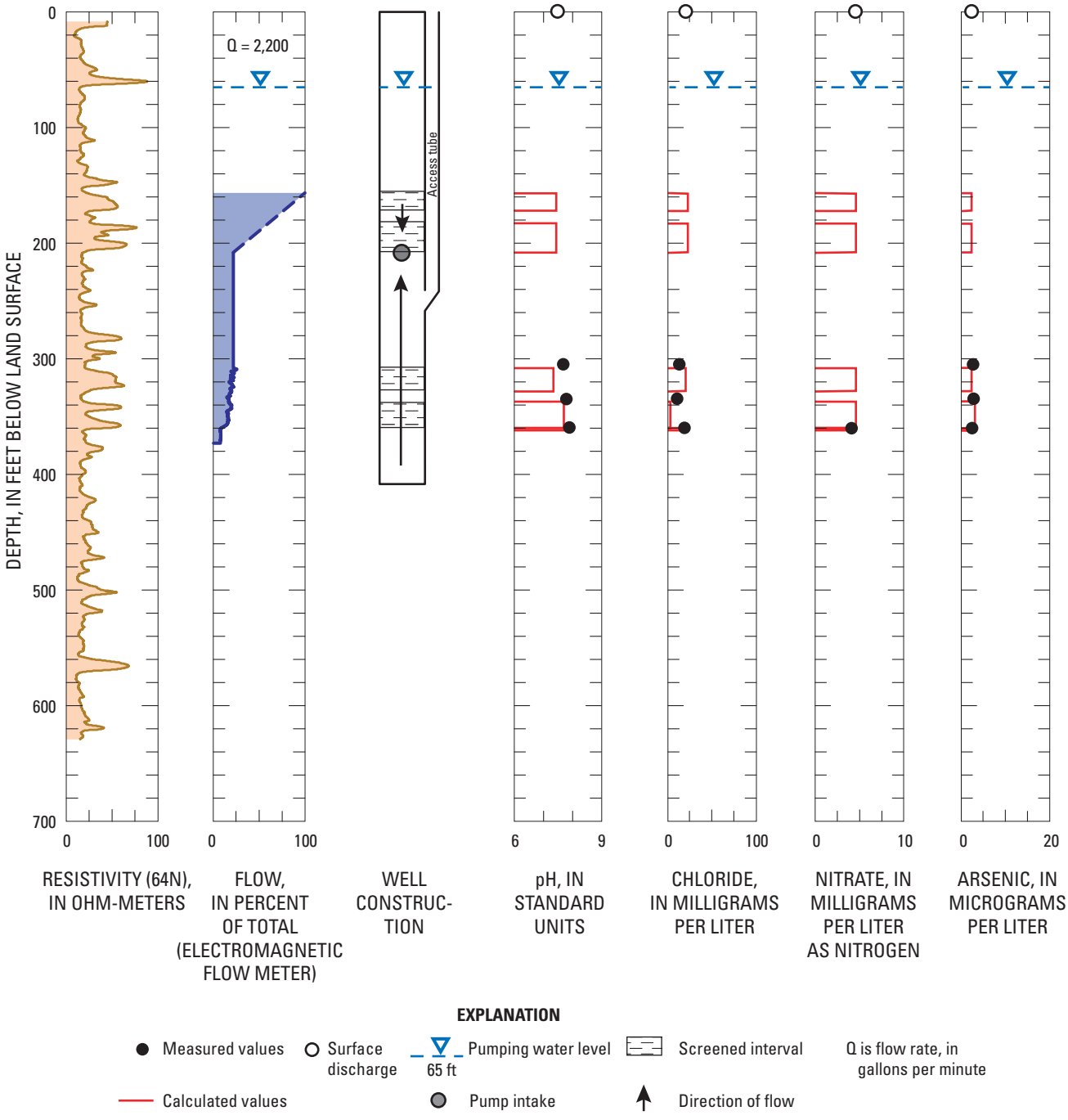
NOTE: Data for pumped and unpumped water levels not available.

Figure 24. Resistivity log, well-bore flow log, well construction, and selected depth-dependent water-quality data from well 001N007E28F001M, Eastern San Joaquin Groundwater Subbasin, California, July 19, 2005.



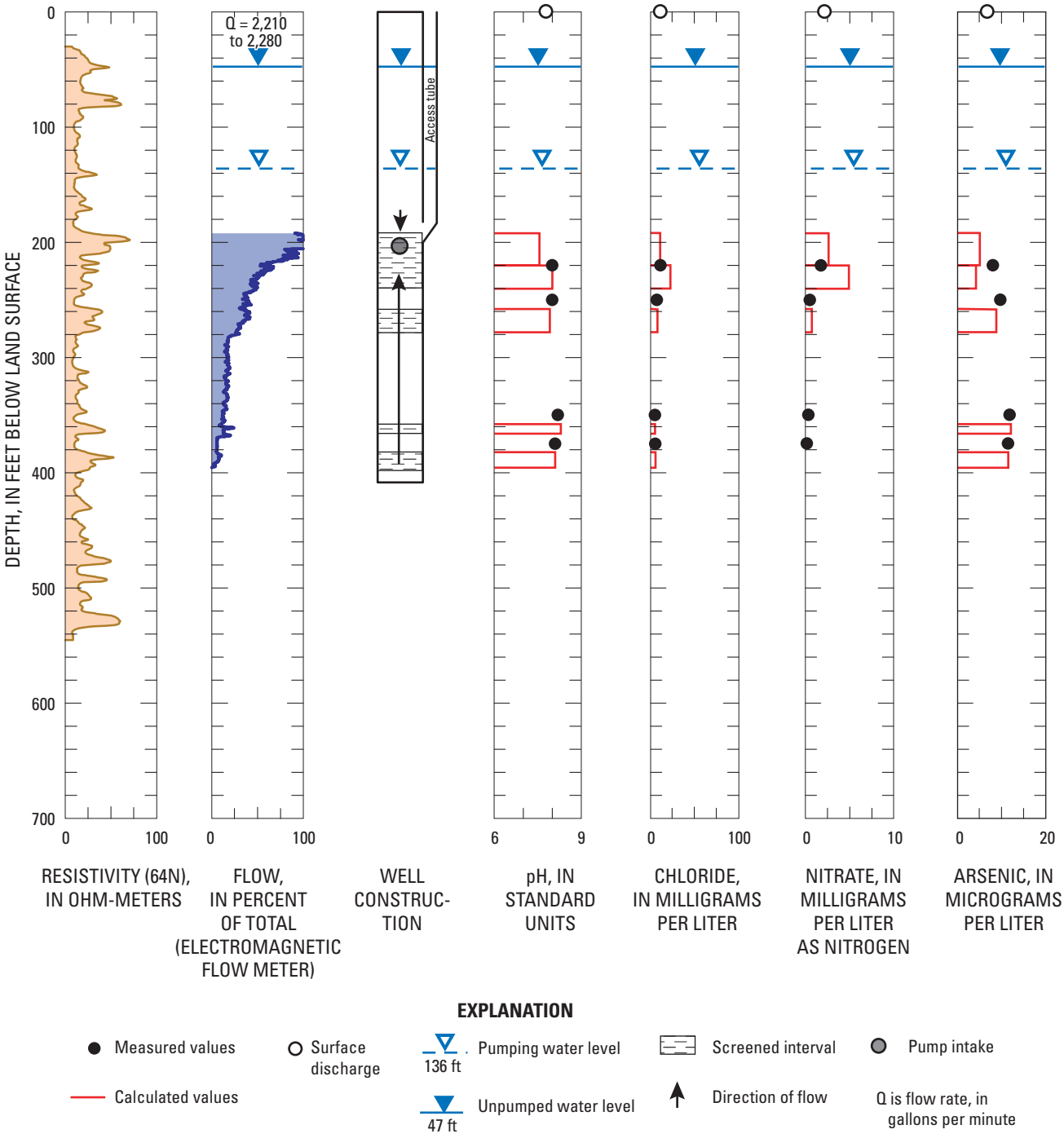
NOTE: Well-bore flow log was run on April 1, 2007; depth-dependent water-quality data was collected on March 26, 2008; unpumped water level not available.

Figure 25. Resistivity log, well-bore flow log, well construction, and selected depth-dependent water-quality data from well 001N007E31C001M, Eastern San Joaquin Ground-Water Subbasin, California, March 26, 2008.



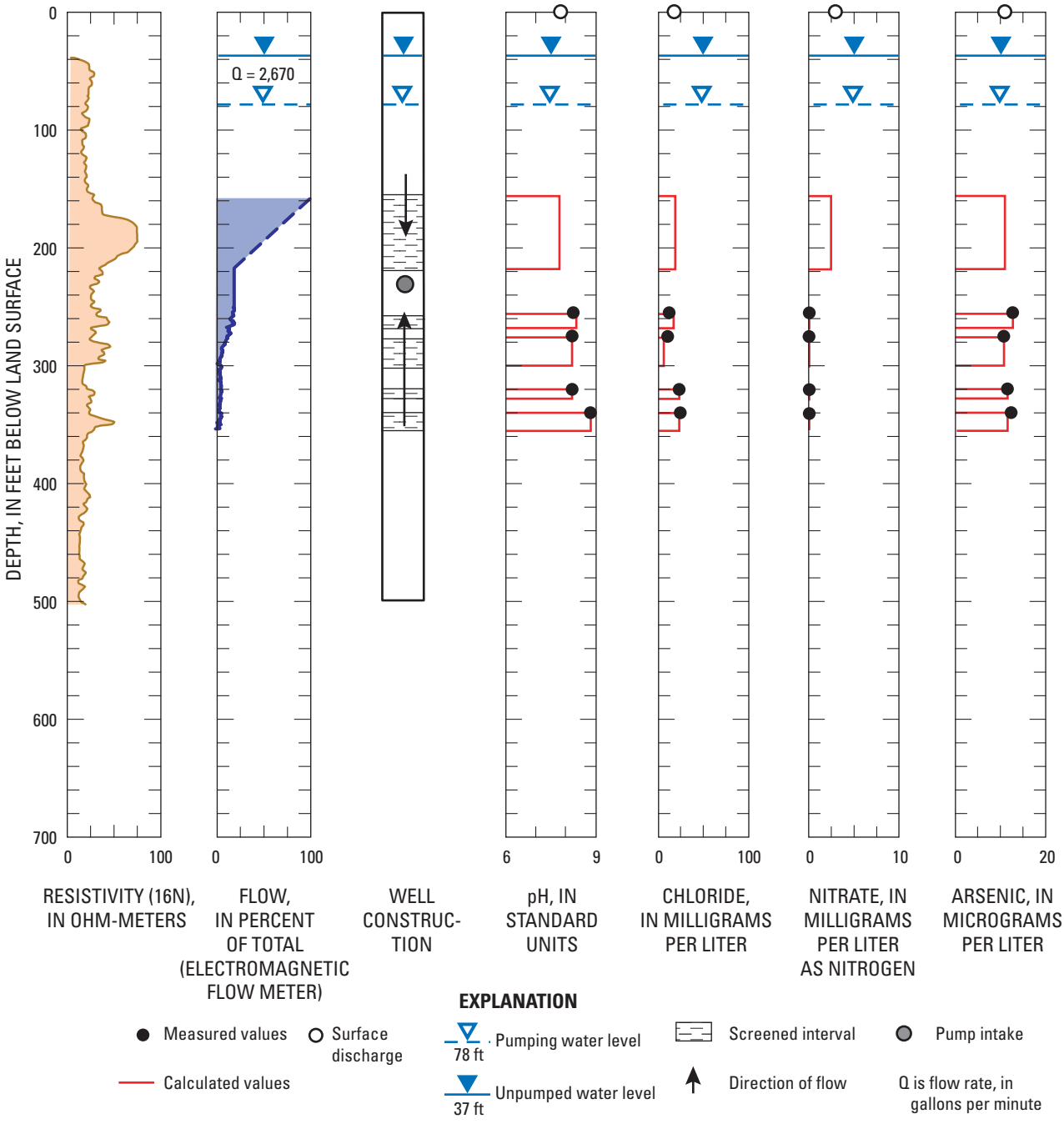
NOTE: Electromagnetic flow meter was normalized for uphole flow; well-bore flow log was run on May 31, 2006; depth-dependent water-quality data was collected on August 9, 2006; unpumped water level not available.

Figure 26. Resistivity log, well-bore flow log, well construction, and selected depth-dependent water-quality data from well 002N006E01Q001M, Eastern San Joaquin Groundwater Subbasin, California, August 9, 2006.



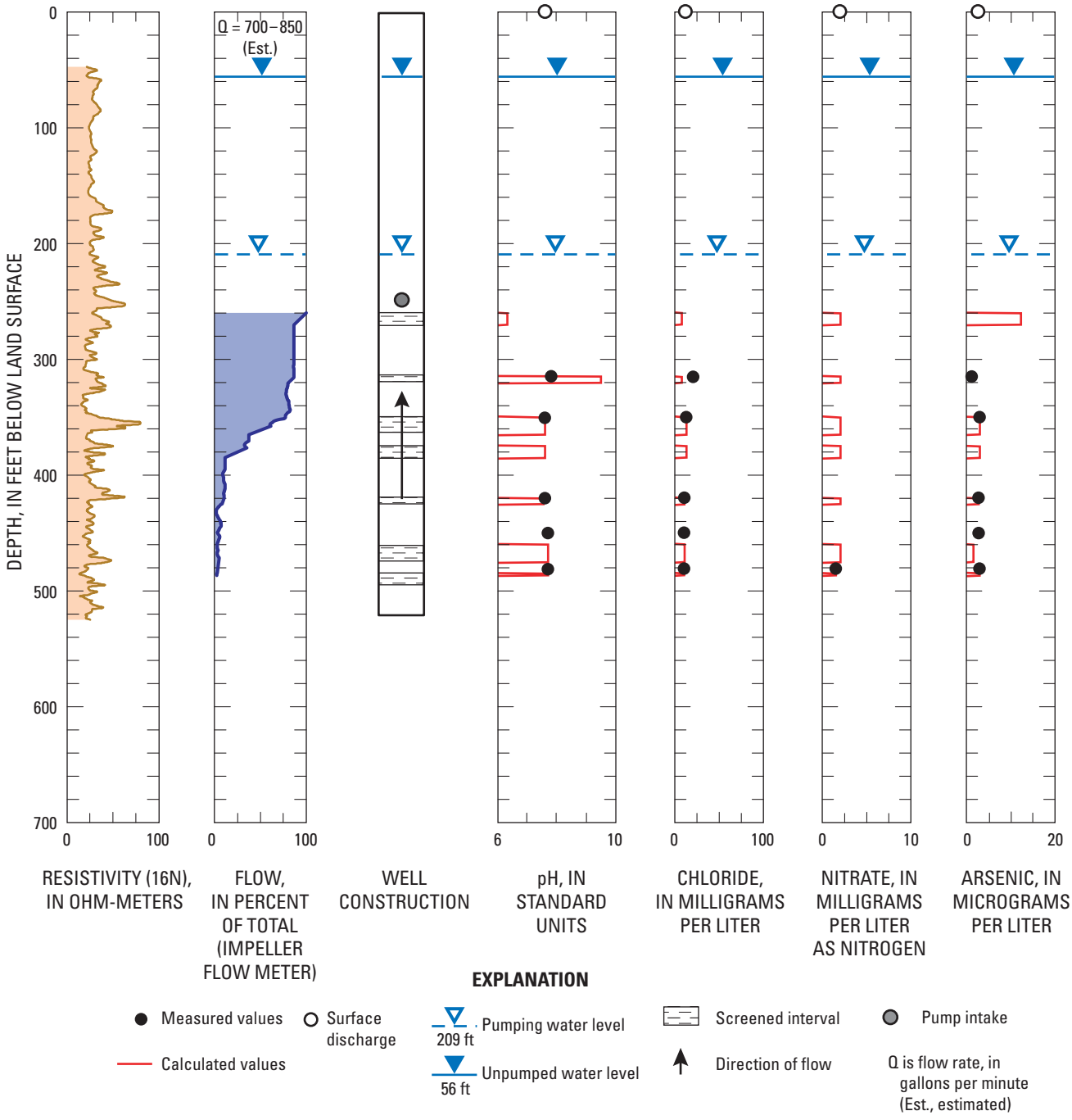
NOTE: Electromagnetic flow meter was normalized for uphole flow; well-bore flow log was run on July 7, 2005; depth-dependent water-quality data was collected on July 13–14, 2005.

Figure 27. Resistivity log, well-bore flow log, well construction, and selected depth-dependent water-quality data from well 002N006E04Q001M, Eastern San Joaquin Groundwater Subbasin, California, July 13–14, 2005.



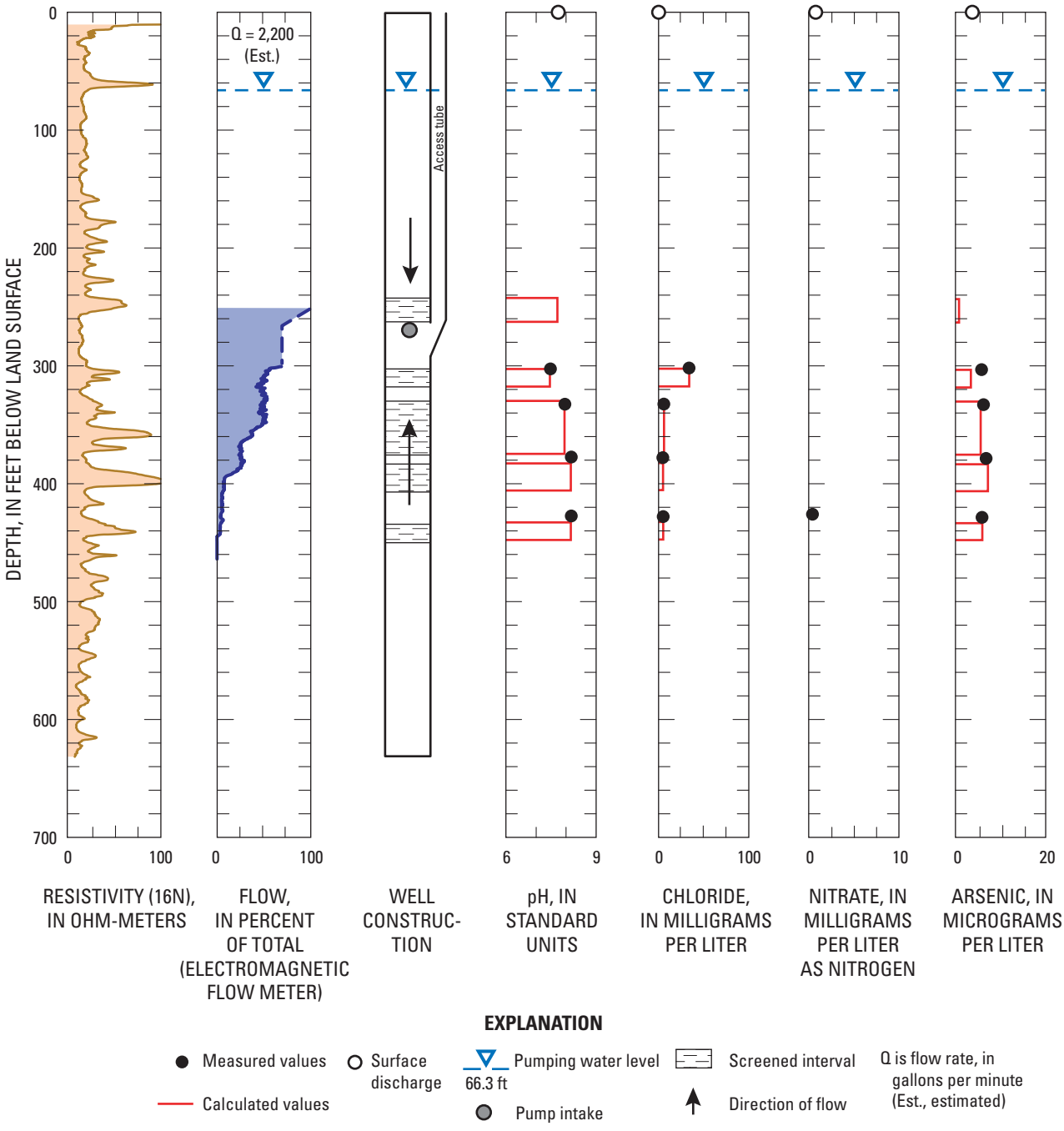
NOTE: Electromagnetic velocity log was normalized for uphole flow; well-bore flow log was run on July 27, 2004; depth-dependent water-quality data was collected on August 3, 2004.

Figure 28. Resistivity log, well-bore flow log, well construction, and selected depth-dependent water-quality data from well 002N006E05F001M, Eastern San Joaquin Groundwater Subbasin, California, August 3, 2004.



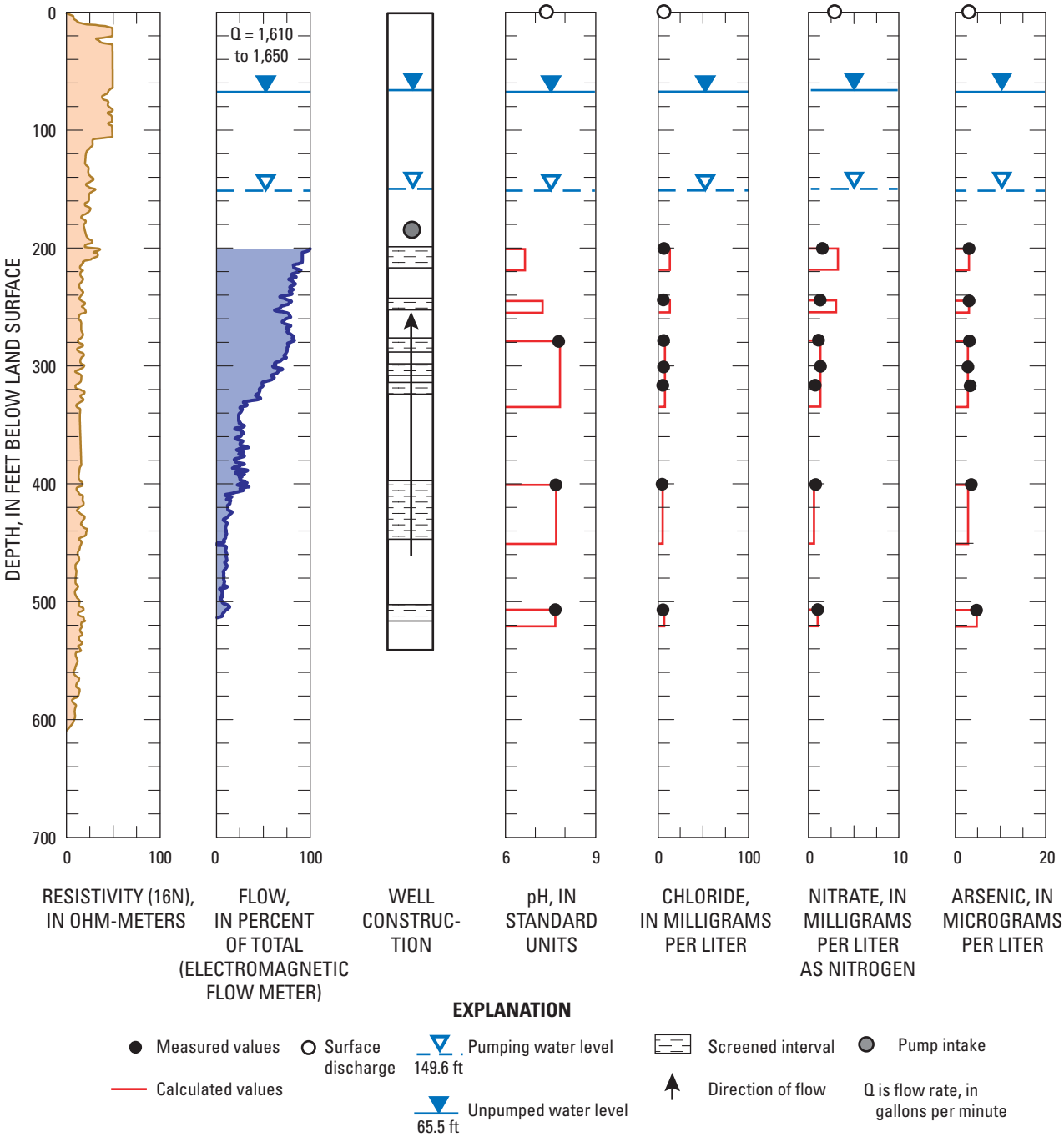
NOTE: Well-bore flow log was run on July 16, 2007; depth-dependent water-quality data was collected on June 20, 2007.

Figure 29. Resistivity log, well-bore flow log, well construction, and selected depth-dependent water-quality data from well 002N006E11H003M, Eastern San Joaquin Groundwater Subbasin, California, June 20, 2007.



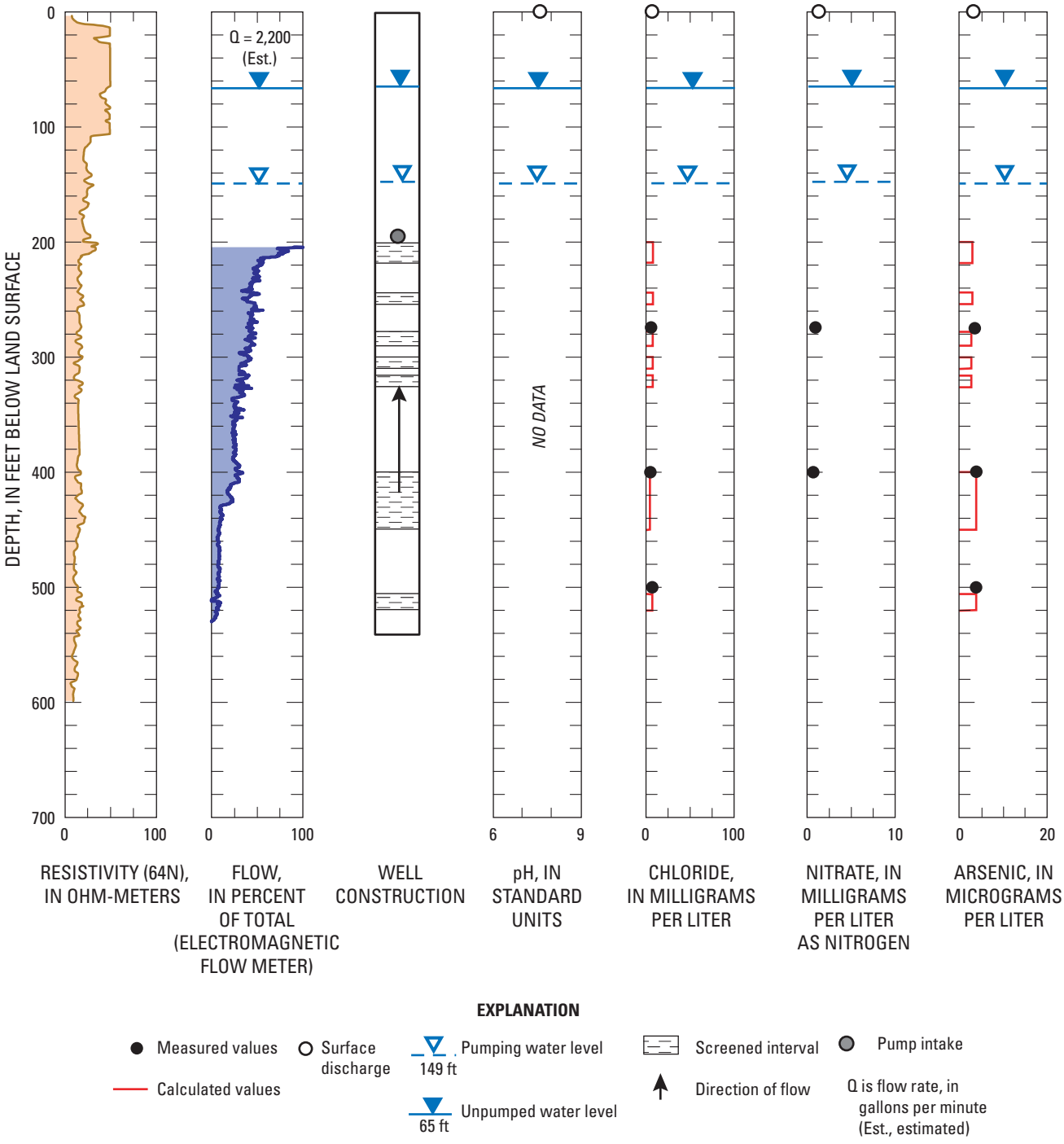
NOTE: Electromagnetic velocity log was normalized for uphole flow; well-bore flow log was run on July 14, 2006; depth-dependent water-quality data was collected on August 8, 2006.

Figure 30. Resistivity log, well-bore flow log, well construction, and selected depth-dependent water-quality data from well 002N006E12J001M, Eastern San Joaquin Groundwater Subbasin, California, August 8, 2006.



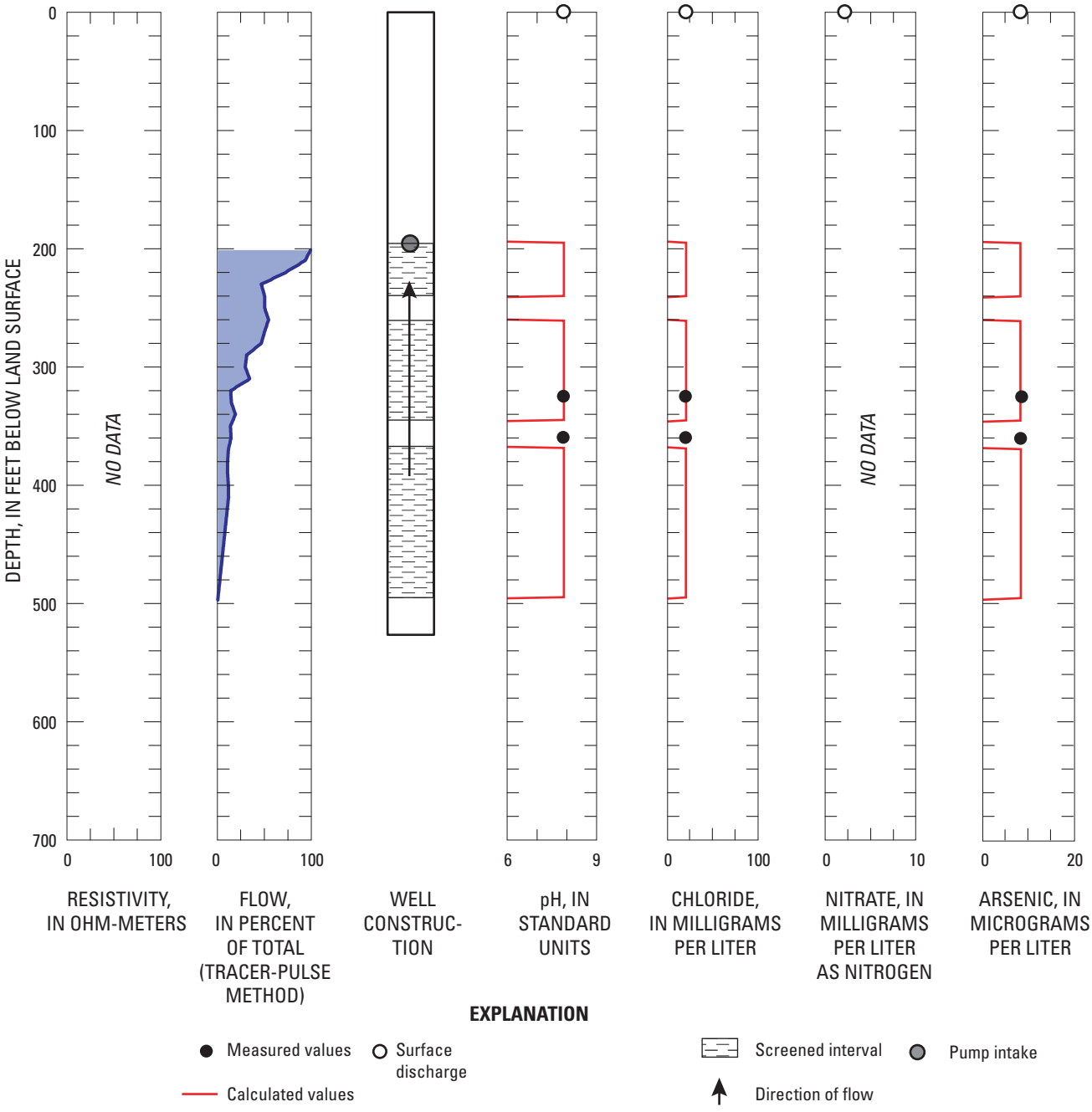
NOTE: Well-bore flow log was run on July 28, 2004; depth-dependent water-quality data was collected on August 5, 2004.

Figure 31. Resistivity log, well-bore flow log, well construction, and selected depth-dependent water-quality data from well 002N006E24P004M, Eastern San Joaquin Groundwater Subbasin, California, August 5, 2004.



NOTE: Well-bore flow log was run on February 15, 2005; depth-dependent water-quality data was collected on January 26–28, 2006.

Figure 32. Resistivity log, well-bore flow log, well construction, and selected depth-dependent water-quality data from well 002N006E24P004M, Eastern San Joaquin Groundwater Subbasin, California, January 26–28, 2006.



NOTE: Well-bore flow log was run on February 16, 2005; depth-dependent water-quality data was collected on February 16, 2005; data for pumping and unpumped water level not available.

Figure 33. Resistivity log, well-bore flow log, well construction, and selected depth-dependent water-quality data from well 002N006E27L001M, Eastern San Joaquin Groundwater Subbasin, California, February 16, 2005.

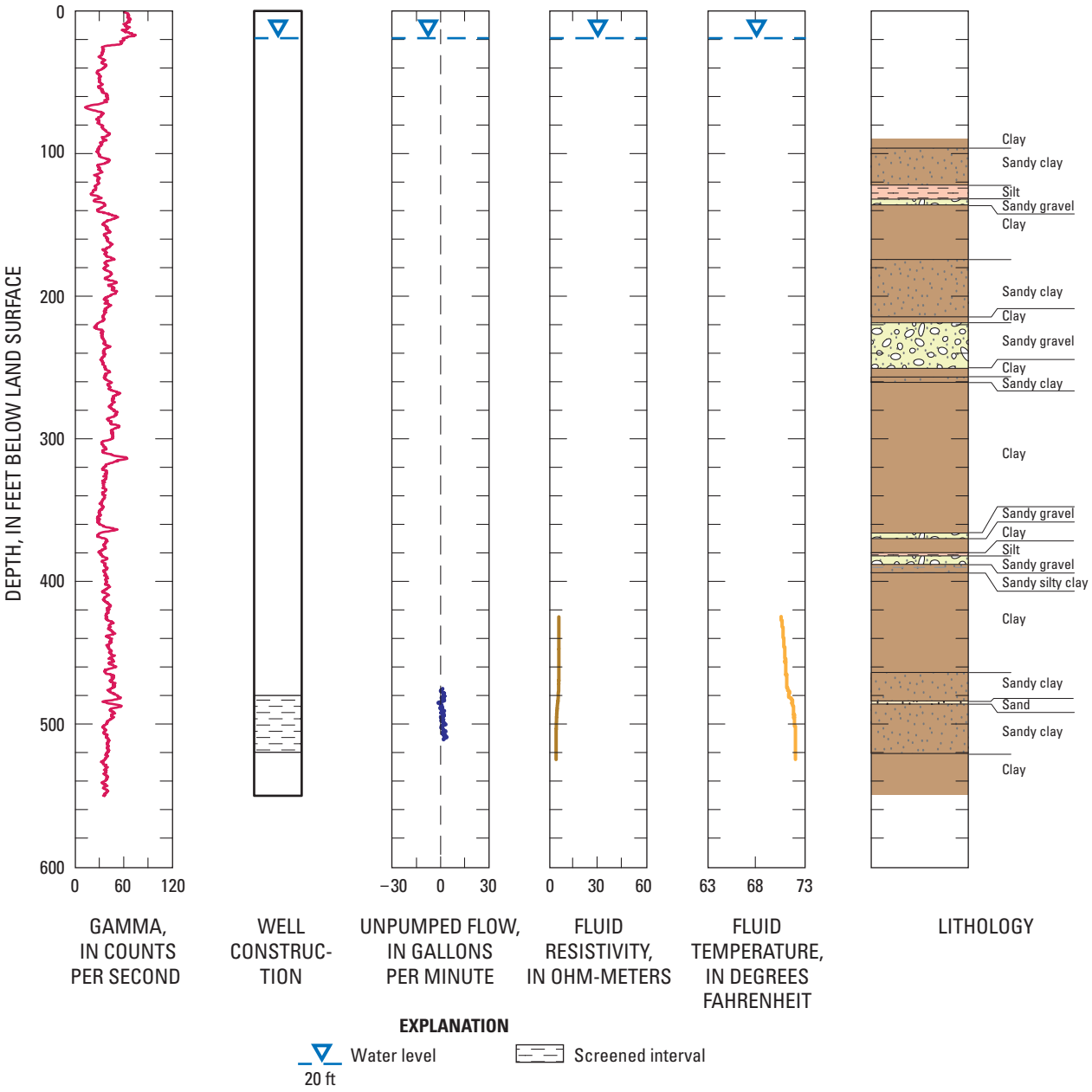


Figure 34. Gamma log, well construction, unpumped well-bore flow, fluid resistivity, fluid temperature, and lithology data from well 001N006E04P002M, Eastern San Joaquin Groundwater Subbasin, California, February 24, 2005.

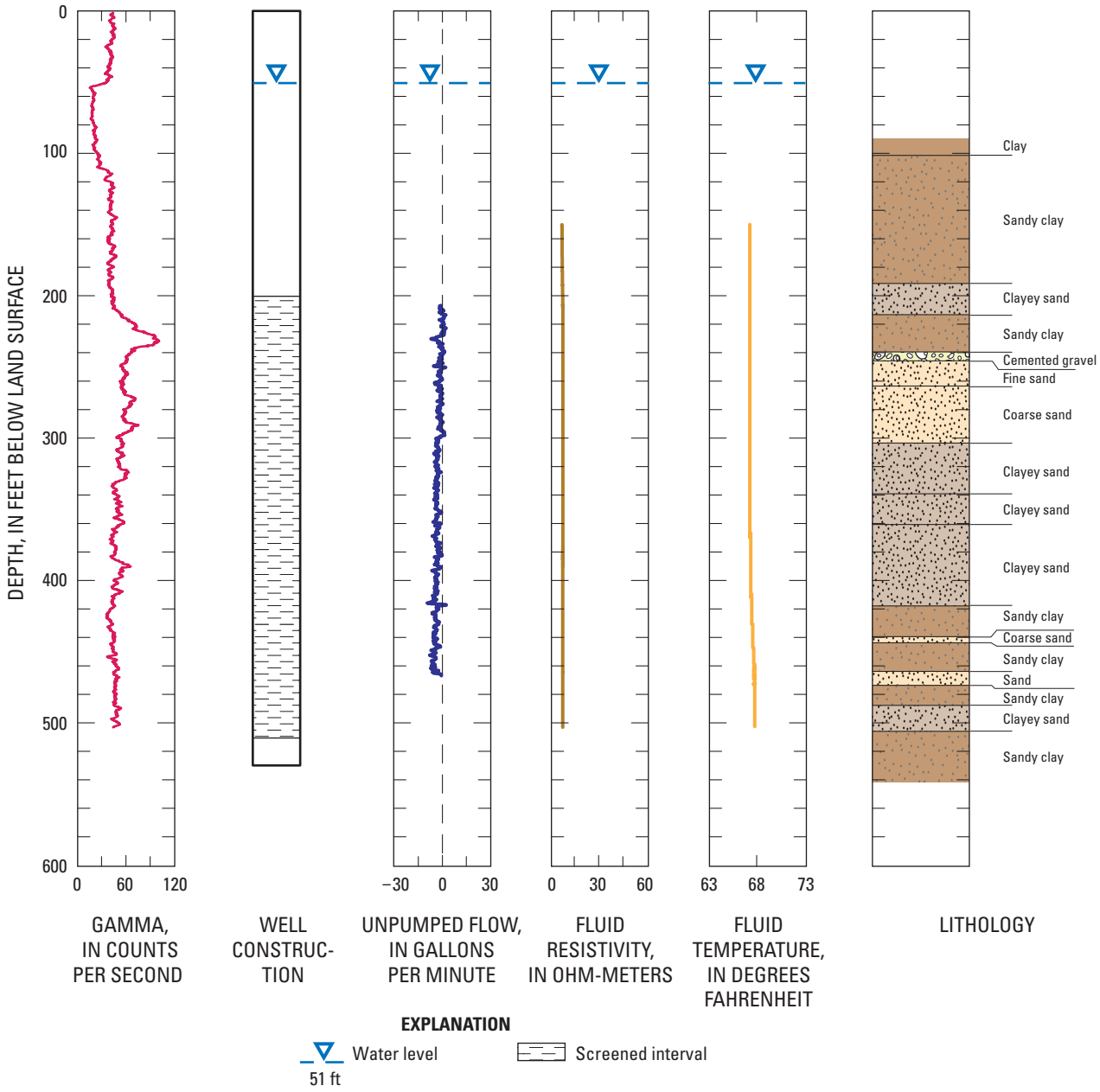


Figure 35. Gamma log, well construction, unpumped well-bore flow, fluid resistivity, fluid temperature, and lithology data from well 001N006E012A001M, Eastern San Joaquin Groundwater Subbasin, California, February 23, 2005.

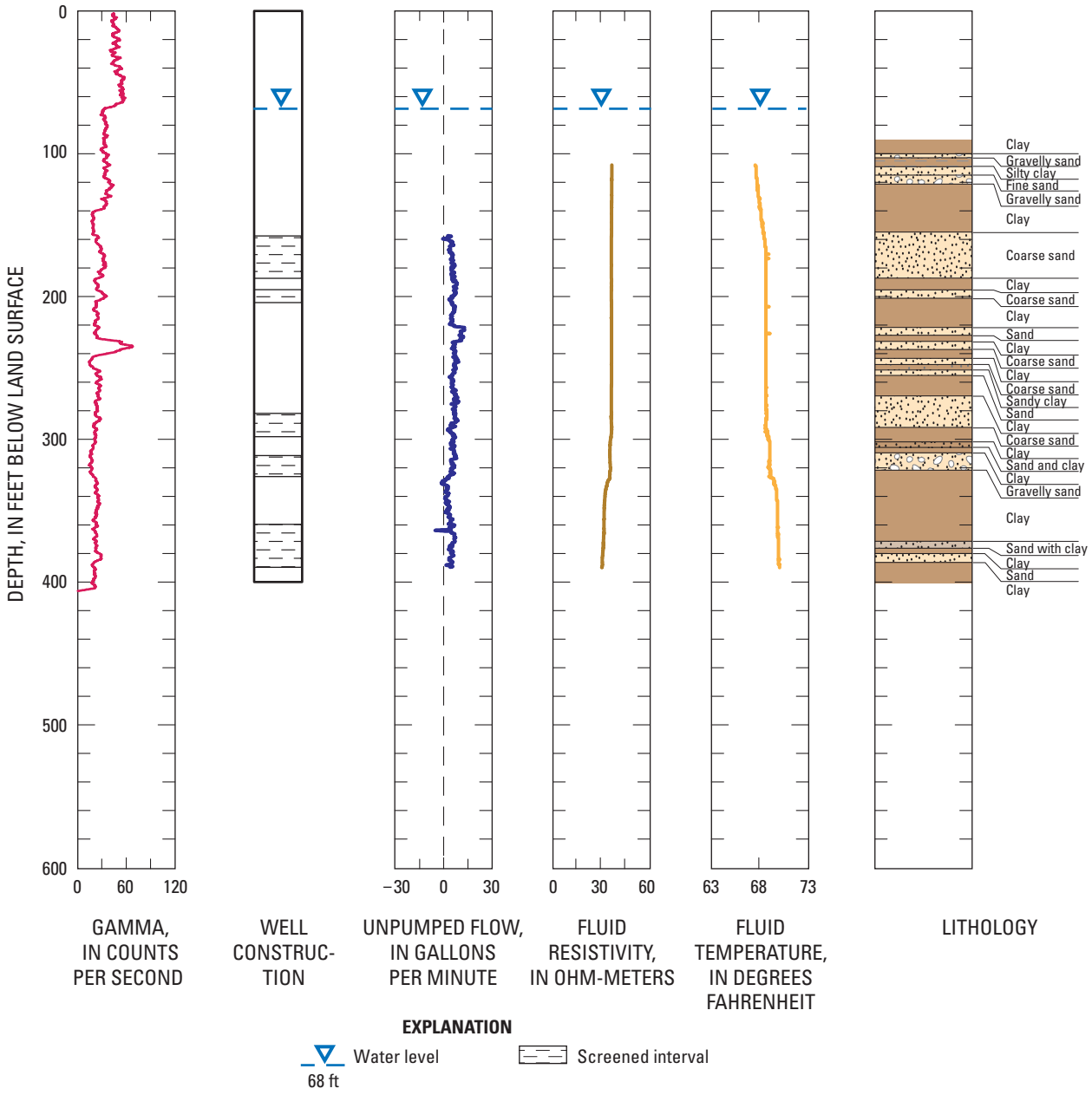


Figure 36. Gamma log, well construction, unpumped well-bore flow, fluid resistivity, fluid temperature, and lithology data from well 001N007E20N001M, Eastern San Joaquin Groundwater Subbasin, California, July 16, 2005.

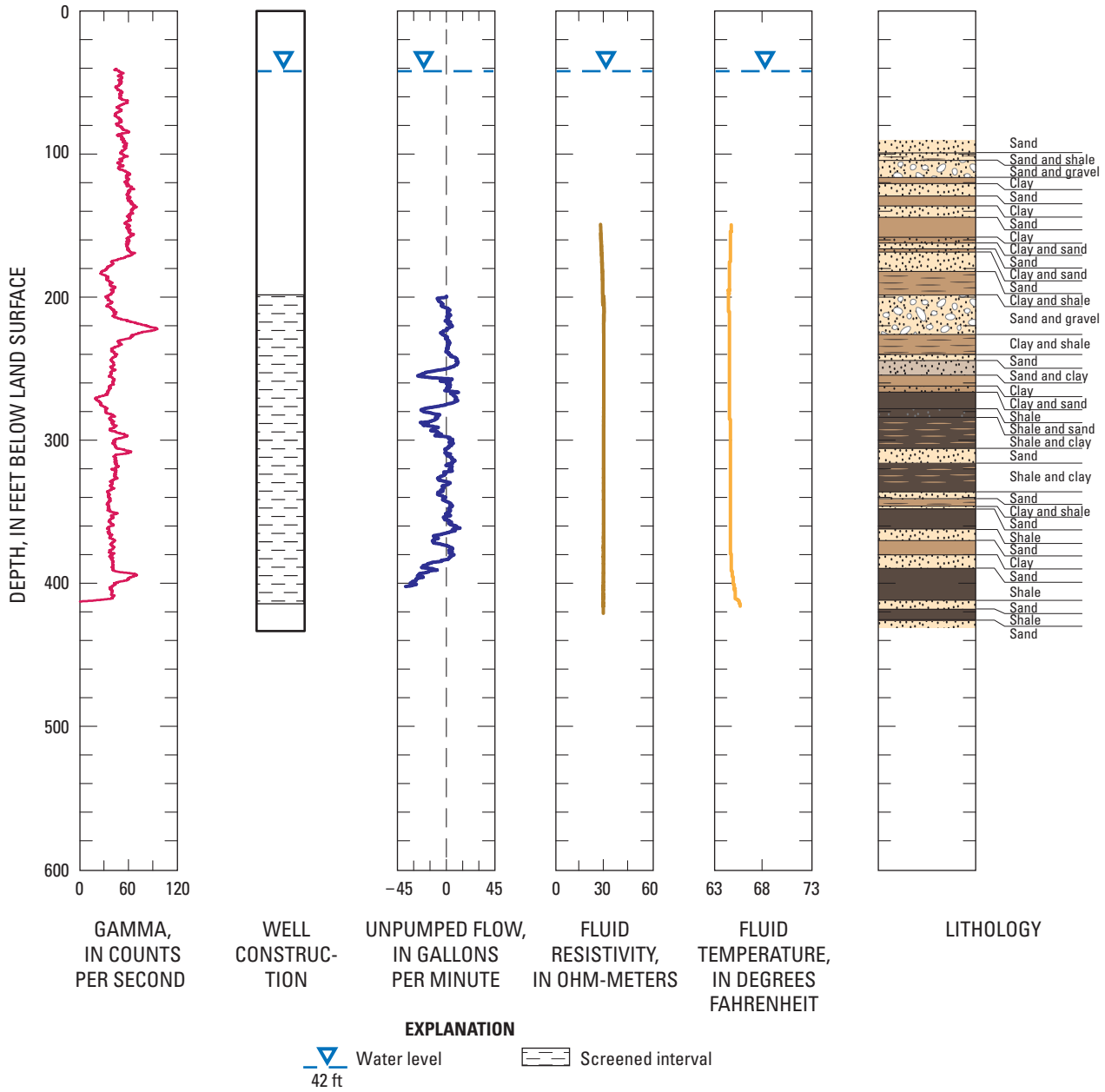


Figure 37. Gamma log, well construction, unpumped well-bore flow, fluid resistivity, fluid temperature, and lithology data from well 001N007E31C001M, Eastern San Joaquin Groundwater Subbasin, California, March 19, 2007.

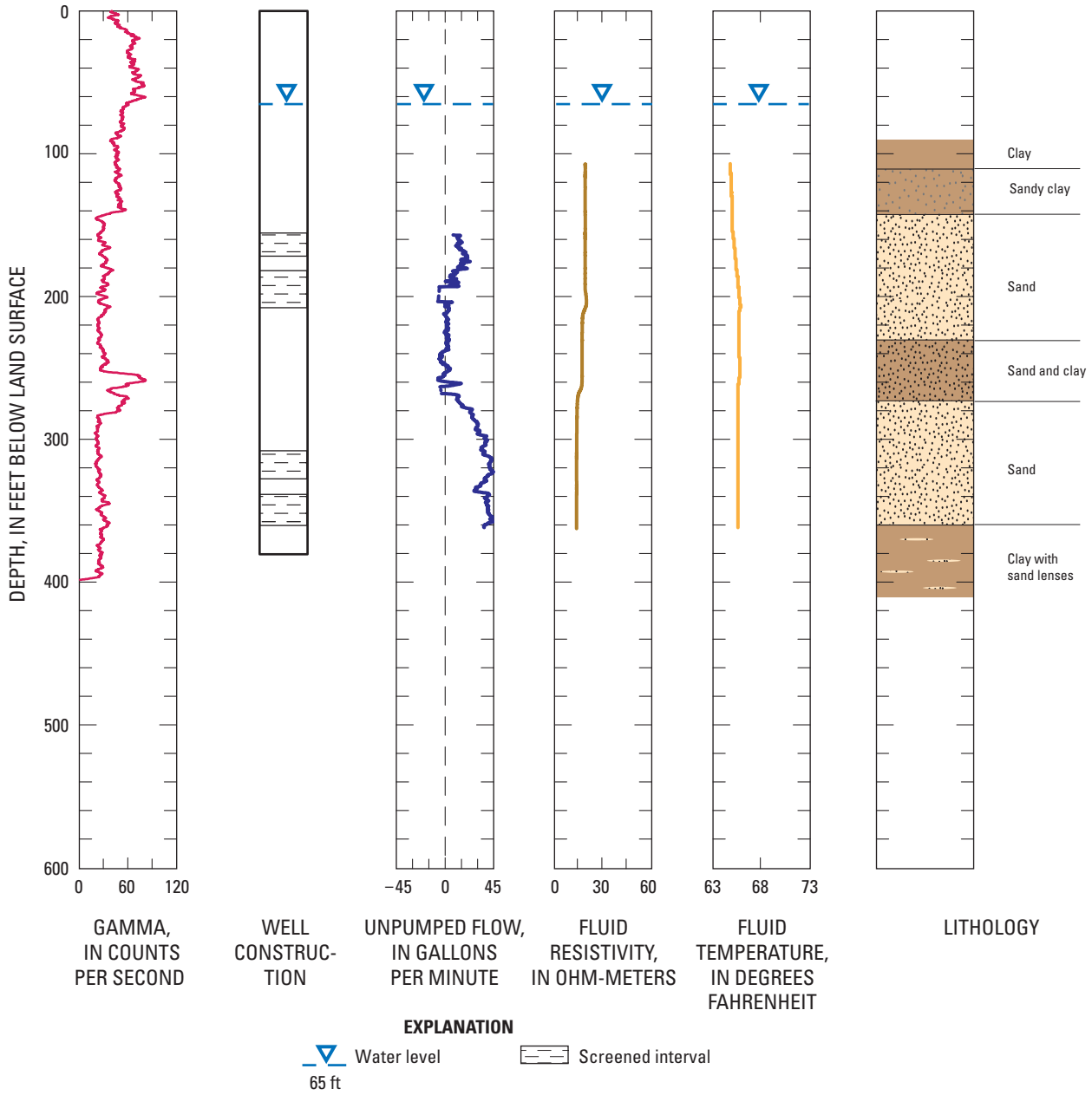


Figure 38. Gamma log, well construction, unpumped well-bore flow, fluid resistivity, fluid temperature, and lithology data from well 002N006E01Q001M, Eastern San Joaquin Groundwater Subbasin, California, January 18, 2006.

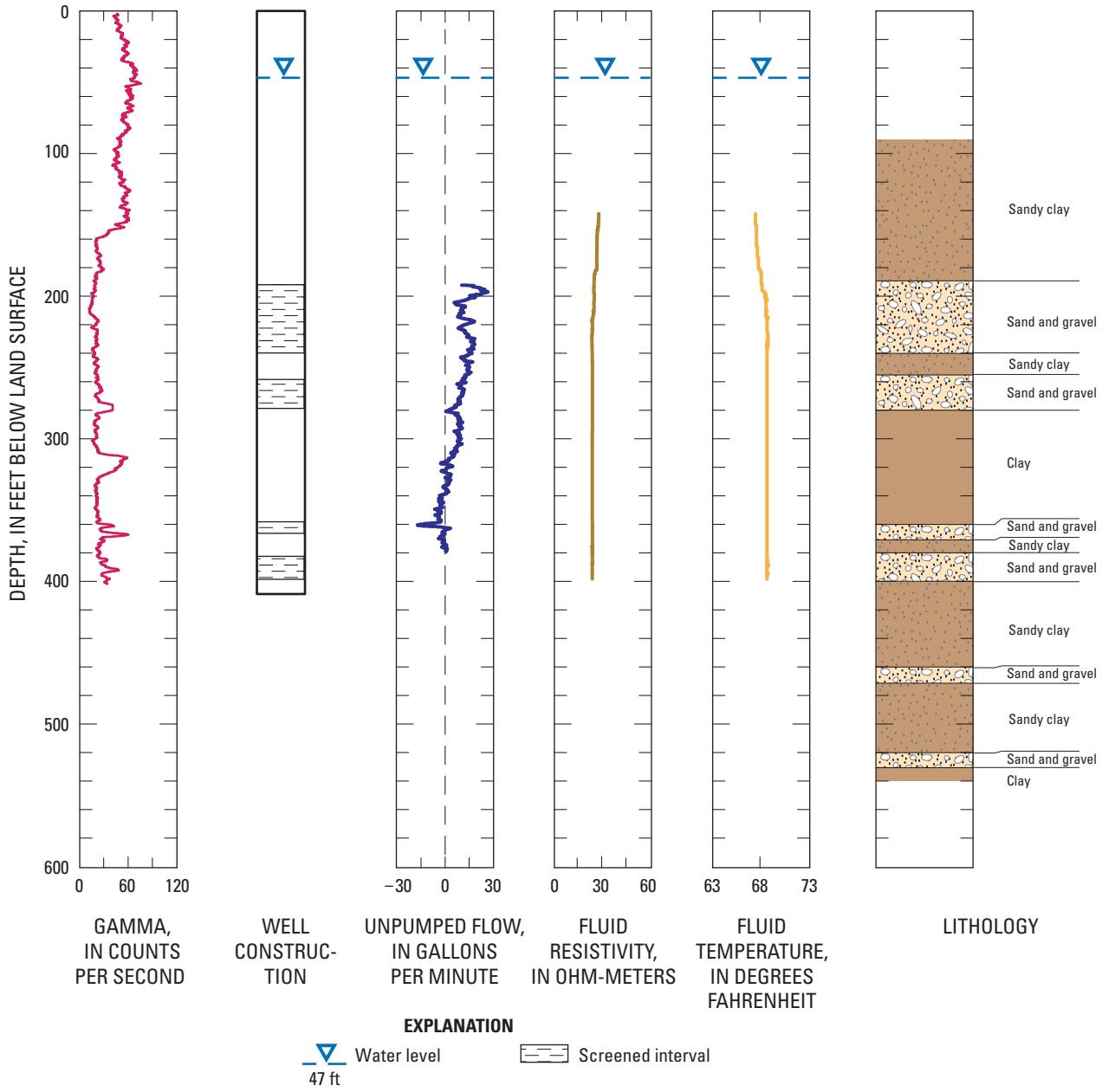


Figure 39. Gamma log, well construction, unpumped well-bore flow, fluid resistivity, fluid temperature, and lithology data from well 002N006E04Q001M, Eastern San Joaquin Groundwater Subbasin, California, June 8, 2005.

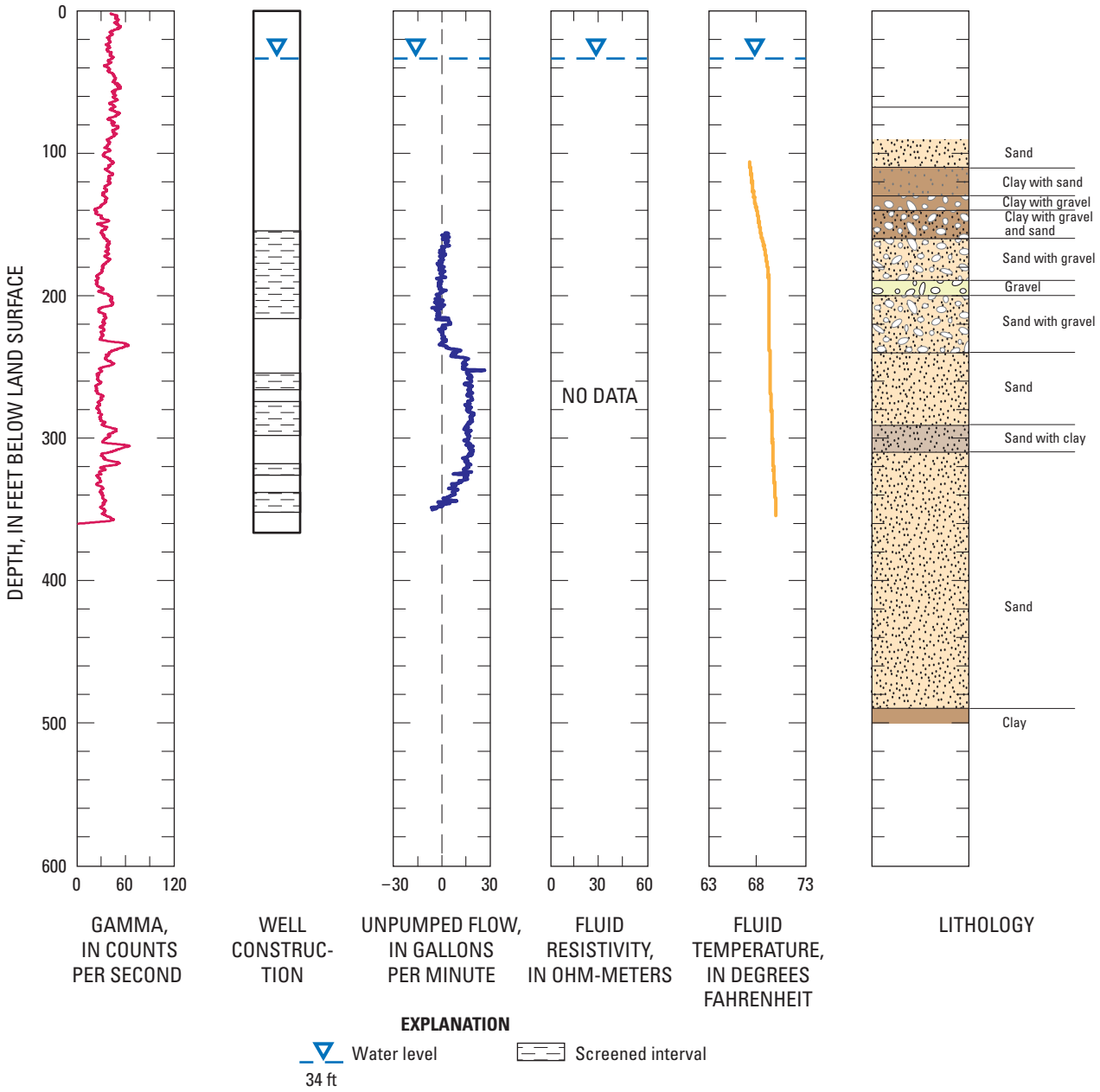


Figure 40. Gamma log, well construction, unpumped well-bore flow, fluid resistivity, fluid temperature, and lithology data from well 002N006E05F001M, Eastern San Joaquin Groundwater Subbasin, California, February 17, 2005.

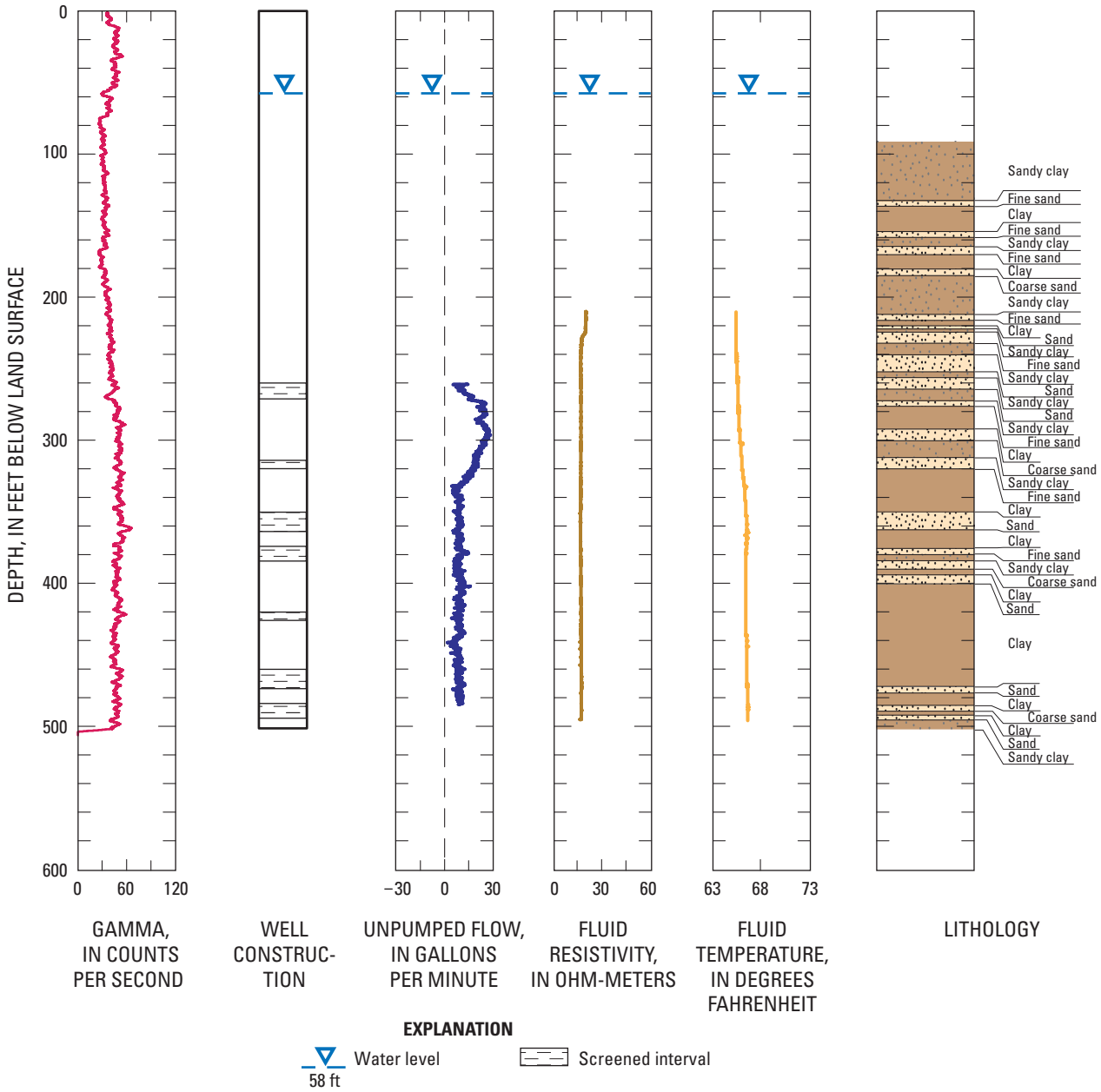


Figure 41. Gamma log, well construction, unpumped well-bore flow, fluid resistivity, fluid temperature, and lithology data from well 002N006E11H003M, Eastern San Joaquin Groundwater Subbasin, California, March 27, 2007.

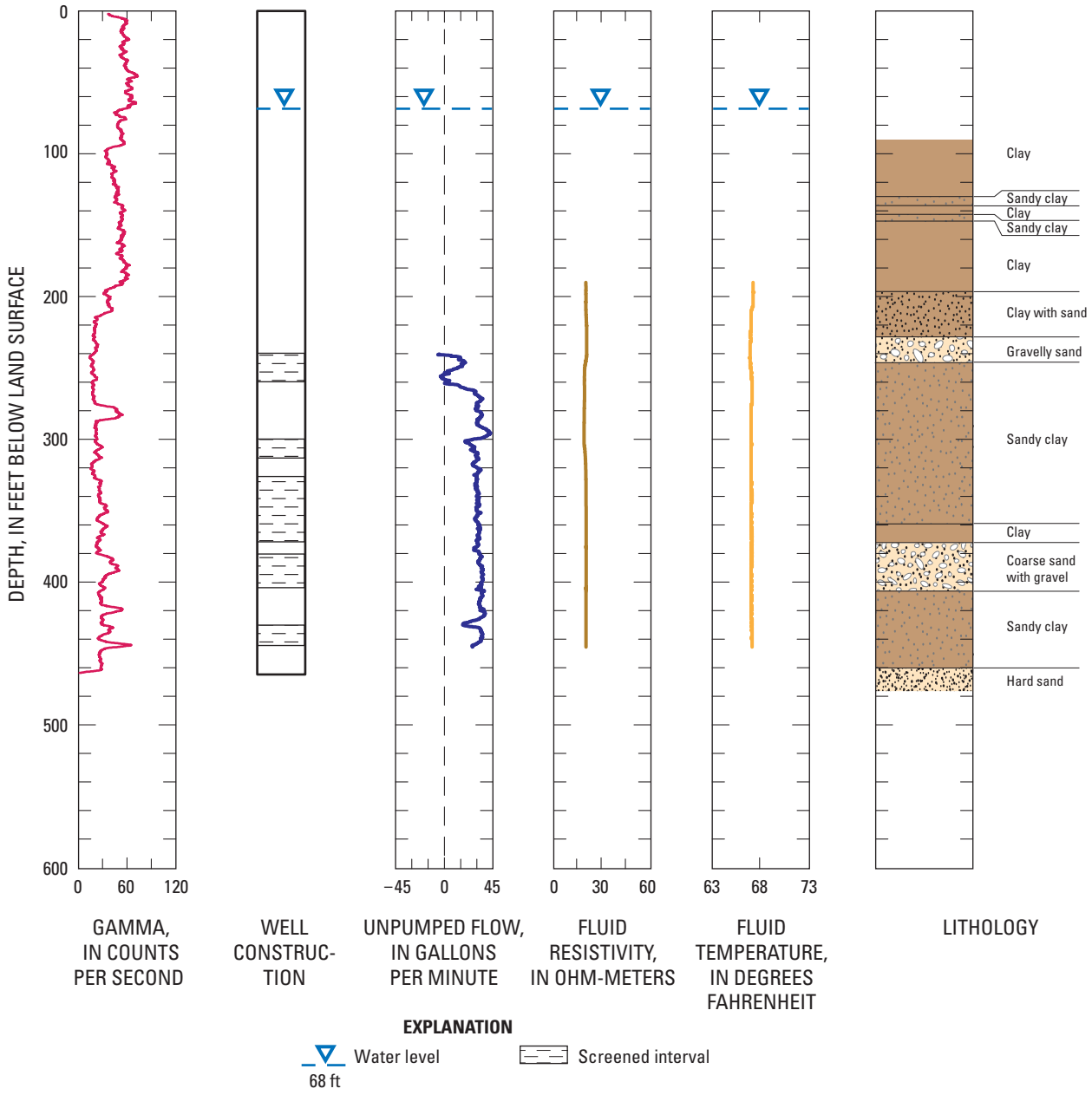


Figure 42. Gamma log, well construction, unpumped well-bore flow, fluid resistivity, fluid temperature, and lithology data from well 002N006E12J001M, Eastern San Joaquin Groundwater Subbasin, California, May 25, 2006.

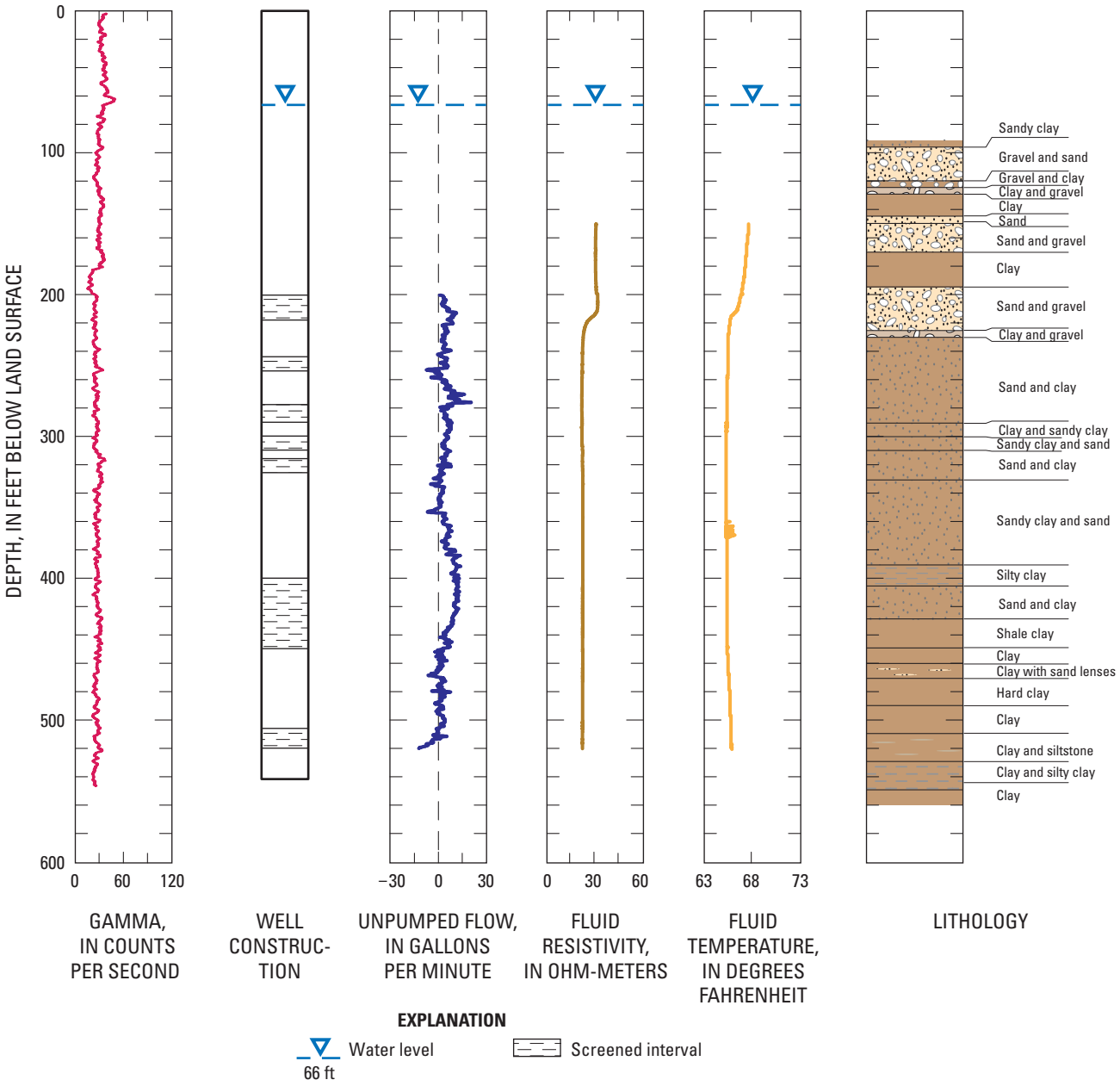


Figure 43. Gamma log, well construction, unpumped well-bore flow, fluid resistivity, fluid temperature, and lithology data from well 002N006E24P004M, Eastern San Joaquin Groundwater Subbasin, California, February 15, 2005.

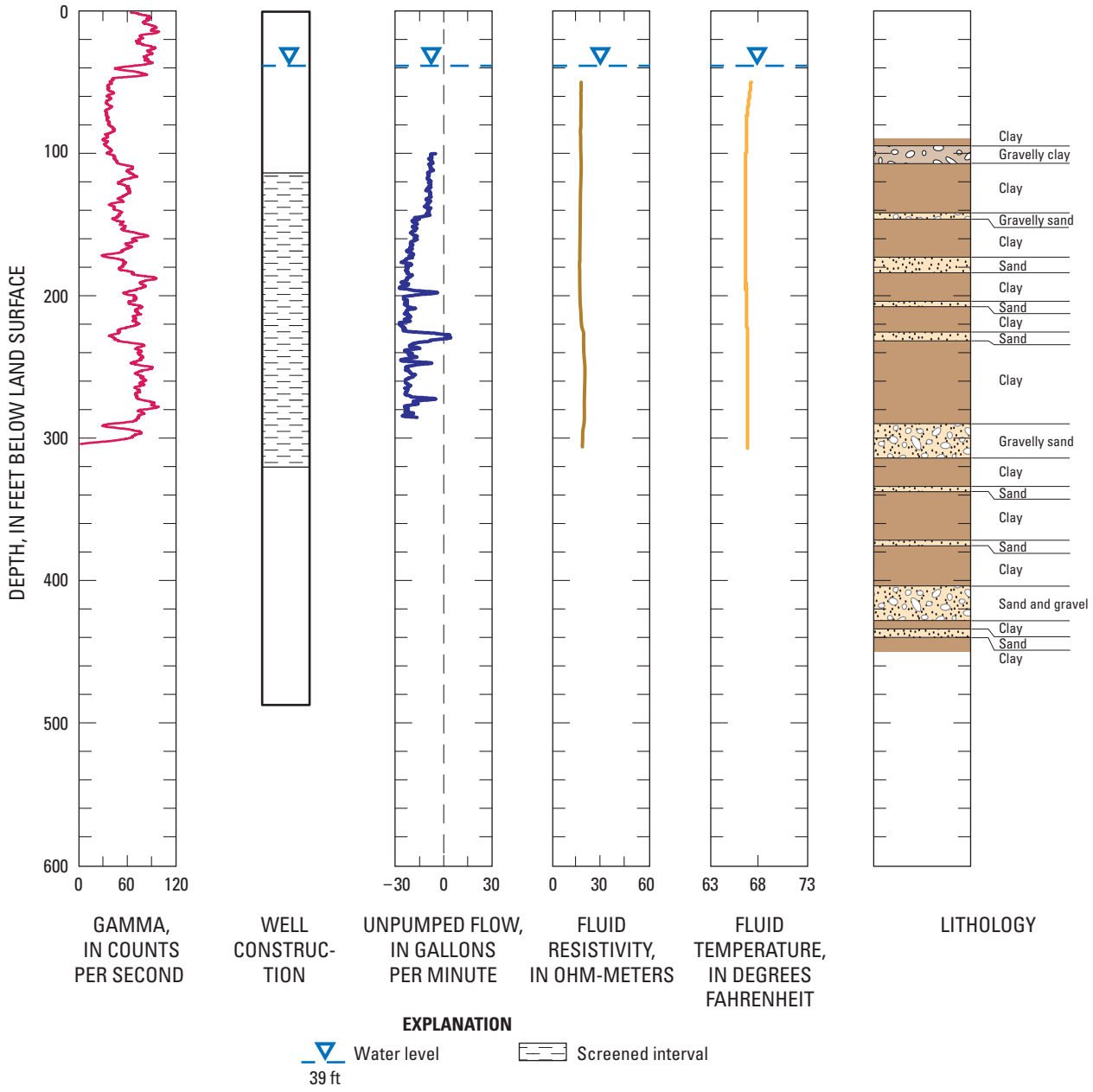


Figure 44. Gamma log, well construction, unpumped well-bore flow, fluid resistivity, fluid temperature, and lithology data from well 003N006E10A001M, Eastern San Joaquin Groundwater Subbasin, California, February 25, 2005.

The impeller, or vertical-axis, flowmeter is the most common tool used to measure flow within production wells under pumped conditions (Hill, 1990). The impeller flowmeter relies on a mechanical impeller that turns as water flows past the impeller vanes. The number of revolutions is transmitted to the surface by electrical impulses triggered by mechanical, electrical, or magnetic counters within the flowmeter. The most commonly used impeller flowmeters are not sensitive to velocities less than about 3 ft/min, although under some conditions it may be possible to measure velocities as low as 1.8 ft/min (Keys, 1990). As a result, impeller flowmeters lack the sensitivity to measure low-flow velocities typically found in unpumped wells or in the deeper parts of pumped wells. Depending on the flowmeter, at very high-flow velocities approaching 200 ft/min or more, the correlation between impeller rotation and fluid velocity may become increasingly nonlinear, and impeller flowmeter data may become inaccurate. Because these flowmeters rely on a mechanical impeller, they are sensitive to mechanical interference from debris in the well.

The EM flowmeter measures the rate of flow through the inside of a hollow, cylindrical measurement section (Paillet, 2000). Electromagnets inside the cylinder create a strong magnetic field across the inside of the cylinder. According to Faraday's Law, the voltage generated by the polar-charged water molecules passing through the magnetic field is directly proportional to its velocity (Young and Pearson, 1995). EM flowmeters are capable of measuring velocities less than 0.3 ft/min and up to a maximum velocity of approximately 250 ft/min. In cased wells or smooth-walled boreholes, the sensitivity of the EM flowmeter can be further improved through the use of diverters that concentrate flow into the measurement section (Paillet, 2000). The EM flowmeter is suitable for use in both pumped and unpumped wells because of its large range. Data from fluid temperature and fluid resistivity sensors embedded within EM flowmeters are useful for hydrologic interpretations, especially in the interpretation of low-flow data from unpumped wells (Newhouse and others, 2005).

Impeller and EM flowmeter data were collected by trolling the flowmeter vertically through the well at a known rate. Impeller flowmeter data were collected at three rates: 30, 60, and 90 ft/min. EM flowmeter data in pumped and unpumped wells were collected at three different rates: 5, 10, and 15 ft/min. Comparison of the flowmeter response at each of the trolling rates was used as a field check on the flowmeter calibration.

The trace-pulse method provides a commercially available alternative method for collecting well-bore flow data in wells having limited access that prevents the use of traditional flowmeters (Izbicki and others, 1999). When the tracer-pulse method is used, a high-pressure hose equipped with valves and hydraulic pumps is used to inject dye into a well under pumping conditions up to 200 ft per minute. The hose, valves, and weights are flexible and less than 2.5 centimeters in diameter. The equipment is designed to enter wells and pass through the small annular spaces between the pump and well casing. The hose is usually mounted on a reel to allow for deployment, retrieval, and storage. Prior to entering the well, the hose is filled with a fluid containing an easily measurable tracer, such as water colored with rhodamine dye. The hose is then lowered to a known depth in the well (d_1) and a small quantity of the tracer is injected into the water using hydraulic or pneumatic pressure. The traveltime of the tracer to a detector at the surface is measured (t_1). If rhodamine dye is used as the tracer, a fluorimeter is used to measure the arrival of the dye at the surface. The hose is then lowered to the next depth (d_2), tracer is again injected into the water, and the traveltime (t_2) is measured. The velocity (V) is calculated as the difference in traveltimes. Assuming piston flow, the flow rate (Q), given a well radius (r), is calculated using the following equations (Izbicki and others, 1999):

$$Q = (Vpr^2) \quad (1)$$

where

V is $(d_2 - d_1)/(t_2 - t_1)$

A series of injections at different depths is done to construct a flow profile for the well. Unlike point measurements obtained from traditional flowmeters, velocity data from the tracer-pulse method represent average values over the measurement interval.

A comparison of well-bore flow data collected from wells 1N/7E–31C1 (SSS 5) using an impellor flowmeter, an electromagnetic flowmeter, and the tracer-pulse technique is shown in figure 45. The well-bore flow data from this well shows the different techniques compare well. The resolution with depth was greater for the EM and impellor flowmeters. The resolution for the tracer-pulse data was slightly less than the flowmeter techniques, because these data are average velocities over the measurement interval rather than continuous data.

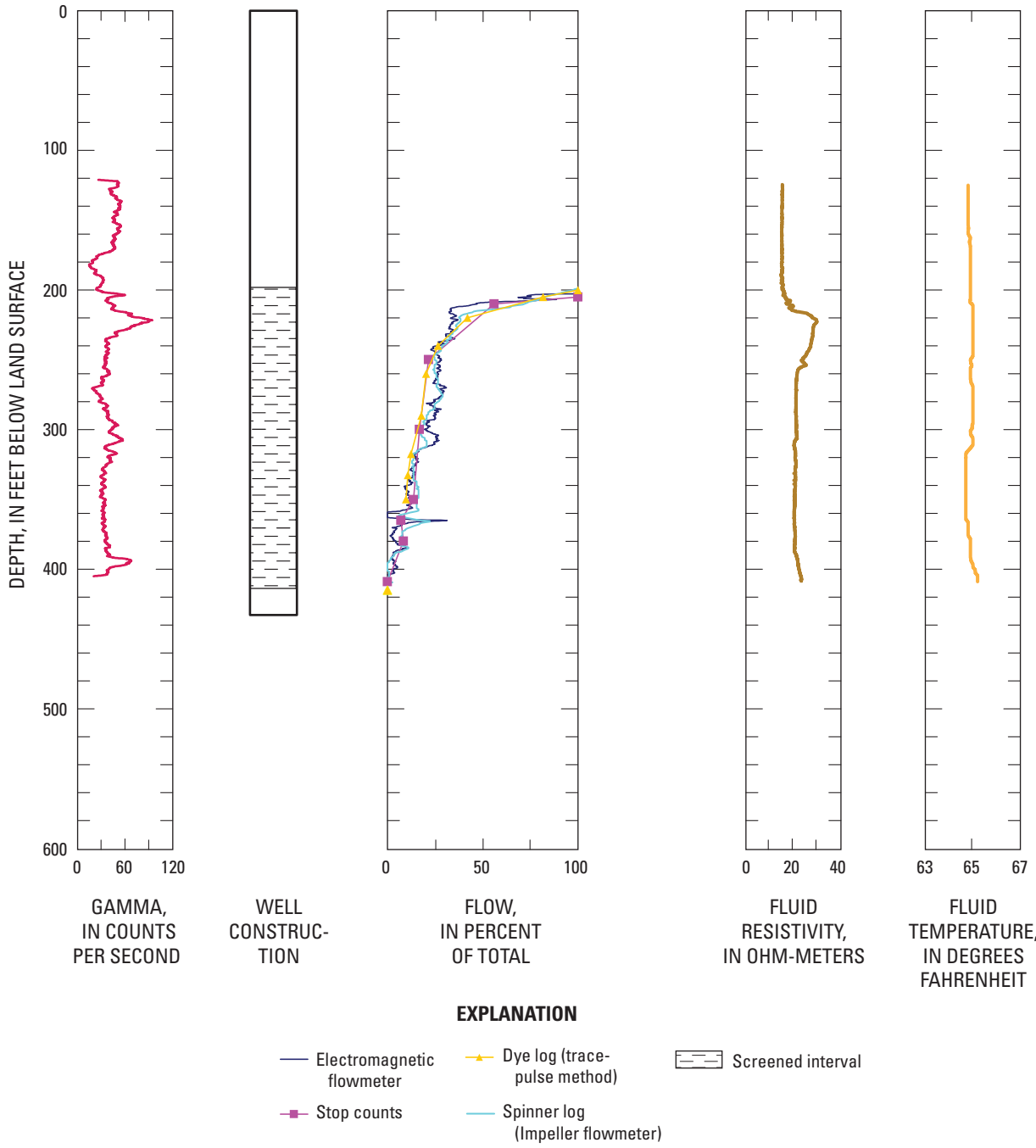


Figure 45. Gamma log, well construction, fluid resistivity, and fluid-temperature data, and flow data collected by use of three methods, from well 001N007E31C001M, Eastern San Joaquin Groundwater Subbasin, California.

Chemical Data

Samples for chemical analysis were collected from (1) the surface discharge of pumps in selected monitoring wells and production wells, (2) different depths (depth-dependent) within production wells under pumping conditions, (3) pore water that was pressure extracted from core material collected during drilling, and (4) acid extractions from core material and cuttings collected during drilling. Sample collection, field handling procedures, and analytical methods are described in the sections below. Quality-control data also are described.

Groundwater Samples

Monitoring-Well and Existing-Well Samples

Water-quality samples were collected from multiple-well monitoring sites and private or public supply wells in this study by USGS personnel (figs. 46–47). Water-quality samples were collected following the USGS field procedures outlined in the U.S. Geological Survey Field Manual for Collection of Water Quality Data (U.S. Geological Survey, 1999).

Water-level measurements were made prior to purging in wells that could be accessed. If installed, pressure transducers were removed from monitoring wells prior to sample collection. For monitoring wells, at least three well-casing volumes were purged from the well by using a portable submersible pump. For domestic, irrigation, industrial, or public-supply wells, at least three casing volumes were purged with the existing pump. The field parameters of specific conductance, pH, and water temperature were monitored for all wells during purging, and samples were collected only after these parameters had stabilized. Stability was attained when three successive measurements taken at intervals of 5 minutes or more differed by less than 5 percent for specific conductance, 0.1 units of pH, and 0.2 degrees Celsius (°C) for water temperature. Purge logs, field measurements, and other information related to sample collection are on file at USGS offices in San Diego or Sacramento, Calif.

Portable meters were used to make the field measurements for specific conductance, pH, and alkalinity; the measurements were made using methods outlined by Wilde (2001). All meters were calibrated in the field prior to making field measurements. Dissolved-oxygen measurements were made by the colorimetric indigo-carmine method just prior to sampling. Water temperature was measured from the pump discharge using a hand-held alcohol-filled thermometer that had a full-scale accuracy of 0.5°C or using a built-in thermistor attached to the conductivity probe (which had an accuracy of plus or minus 0.1°C). Both measuring devices were checked annually against an American Standard Laboratory and Materials standard mercury thermometer and were within 0.5°C. Instrument log and calibration data are on file at the USGS office in San Diego, Calif.

Water samples for analyses of major ions, nutrients, and selected trace elements were pressure-filtered in the field using a membrane polyethersulfone (PES) filter capsule that had a pore size of 0.45 micrometer (µm). Laboratory samples for the analysis of pH and specific conductance were not filtered. Most of the samples were collected in polyethylene bottles that were rinsed three times with sample water prior to filling. Samples for nutrient determinations were collected in dark, opaque polyethylene bottles and preserved on ice to inhibit bacterial growth. Samples for cation and selected trace-element concentrations were collected in acid-rinsed polyethylene bottles and preserved by acidifying the sample to a pH less than 2 using a 2-milliliter (mL) vial of concentrated ultrapure nitric acid. Samples were shipped to the USGS National Water Quality Laboratory (NWQL) in Denver, Colorado, for analysis following standard methods outlined by Fishman and Friedman (1989), Fishman (1993), Faires (1993), Patton and Truitt (1992), Jones and Garbarino (1999), Struzeski and others (1996), Beukens, R.P. (1992), Gleason and others (1969), Coplen and others (1991), Epstein and Mayeda (1953), and Thatcher and others (1977; table 10).

Water samples for analysis of the stable isotopes hydrogen-2 (deuterium) and oxygen-18 of water were collected in 10-mL glass vials or in 60-mL glass bottles. The samples were not filtered. The bottles and vials were not rinsed prior to filling. The bottles and vials were sealed with a polyseal (conical) cap to minimize exchange with the atmosphere. These samples were shipped to the USGS Stable Isotope Laboratory in Reston, Virginia, for analysis according to methods outlined by Coplen and others (1991). The results of these analyses are expressed in terms of per mil values relative to Vienna Standard Mean Ocean Water (Gonfiantini, 1978). The estimate of precision (two sigma) for deuterium and oxygen-18 is 1 per mil and 0.1 per mil, respectively.

Water samples for analysis of tritium were collected in clean, dry 1-liter (L) polyethylene bottles. The samples were not filtered. Bottles were not rinsed, and care was taken not to aerate the samples during collection. Samples were sealed with a polyseal (conical) cap to minimize exchange with the atmosphere. Tritium was measured by gas scintillation (Thatcher and others, 1977) with electrolytic enrichment (Ostlund and Warner, 1962) by USGS laboratories or by laboratories under contract arrangements with the USGS. Tritium activity was reported in picocuries per liter (pCi/L). The 2-sigma detection limit for tritium ranged from 0.1 to 3.2 pCi/L, and most samples had a detection limit of 0.6– 1.3 pCi/L. The detection limit was a function of the statistics associated with the liquid scintillation counter. In general, the longer the counting time, the better the precision and the lower the detection limit.

Photograph by Russell Johnson, U.S. Geological Survey, 2004.

Figure 46. Water-quality sampling using a Keck 2-inch diameter sample pump at multiple-well monitoring site 002N006E20E001M, –20E002M, and –20E003M (Swenson Park), Swenson Park, Stockton, California, April 27, 2004.

Photograph by Russell Johnson, U.S. Geological Survey, 2004.

Figure 47. Water-quality sampling using a Grundfos 2-inch diameter sample pump at Sperry Road multiple-well monitoring site 001N006E36C003M and –36C004M, near Sperry Road, Stockton, California, April 29, 2004.

Water samples intended for analysis of carbon-13/12 isotope ratio and carbon-14 isotopes were collected in 1-L amber glass bottles. Samples were filtered in the field using a membrane (PES) filter capsule with 0.45-µm pore size. The bottle was bottom-filled and allowed to overflow to an amount three times the bottle volume, then sealed with Teflon-septa cap and held on ice. Carbon-13 and carbon-14 isotopes of the dissolved inorganic carbon were analyzed by USGS-approved contract laboratories using mass spectrometry (Gleason and others, 1969) and accelerator mass spectrometry analytical methods and reporting (Beukens, 1992; table 10). Results of the carbon-13 analyses are reported in per mil relative to the Vienna PeeDee Belemnite standard (Coplen, 1994). The activity of carbon-14 is reported with one-sigma estimate of precision relative to the 1950 National Bureau of Standards for oxalic acid standard (Stuiver and Polach, 1977; Wigley and Muller, 1981).

Unfiltered samples from private and public supply wells were collected by DWR personnel in 1-L bottles from a groundwater salinity monitoring network operated by the County of San Joaquin during July–August 2004. These samples were analyzed as part of this study for a limited number of constituents including chloride, bromide, iodide, barium, and boron. These chemical constituents are considered to be conservative (nonreactive) and are valuable in determining the sources of high-chloride water to wells (Izbicki and others, 2005). Samples were filtered after arrival at the USGS laboratory in San Diego, Calif., prior to shipment to the NWQL for analysis. The pH and specific conductance of these samples were not determined in the field, but instead were determined in the San Diego laboratory prior to filtration.

For multiple-well sites sampled as part of this study, nutrient data are provided in table 11, field measurements and water-quality data are provided in table 12, and isotopic data are provided in table 13. For selected public-supply, industrial, agricultural, or domestic wells, nutrient data are provided in table 14, field measurements and water-quality data are provided in table 15, and isotopic data are provided in table 16. Construction data for sampled public-supply, industrial, agricultural, or domestic wells are provided in table 17, and the location of these wells is shown in figure 48.

Table 10. Analytical methods and reporting limits for water samples submitted to the U.S. Geological Survey National Water Quality Laboratory, Denver, Colorado.

[**Abbreviations**: ASF, automated-segmented flow; std, standard; mg/L, milligram per liter; pCi/L, picocuries per liter; per mil, parts per thousand; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25° Celsius; °C, degree Celsius]

Constituent	Methodology	Reporting limit	Reference
	Field parameters		
pH	pH electrode	0.1 std units	Fishman and Friedman, 1989
Specific conductance	Wheatstone bridge	1.0 µS/cm	Fishman and Friedman, 1989
Dissolved oxygen	Indigo carmine	0.2 mg/L	CHEMetrics, Inc., Calverton, Va.
Alkalinity	Titration with sulfuric acid	1.0 mg/L	Fishman and Friedman, 1989
	Major ions		
Calcium, dissolved	Inductively coupled plasma	0.011 mg/L	Fishman, 1993
Chloride, dissolved	Ion chromatography	0.08 mg/L	Fishman and Friedman, 1989
Dissolved solids	Gravimetric, residue on evaporation at 180°C	10 mg/L	Fishman and Friedman, 1989
Magnesium, dissolved	Inductively coupled plasma	0.008 mg/L	Fishman, 1993
Potassium, dissolved	Atomic adsorption, flame	0.09 mg/L	Fishman and Friedman, 1989
Silica, dissolved	Colorimetry, ASF	0.48 mg/L	Fishman and Friedman, 1989
Sodium, dissolved	Inductively coupled plasma	0.06 mg/L	Fishman, 1993
Sulfate, dissolved	Ion chromatography	0.11 mg/L	Fishman and Friedman, 1989
	Nutrients		
Nitrite, dissolved	Colorimetry, ASF,	0.006 mg/L	Fishman, 1993
Nitrite + nitrate, dissolved	Colorimetry, ASF, cadmium reduction-diazotization	0.047 mg/L	Fishman, 1993
Ammonia, dissolved	Colorimetry, ASF, salicylate-hypochlorite	0.041 mg/L	Fishman, 1993
Ammonia + organic nitrogen, dissolved	Colorimetry, ASF, micro-Kjeldahl digestion	0.10 mg/L	Patton and Truitt, 1992
Phosphorus, dissolved	Colorimetry, ASF, micro-Kjeldahl digestion	0.05 mg/L	Patton and Truitt, 1992
Orthophosphate, dissolved	Colorimetry, ASF, phosphomolybdate	0.018 mg/L	Fishman, 1993
	Trace elements		
Arsenic, dissolved	Graphite furnace atomic adsorption	2.0 µg/L	Jones and Garbarino, 1999
Barium, dissolved	Inductively coupled plasma	0.9 µg/L	Fishman, 1993
Boron, dissolved	Inductively coupled plasma	13 µg/L	Struzeski and others, 1996
Bromide, dissolved	Colorimetry, ASF	0.01 mg/L	Fishman and Friedman, 1989
Fluoride, dissolved	ASF, ion-selective electrode	0.16 mg/L	Fishman and Friedman, 1989
Iodide, dissolved	Colorimetry, ASF, ceric-arseneous	0.001 mg/L	Fishman and Friedman, 1989
Iron, dissolved	Inductively coupled plasma	10.0 µg/L	Fishman, 1993
Manganese, dissolved	Inductively coupled plasma	3.2 µg/L	Fishman, 1993
	Isotopes		
Carbon-14	Accelerator mass spectrometry	0.3 percent	Beukens, R.P., 1992
Carbon-13/carbon-12	Mass spectrometry	0.15 per mil	Gleason and others, 1969
Deuterium/protium	Mass spectrometry	2 per mil	Coplen and others, 1991
Oxygen-18/oxygen-16	Mass spectrometry	0.2 per mil	Epstein and Mayeda, 1953
Tritium	Electrolytic enrichment and liquid scintillation	1.0 pCi/L	Thatcher and others, 1977

Table 11. Nutrient data for water from selected multiple-well monitoring sites, Eastern San Joaquin Groundwater Subbasin, California, 2004–7.

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State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Ammonia plus organic nitrogen (mg/L as N) (00623)	Ammonia (mg/L as N) (00608)	Nitrate plus nitrite (mg/L as N) (00631)	Nitrate (mg/L as N) (00618)	Nitrite (mg/L as N) (00613)	Ortho-phosphate (mg/L as P) (00671)	Phosphorus (mg/L as P) (00666)
001N006E04J003M	NWQL	01/25/2006	14:30	E0.08	0.050	<0.06	<0.06	<0.008	0.130	0.14
	NWQL	08/08/2006	15:00	E0.08	0.051	<0.06	<0.06	<0.002	0.112	0.09
001N006E04J004M	NWQL	01/27/2006	16:40	0.19	0.100	<0.06	<0.06	<0.008	0.230	0.26
	NWQL	08/09/2006	11:50	0.14	0.101	<0.06	<0.06	<0.002	0.251	0.23
001N006E04J005M	NWQL	01/27/2006	14:30	0.17	0.090	<0.06	<0.06	<0.008	0.700	0.71
	NWQL	08/10/2006	11:45	0.14	0.078	<0.06	<0.06	<0.002	0.419	0.39
001N006E36C003M	NWQL	04/29/2004	14:30	<0.10	E0.040	<0.06	<0.06	<0.008	0.050	0.04
001N006E36C004M	NWQL	04/29/2004	16:30	<0.10	E0.030	<0.06	<0.06	<0.008	0.170	0.15
001N006E36C005M	NWQL	04/30/2004	11:30	<0.10	<0.040	<0.06	<0.06	<0.008	0.030	E0.02
002N005E01A002M	NWQL	05/25/2005	16:00	0.14	0.130	<0.06	<0.06	<0.008	0.440	0.59
	NWQL	07/14/2006	15:15	0.19	0.145	<0.06	<0.06	<0.002	0.221	0.24
002N005E01A003M	NWQL	05/26/2005	11:30	0.14	0.130	<0.06	<0.06	<0.008	0.400	0.61
	NWQL	07/13/2006	20:05	0.16	0.133	<0.06	<0.06	<0.002	1.210	1.27
002N005E01A004M	NWQL	05/24/2005	14:00	0.16	0.160	<0.06	<0.06	<0.008	0.150	0.26
	NWQL	07/13/2006	13:00	0.21	0.158	<0.06	<0.06	<0.002	0.102	0.09
002N005E01A005M	NWQL	05/24/2005	17:20	0.15	0.140	<0.06	<0.06	<0.008	0.250	0.56
	NWQL	07/13/2006	16:00	0.16	0.138	<0.06	<0.06	<0.002	1.020	1.06
002N005E01A006M	NWQL	05/25/2005	17:20	E0.09	<0.040	<0.06	<0.06	<0.008	0.260	0.68
	NWQL	07/14/2006	10:00	0.15	0.061	0.21	0.18	0.030	1.090	1.16
002N006E08N001M	NWQL	07/14/2006	20:35	0.10	0.028	<0.06	<0.06	<0.002	0.078	0.07
002N006E08N002M	NWQL	07/11/2006	20:00	E0.09	0.032	<0.06	<0.06	<0.002	0.222	0.27
002N006E08N003M	NWQL	07/11/2006	15:00	E0.10	0.023	<0.06	<0.06	<0.002	0.081	0.10
002N006E11H004M	NWQL	05/27/2005	13:00	<0.10	<0.040	<0.06	<0.06	<0.008	0.120	0.12
002N006E11H005M	NWQL	05/28/2005	13:00	<0.10	<0.040	<0.06	<0.06	<0.008	0.170	0.31
002N006E11H006M	NWQL	05/28/2005	15:00	<0.10	<0.040	1.79	1.79	<0.008	0.070	0.16
002N006E11H007M	NWQL	05/27/2005	15:00	<0.10	<0.040	3.13	3.13	<0.008	0.070	0.16
002N006E11H008M	NWQL	01/23/2006	11:00	0.12	<0.040	<0.06	<0.06	<0.008	0.030	E0.04
002N006E12H002M	NWQL	08/21/2007	17:00	<0.10	<0.020	0.61	0.61	<0.002	0.052	E0.04
002N006E12H003M	NWQL	08/21/2007	13:10	<0.10	<0.020	0.96	E0.96	E0.001	0.051	E0.03
002N006E20E001M	NWQL	04/28/2004	18:00	<0.10	<0.040	<0.06	<0.06	<0.008	0.140	0.15

Table 11. Nutrient data for water from selected multiple-well monitoring sites, Eastern San Joaquin Groundwater Subbasin, California, 2004–7.—Continued

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State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Ammonia plus organic nitrogen (mg/L as N) (00623)	Ammonia (mg/L as N) (00608)	Nitrate plus nitrite (mg/L as N) (00631)	Nitrate (mg/L as N) (00618)	Nitrite (mg/L as N) (00613)	Ortho-phosphate (mg/L as P) (00671)	Phosphorus (mg/L as P) (00666)
002N006E20E002M	NWQL	04/28/2004	16:30	<0.10	<0.040	<0.06	<0.06	<0.008	0.190	0.19
002N006E20E003M	NWQL	04/27/2004	18:00	<0.10	<0.040	<0.06	<0.06	<0.008	0.080	0.08
002N006E24P001M	SD	07/28/2004	16:11	–	–	–	0.86	<0.030	<0.500	–
	NWQL	07/28/2004	18:00	<0.10	<0.040	0.71	0.71	<0.008	0.030	E0.02
	SD	07/28/2004	18:01	–	–	–	0.70	<0.030	<0.500	–
	NWQL	02/01/2005	12:30	–	<0.040	0.77	0.76	0.016	0.022	–
002N006E24P002M	NWQL	07/28/2004	16:10	<0.10	<0.040	0.87	0.87	<0.008	0.030	E0.03
	NWQL	02/02/2005	11:00	–	<0.040	0.70	0.70	<0.008	0.030	–
002N006E24P003M	NWQL	07/26/2004	15:30	<0.10	<0.040	0.96	0.96	<0.008	0.040	E0.02
	SD	07/26/2004	15:31	–	–	–	A0.95	<0.030	<0.500	–
	NWQL	02/03/2005	11:30	–	<0.040	1.06	1.06	<0.008	0.031	–
002N006E29H001M	NWQL	07/12/2006	15:30	E0.08	0.025	<0.06	<0.06	<0.002	0.294	0.32
002N006E29H002M	NWQL	07/12/2006	17:15	0.11	0.030	<0.06	<0.06	<0.002	0.666	0.84
002N006E29H003M	NWQL	07/12/2006	12:10	E0.10	0.025	<0.06	<0.06	<0.002	0.442	0.56
002N007E07K006M	NWQL	07/11/2007	14:00	<0.10	<0.020	0.41	0.41	<0.002	0.044	E0.02
002N007E07K007M	NWQL	07/11/2007	13:10	<0.10	<0.020	1.00	1.00	<0.002	0.053	0.04

Table 12. Field measurements and water-quality data for water from selected multiple-well monitoring sites, Eastern San Joaquin Groundwater Subbasin, California, 2004–7.

[Site locations are shown in figure 2. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Data analyzed by U.S. Geological Survey National Water Quality Laboratory in Arvada, Colorado (NWQL), and the U.S. Geological Survey Laboratory in San Diego, California (SD). Dissolved oxygen, specific conductance, and pH were analyzed in the field. **Abbreviations**: A, average value; E, estimated value; FET, fixed end-point titration; hh:mm, hour:minute; INC, incremental titration; mg/L, milligrams per liter; mm/dd/yyyy; month/day/year; µS/cm, microsiemens per centimeter at 25° Celsius; °C, degrees Celsius; –, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Dissolved oxygen, unfiltered (mg/L) (00300)	pH, unfiltered field, standard units (00400)	pH, unfiltered laboratory, standard units (00403)	Specific conductance, unfiltered laboratory (µS/cm) (90095)	Specific conductance, unfiltered field (µS/cm) (00095)	Temperature (°C) (00010)	Calcium, filtered (mg/L as Ca) (00915)	Magnesium, filtered (mg/L as Mg) (00925)
001N006E04J003M	NWQL	01/25/2006	14:30	–	7.8	8.1	1,240	1,230	20.1	17.6	9.22
	NWQL	08/08/2006	15:00	0.5	7.8	7.8	1,290	1,320	22.0	19.0	9.91
	NWQL	03/28/2007	10:10	–	–	–	1,270	–	–	–	–
	NWQL	10/24/2007	16:35	–	7.6	–	–	1,320	–	–	–
001N006E04J004M	NWQL	01/27/2006	16:40	–	7.7	7.8	1,780	1,790	22.0	34.3	20.6
	NWQL	08/09/2006	11:50	0.3	7.7	7.5	1,800	1,780	21.5	35.3	20.6
	NWQL	03/28/2007	11:15	–	–	–	1,390	–	–	–	–
	NWQL	10/25/2007	10:10	–	7.5	–	–	1,360	–	–	–
001N006E04J005M	NWQL	01/27/2006	14:30	0.4	8.1	8.1	667	685	22.0	10.8	5.11
	NWQL	08/10/2006	11:45	0.2	8.0	8.0	499	498	20.5	6.58	3.77
	NWQL	03/28/2007	12:25	–	–	–	487	–	–	–	–
	NWQL	10/25/2007	11:15	–	7.5	–	–	521	–	–	–
001N006E36C003M	NWQL	04/29/2004	14:30	–	7.8	7.7	741	789	22.0	24.6	9.15
	NWQL	03/28/2007	17:15	–	–	–	629	–	–	–	–
	NWQL	10/25/2007	13:35	–	7.3	–	–	795	–	–	–
001N006E36C004M	NWQL	04/29/2004	16:30	–	8.1	7.8	303	328	21.5	10.8	3.47
	NWQL	03/28/2007	18:10	–	–	–	321	–	–	–	–
	NWQL	10/25/2007	15:00	–	7.1	–	–	351	–	–	–
001N006E36C005M	NWQL	04/30/2004	11:30	–	7.8	7.7	438	469	20.0	44.9	16.6
	NWQL	03/28/2007	18:55	–	–	–	475	–	–	–	–
	NWQL	10/25/2007	16:15	–	7.3	–	–	466	–	–	–
002N005E01A002M	NWQL	04/28/2005	10:00	–	–	–	–	4,060	–	–	–
	NWQL	04/30/2005	10:00	–	–	–	–	2,190	–	–	–
	NWQL	05/25/2005	16:00	–	7.5	7.6	5,280	5,500	23.4	176	89.8
	NWQL	07/14/2006	15:15	0.1	7.7	7.5	5,750	5,680	22.1	186	91.0
	NWQL	07/25/2006	10:00	–	–	–	–	10,800	–	–	–
	NWQL	07/25/2006	10:01	–	–	–	–	8,120	–	–	–
	NWQL	07/25/2006	10:02	–	–	–	–	3,480	–	–	–
	NWQL	07/31/2006	10:00	–	–	–	–	–	–	–	–
	NWQL	07/31/2006	10:01	–	–	–	–	–	–	–	–
	NWQL	07/31/2006	10:02	–	–	–	–	–	–	–	–
002N005E01A002M	NWQL	03/26/2007	10:45	–	–	–	5,790	–	–	–	–
	NWQL	11/08/2007	07:25	–	7.6	–	–	5,630	–	–	–

Table 12. Field measurements and water-quality data for water from selected multiple-well monitoring sites, Eastern San Joaquin Groundwater Subbasin, California, 2004–7.—Continued

[Site locations are shown in figure 2. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Data analyzed by U.S. Geological Survey National Water Quality Laboratory in Arvada, Colorado (NWQL), and the U.S. Geological Survey Laboratory in San Diego, California (SD). Dissolved oxygen, specific conductance, and pH were analyzed in the field. **Abbreviations**: A, average value; E, estimated value; FET, fixed end-point titration; hh:mm, hour:minute; INC, incremental titration; mg/L, milligrams per liter; mm/dd/yyyy; month/day/year; µS/cm, microsiemens per centimeter at 25° Celsius; °C, degrees Celsius; –, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Dissolved oxygen, unfiltered (mg/L) (00300)	pH, unfiltered field, standard units (00400)	pH, unfiltered laboratory, standard units (00403)	Specific conductance, unfiltered laboratory (µS/cm) (90095)	Specific conductance, unfiltered field (µS/cm) (00095)	Temperature (°C) (00010)	Calcium, filtered (mg/L as Ca) (00915)	Magnesium, filtered (mg/L as Mg) (00925)
002N005E01A003M	NWQL	05/26/2005	11:30	–	7.5	7.6	2,120	2,160	21.6	98.5	49.0
	NWQL	07/13/2006	20:05	–	7.5	7.6	2,070	2,030	21.1	89.3	40.8
	NWQL	03/26/2007	12:00	–	–	–	2,110	–	–	–	–
	NWQL	11/08/2007	08:25	–	7.4	–	–	2,070	–	–	–
002N005E01A004M	NWQL	05/24/2005	14:00	–	7.4	7.5	3,100	3,250	22.2	152	73.7
	NWQL	07/13/2006	13:00	0.2	7.4	7.5	3,150	3,090	21.2	155	71.5
	NWQL	03/26/2007	13:50	–	–	–	3,140	–	–	–	–
	NWQL	11/08/2007	09:15	–	7.4	–	–	3,070	–	–	–
002N005E01A005M	NWQL	05/24/2005	17:20	–	7.6	7.7	1,890	1,980	21.6	107	57.2
	NWQL	07/13/2006	16:00	0.1	7.6	7.7	1,980	1,940	20.7	132	54.7
	NWQL	03/26/2007	14:45	–	–	–	1,940	–	–	–	–
	NWQL	11/08/2007	10:00	–	7.4	–	–	2,150	–	–	–
002N005E01A006M	NWQL	05/25/2005	17:20	–	7.2	7.3	5,900	6,110	20.7	550	223
	NWQL	07/14/2006	10:00	0.1	7.6	7.3	6,200	5,900	19.4	582	219
	NWQL	03/26/2007	15:35	–	–	–	6,290	–	–	–	–
	NWQL	11/08/2007	10:30	–	7.4	–	–	6,210	–	–	–
002N006E08N001M	NWQL	07/14/2006	20:35	–	8.1	8.0	643	641	20.7	14.7	5.22
	NWQL	07/21/2006	10:02	–	–	–	–	–	–	–	–
	NWQL	07/21/2006	10:03	–	–	–	–	–	–	–	–
	NWQL	03/26/2007	17:15	–	–	–	767	–	–	–	–
	NWQL	11/08/2007	12:35	–	7.6	–	–	664	–	–	–
002N006E08N002M	NWQL	07/11/2006	20:00	0.1	8.1	8.2	380	379	20.2	8.52	2.94
	NWQL	03/26/2007	17:40	–	–	–	356	–	–	–	–
	NWQL	11/08/2007	13:05	–	7.4	–	–	394	–	–	–
002N006E08N003M	NWQL	07/11/2006	15:00	–	8.0	8.1	275	272	19.7	22.2	7.25
	NWQL	03/26/2007	18:00	–	–	–	273	–	–	–	–
	NWQL	11/08/2007	13:30	–	7.3	–	–	296	–	–	–
002N006E11H004M	NWQL	05/04/2005	10:00	–	–	–	–	601	–	–	–
	NWQL	05/27/2005	13:00	–	8.2	8.2	324	353	21.9	3.88	1.76
002N006E11H005M	NWQL	05/28/2005	13:00	–	8.2	7.3	226	227	20.8	12.3	5.65
002N006E11H006M	NWQL	05/28/2005	15:00	2.3	7.6	7.6	435	486	19.9	44.0	25.2
002N006E11H007M	NWQL	05/27/2005	15:00	0.4	7.7	7.8	333	367	21.5	33.4	18.7
002N006E11H008M	NWQL	01/23/2006	11:00	4.5	8.0	8.0	184	179	16.0	16.8	7.89

Table 12. Field measurements and water-quality data for water from selected multiple-well monitoring sites, Eastern San Joaquin Groundwater Subbasin, California, 2004–7.—Continued

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State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Dissolved oxygen, unfiltered (mg/L) (00300)	pH, unfiltered field, standard units (00400)	pH, unfiltered laboratory, standard units (00403)	Specific conductance, unfiltered laboratory (µS/cm) (90095)	Specific conductance, unfiltered field (µS/cm) (00095)	Temperature (°C) (00010)	Calcium, filtered (mg/L as Ca) (00915)	Magnesium, filtered (mg/L as Mg) (00925)
002N006E11H010MLYS	NWQL	01/28/2006	11:30	–	7.4	–	–	188	–	18.4	6.66
	NWQL	01/28/2006	11:30	–	7.4	–	–	188	–	–	–
002N006E12H002M	NWQL	08/21/2007	17:00	4.8	7.8	7.9	247	247	21.5	20.2	11.0
002N006E12H003M	NWQL	08/21/2007	13:10	3.9	7.6	7.7	373	367	22.0	33.1	16.8
002N006E20E001M	NWQL	04/28/2004	18:00	–	8.1	8.0	570	625	22.0	7.80	2.57
	NWQL	03/27/2007	11:15	–	–	–	610	–	–	–	–
	NWQL	11/07/2007	07:20	–	7.0	–	–	637	–	–	–
002N006E20E002M	NWQL	04/28/2004	16:30	–	8.1	7.9	399	437	21.0	7.60	2.77
	NWQL	03/27/2007	12:55	–	–	–	421	–	–	–	–
	NWQL	11/07/2007	09:45	–	7.5	–	–	454	–	–	–
002N006E20E003M	NWQL	04/27/2004	18:00	–	8.1	E7.7	309	337	20.5	17.8	5.98
	NWQL	03/27/2007	14:20	–	–	–	323	–	–	–	–
	NWQL	11/07/2007	08:35	–	7.8	–	–	346	–	–	–
002N006E24P001M	SD	07/28/2004	16:11	–	–	–	–	–	–	–	–
	NWQL	07/28/2004	18:00	–	7.8	8.1	246	253	23.0	19.0	11.5
	SD	07/28/2004	18:01	–	–	–	–	–	–	–	–
	NWQL	02/01/2005	12:30	3.4	8.0	7.8	242	252	20.7	19.2	12.2
002N006E24P002M	NWQL	07/28/2004	16:10	3.6	7.5	7.7	269	281	21.0	22.7	13.0
	NWQL	02/02/2005	11:00	5.9	7.7	7.9	238	262	20.5	20.4	12.2
002N006E24P003M	NWQL	07/26/2004	15:30	0.2	7.2	7.6	297	298	23.1	25.8	14.2
	SD	07/26/2004	15:31	–	–	–	–	–	–	–	–
	NWQL	02/03/2005	11:30	1.4	7.6	7.6	286	313	21.1	27.4	15.7
002N006E29H001M	NWQL	07/12/2006	15:30	0.2	8.1	8.2	572	576	24.7	4.35	1.76
	NWQL	07/21/2006	10:00	–	–	–	–	–	–	–	–
	NWQL	07/21/2006	10:01	–	–	–	–	–	–	–	–
	NWQL	11/07/2007	12:10	–	7.7	–	–	606	–	–	–
002N006E29H002M	NWQL	07/12/2006	17:15	0.1	8.4	8.5	491	498	20.7	3.96	1.22
	NWQL	11/07/2007	12:55	–	7.7	–	–	499	–	–	–
002N006E29H003M	NWQL	07/12/2006	12:10	0.2	8.5	8.6	310	310	19.7	4.66	2.12
	NWQL	11/07/2007	13:40	–	7.7	–	–	337	–	–	–
002N007E07K006M	NWQL	07/11/2007	14:00	3.7	7.7	7.7	238	238	21.5	18.2	10.5
002N007E07K007M	NWQL	07/11/2007	13:10	2.8	7.4	7.7	466	461	20.0	43.5	25.2

Table 12. Field measurements and water-quality data for water from selected multiple-well monitoring sites, Eastern San Joaquin Groundwater Subbasin, California, 2004–7.—Continued

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State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Potassium, filtered (mg/L as K) (00935)	Sodium, filtered (mg/L as Na) (00930)	Alkalinity, filtered, FET field (mg/L as $CaCO_3$) (39036)	Alkalinity, filtered, FET laboratory (mg/L as $CaCO_3$) (29801)	Alkalinity, filtered, INC field (mg/L as $CaCO_3$) (39086)	Bicarbonate, filtered, FET field (mg/L as HCO_3) (29804)	Bicarbonate, filtered, INC field (mg/L as HCO_3) (00453)	Bromide, filtered (mg/L as Br) (71870)
001N006E04J003M	NWQL	01/25/2006	14:30	1.84	214	–	157	–	–	–	1.05
	NWQL	08/08/2006	15:00	1.73	221	150	155	151	182	182	1.09
	NWQL	03/28/2007	10:10	–	–	–	–	–	–	–	1.07
	NWQL	10/24/2007	16:35	–	–	–	–	–	–	–	1.10
001N006E04J004M	NWQL	01/27/2006	16:40	2.15	272	–	125	–	–	–	1.78
	NWQL	08/09/2006	11:50	1.93	274	120	126	123	149	149	1.73
	NWQL	03/28/2007	11:15	–	–	–	–	–	–	–	1.27
	NWQL	10/25/2007	10:10	–	–	–	–	–	–	–	1.19
001N006E04J005M	NWQL	01/27/2006	14:30	1.44	121	–	156	–	–	–	0.44
	NWQL	08/10/2006	11:45	0.66	96.2	160	162	160	193	193	0.23
	NWQL	03/28/2007	12:25	–	–	–	–	–	–	–	0.22
	NWQL	10/25/2007	11:15	–	–	–	–	–	–	–	0.23
001N006E36C003M	NWQL	04/29/2004	14:30	2.49	128	130	139	130	159	157	0.57
	NWQL	03/28/2007	17:15	–	–	–	–	–	–	–	0.39
	NWQL	10/25/2007	13:35	–	–	–	–	–	–	–	0.51
001N006E36C004M	NWQL	04/29/2004	16:30	0.93	62.5	130	191	133	160	159	0.09
	NWQL	03/28/2007	18:10	–	–	–	–	–	–	–	0.08
	NWQL	10/25/2007	15:00	–	–	–	–	–	–	–	0.08
001N006E36C005M	NWQL	04/30/2004	11:30	3.61	37.2	190	147	193	233	233	0.10
	NWQL	03/28/2007	18:55	–	–	–	–	–	–	–	0.08
	NWQL	10/25/2007	16:15	–	–	–	–	–	–	–	0.09
002N005E01A002M	NWQL	04/28/2005	10:00	–	–	–	–	–	–	–	3.93
	NWQL	04/30/2005	10:00	–	–	–	–	–	–	–	1.77
	NWQL	05/25/2005	16:00	15.6	867	120	121	119	145	144	6.27
	NWQL	07/14/2006	15:15	17.6	808	100	116	104	126	126	7.08
	NWQL	07/25/2006	10:00	–	–	–	–	–	–	–	10.0
	NWQL	07/25/2006	10:01	–	–	–	–	–	–	–	6.89
	NWQL	07/25/2006	10:02	–	–	–	–	–	–	–	3.35
	NWQL	07/31/2006	10:00	–	–	–	–	–	–	–	–
	NWQL	07/31/2006	10:01	–	–	–	–	–	–	–	–
	NWQL	07/31/2006	10:02	–	–	–	–	–	–	–	–
002N005E01A002M	NWQL	03/26/2007	10:45	–	–	–	–	–	–	–	6.81
	NWQL	11/08/2007	07:25	–	–	–	–	–	–	–	6.49

Table 12. Field measurements and water-quality data for water from selected multiple-well monitoring sites, Eastern San Joaquin Groundwater Subbasin, California, 2004–7.—Continued

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State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Potassium, filtered (mg/L as K) (00935)	Sodium, filtered (mg/L as Na) (00930)	Alkalinity, filtered, FET field (mg/L as $CaCO_3$) (39036)	Alkalinity, filtered, FET laboratory (mg/L as $CaCO_3$) (29801)	Alkalinity, filtered, INC field (mg/L as $CaCO_3$) (39086)	Bicarbonate, filtered, FET field (mg/L as HCO_3) (29804)	Bicarbonate, filtered, INC field (mg/L as HCO_3) (00453)	Bromide, filtered (mg/L as Br) (71870)
002N005E01A003M	NWQL	05/26/2005	11:30	21.2	242	110	107	105	128	128	2.49
	NWQL	07/13/2006	20:05	21.7	228	110	114	108	131	130	2.27
	NWQL	03/26/2007	12:00	–	–	–	–	–	–	–	2.21
	NWQL	11/08/2007	08:25	–	–	–	–	–	–	–	2.18
002N005E01A004M	NWQL	05/24/2005	14:00	33.9	359	120	116	115	140	139	3.55
	NWQL	07/13/2006	13:00	34.9	321	110	117	113	137	137	3.48
	NWQL	03/26/2007	13:50	–	–	–	–	–	–	–	3.54
	NWQL	11/08/2007	09:15	–	–	–	–	–	–	–	3.43
002N005E01A005M	NWQL	05/24/2005	17:20	16.2	176	120	116	114	140	138	1.87
	NWQL	07/13/2006	16:00	11.9	140	110	116	108	132	130	2.02
	NWQL	03/26/2007	14:45	–	–	–	–	–	–	–	2.01
	NWQL	11/08/2007	10:00	–	–	–	–	–	–	–	2.11
002N005E01A006M	NWQL	05/25/2005	17:20	8.18	240	310	313	312	378	379	5.01
	NWQL	07/14/2006	10:00	8.79	252	300	319	307	367	372	5.56
	NWQL	03/26/2007	15:35	–	–	–	–	–	–	–	5.50
	NWQL	11/08/2007	10:30	–	–	–	–	–	–	–	5.27
002N006E08N001M	NWQL	07/14/2006	20:35	8.45	99.0	140	149	134	162	160	0.41
	NWQL	07/21/2006	10:02	–	–	–	–	–	–	–	0.14
	NWQL	07/21/2006	10:03	–	–	–	–	–	–	–	0.49
	NWQL	03/26/2007	17:15	–	–	–	–	–	–	–	0.51
	NWQL	11/08/2007	12:35	–	–	–	–	–	–	–	0.39
002N006E08N002M	NWQL	07/11/2006	20:00	5.84	63.9	130	137	130	155	156	0.15
	NWQL	03/26/2007	17:40	–	–	–	–	–	–	–	0.13
	NWQL	11/08/2007	13:05	–	–	–	–	–	–	–	0.13
002N006E08N003M	NWQL	07/11/2006	15:00	3.24	22.0	100	107	100	122	120	0.08
	NWQL	03/26/2007	18:00	–	–	–	–	–	–	–	0.07
	NWQL	11/08/2007	13:30	–	–	–	–	–	–	–	0.07
002N006E11H004M	NWQL	05/04/2005	10:00	–	–	–	–	–	–	–	0.07
	NWQL	05/27/2005	13:00	4.58	76.3	170	173	172	207	207	0.04
002N006E11H005M	NWQL	05/28/2005	13:00	4.28	27.7	97	103	95	117	115	0.03
002N006E11H006M	NWQL	05/28/2005	15:00	5.72	19.2	190	196	190	232	231	0.05
002N006E11H007M	NWQL	05/27/2005	15:00	3.84	16.4	160	161	155	190	188	0.04
002N006E11H008M	NWQL	01/23/2006	11:00	1.43	8.53	–	86	–	–	–	E0.01

Table 12. Field measurements and water-quality data for water from selected multiple-well monitoring sites, Eastern San Joaquin Groundwater Subbasin, California, 2004–7.—Continued

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State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Potassium, filtered (mg/L as K) (00935)	Sodium, filtered (mg/L as Na) (00930)	Alkalinity, filtered, FET field (mg/L as $CaCO_3$) (39036)	Alkalinity, filtered, FET laboratory (mg/L as $CaCO_3$) (29801)	Alkalinity, filtered, INC field (mg/L as $CaCO_3$) (39086)	Bicarbonate, filtered, FET field (mg/L as HCO_3) (29804)	Bicarbonate, filtered, INC field (mg/L as HCO_3) (00453)	Bromide, filtered (mg/L as Br) (71870)
002N006E11H010MLYS	NWQL	01/28/2006	11:30	0.78	9.31	–	–	–	–	–	–
	NWQL	01/28/2006	11:30	–	–	–	–	–	–	–	E0.02
002N006E12H002M	NWQL	08/21/2007	17:00	4.71	11.1	110	109	108	131	130	E0.02
002N006E12H003M	NWQL	08/21/2007	13:10	4.44	14.7	150	154	151	182	183	0.03
002N006E20E001M	NWQL	04/28/2004	18:00	7.16	133	230	143	230	272	277	0.22
	NWQL	03/27/2007	11:15	–	–	–	–	–	–	–	0.19
	NWQL	11/07/2007	07:20	–	–	–	–	–	–	–	0.21
002N006E20E002M	NWQL	04/28/2004	16:30	4.13	88.7	180	160	183	218	219	0.11
	NWQL	03/27/2007	12:55	–	–	–	–	–	–	–	0.10
	NWQL	11/07/2007	09:45	–	–	–	–	–	–	–	0.10
002N006E20E003M	NWQL	04/27/2004	18:00	3.96	49.5	160	229	161	195	194	0.04
	NWQL	03/27/2007	14:20	–	–	–	–	–	–	–	0.03
	NWQL	11/07/2007	08:35	–	–	–	–	–	–	–	0.03
002N006E24P001M	SD	07/28/2004	16:11	–	–	–	–	–	–	–	<0.30
	NWQL	07/28/2004	18:00	5.23	16.6	–	120	118	–	142	0.04
	SD	07/28/2004	18:01	–	–	–	–	–	–	–	<0.30
	NWQL	02/01/2005	12:30	5.25	16.4	–	120	–	–	–	0.06
002N006E24P002M	NWQL	07/28/2004	16:10	5.30	13.7	–	127	125	–	152	0.04
	NWQL	02/02/2005	11:00	5.11	13.4	–	116	–	–	–	0.06
002N006E24P003M	NWQL	07/26/2004	15:30	4.63	15.0	–	130	127	–	155	0.05
	SD	07/26/2004	15:31	–	–	–	–	–	–	–	<0.30
	NWQL	02/03/2005	11:30	4.72	15.3	–	133	–	–	–	0.08
002N006E29H001M	NWQL	07/12/2006	15:30	3.42	125	230	254	235	281	282	0.13
	NWQL	07/21/2006	10:00	–	–	–	–	–	–	–	0.08
	NWQL	07/21/2006	10:01	–	–	–	–	–	–	–	0.14
	NWQL	11/07/2007	12:10	–	–	–	–	–	–	–	0.13
002N006E29H002M	NWQL	07/12/2006	17:15	3.15	107	230	251	233	277	278	0.04
	NWQL	11/07/2007	12:55	–	–	–	–	–	–	–	0.04
002N006E29H003M	NWQL	07/12/2006	12:10	1.65	63.6	150	161	147	176	174	E0.02
	NWQL	11/07/2007	13:40	–	–	–	–	–	–	–	E0.02
002N007E07K006M	NWQL	07/11/2007	14:00	4.09	12.5	100	106	104	126	126	E0.01
002N007E07K007M	NWQL	07/11/2007	13:10	5.54	14.4	180	186	183	222	223	0.04

Table 12. Field measurements and water-quality data for water from selected multiple-well monitoring sites, Eastern San Joaquin Groundwater Subbasin, California, 2004–7.—Continued

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State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Chloride, filtered (mg/L as Cl) (00940)	Fluoride, filtered (mg/L as F) (00950)	Iodide, filtered (mg/L as I) (71865)	Silica, filtered (mg/L as SiO_2) (00955)	Sulfate, filtered (mg/L as SO_4) (00945)	Residue on evaporation, dried at 180 °C, filtered (mg/L) (70300)	Aluminum, filtered (µg/L as Al) (01106)	Arsenic, filtered (µg/L as As) (01000)
001N006E04J003M	NWQL	01/25/2006	14:30	292	E0.09	0.628	62.9	<0.18	700	E1.5	57.5
	NWQL	08/08/2006	15:00	310	E0.07	0.654	63.0	E0.11	729	E1.1	58.7
	NWQL	03/28/2007	10:10	305	–	0.621	–	–	–	–	–
	NWQL	10/24/2007	16:35	311	–	0.715	–	–	–	–	–
001N006E04J004M	NWQL	01/27/2006	16:40	506	E0.06	0.930	55.1	<0.90	972	E1.4	39.7
	NWQL	08/09/2006	11:50	487	<0.20	0.999	54.4	<0.90	1,030	E1.1	40.4
	NWQL	03/28/2007	11:15	367	–	0.704	–	–	–	–	–
	NWQL	10/25/2007	10:10	340	–	0.733	–	–	–	–	–
001N006E04J005M	NWQL	01/27/2006	14:30	123	0.12	0.111	47.2	0.92	408	3.1	41.9
	NWQL	08/10/2006	11:45	63.0	0.12	0.144	47.3	0.41	322	2.8	26.1
	NWQL	03/28/2007	12:25	60.2	–	0.137	–	–	–	–	–
	NWQL	10/25/2007	11:15	62.4	–	0.162	–	–	–	–	–
001N006E36C003M	NWQL	04/29/2004	14:30	165	<0.17	0.372	57.2	<0.18	466	E1.1	35.0
	NWQL	03/28/2007	17:15	111	–	0.219	–	–	–	–	–
	NWQL	10/25/2007	13:35	163	–	0.348	–	–	–	–	–
001N006E36C004M	NWQL	04/29/2004	16:30	22.4	<0.17	0.057	54.1	0.19	231	E1.1	27.8
	NWQL	03/28/2007	18:10	22.4	–	0.053	–	–	–	–	–
	NWQL	10/25/2007	15:00	20.8	–	0.057	–	–	–	–	–
001N006E36C005M	NWQL	04/30/2004	11:30	20.2	<0.17	0.032	31.8	22.5	292	<1.6	7.4
	NWQL	03/28/2007	18:55	18.0	–	0.035	–	–	–	–	–
	NWQL	10/25/2007	16:15	18.2	–	0.040	–	–	–	–	–
002N005E01A002M	NWQL	04/28/2005	10:00	1,270	–	–	–	–	–	–	–
	NWQL	04/30/2005	10:00	490	–	–	–	–	–	–	–
	NWQL	05/25/2005	16:00	1,730	E0.06	3.32	59.4	<1.80	3,160	<4.8	64.3
	NWQL	07/14/2006	15:15	1,820	<0.10	3.24	52.0	<1.80	3,290	<4.8	66.8
	NWQL	07/25/2006	10:00	3,590	–	0.482	–	–	–	–	–
	NWQL	07/25/2006	10:01	2,400	–	0.412	–	–	–	–	–
	NWQL	07/25/2006	10:02	1,120	–	0.306	–	–	–	–	–
	NWQL	07/31/2006	10:00	–	–	–	–	–	–	–	<12.0
	NWQL	07/31/2006	10:01	–	–	–	–	–	–	–	<12.0
	NWQL	07/31/2006	10:02	–	–	–	–	–	–	–	<12.0
002N005E01A002M	NWQL	03/26/2007	10:45	1,820	–	3.16	–	–	–	–	–
	NWQL	11/08/2007	07:25	1,940	–	3.51	–	–	–	–	–

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State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Chloride, filtered (mg/L as Cl) (00940)	Fluoride, filtered (mg/L as F) (00950)	Iodide, filtered (mg/L as I) (71865)	Silica, filtered (mg/L as SiO_2) (00955)	Sulfate, filtered (mg/L as SO_4) (00945)	Residue on evaporation, dried at 180 °C, filtered (mg/L) (70300)	Aluminum, filtered (µg/L as Al) (01106)	Arsenic, filtered (µg/L as As) (01000)
002N005E01A003M	NWQL	05/26/2005	11:30	626	<0.10	1.32	55.9	1.54	1,240	E1.0	29.1
	NWQL	07/13/2006	20:05	580	<0.10	1.16	54.7	1.05	1,320	E0.9	28.2
	NWQL	03/26/2007	12:00	591	–	1.06	–	–	–	–	–
	NWQL	11/08/2007	08:25	596	–	1.23	–	–	–	–	–
002N005E01A004M	NWQL	05/24/2005	14:00	962	<0.10	1.85	51.2	1.42	1,810	E1.3	34.6
	NWQL	07/13/2006	13:00	932	<0.10	1.81	53.7	<0.90	1,910	<3.2	31.5
	NWQL	03/26/2007	13:50	929	–	1.72	–	–	–	–	–
	NWQL	11/08/2007	09:15	962	–	1.85	–	–	–	–	–
002N005E01A005M	NWQL	05/24/2005	17:20	547	E0.05	1.10	54.3	1.62	1,130	E1.0	10.2
	NWQL	07/13/2006	16:00	551	E0.06	0.936	47.3	2.89	1,260	E1.1	5.9
	NWQL	03/26/2007	14:45	538	–	0.876	–	–	–	–	–
	NWQL	11/08/2007	10:00	627	–	1.00	–	–	–	–	–
002N005E01A006M	NWQL	05/25/2005	17:20	1,840	<0.10	0.775	44.1	24.8	3,640	<4.8	11.5
	NWQL	07/14/2006	10:00	1,900	<0.10	0.673	45.0	25.4	4,110	<4.8	7.8
	NWQL	03/26/2007	15:35	1,970	–	0.609	–	–	–	–	–
	NWQL	11/08/2007	10:30	2,050	–	0.691	–	–	–	–	–
002N006E08N001M	NWQL	07/14/2006	20:35	112	E0.07	0.236	44.9	E0.11	382	3.7	19.9
	NWQL	07/21/2006	10:02	51.4	–	0.046	–	–	–	–	–
	NWQL	07/21/2006	10:03	142	–	0.253	–	–	–	–	–
	NWQL	03/26/2007	17:15	158	–	0.298	–	–	–	–	–
	NWQL	11/08/2007	12:35	112	–	0.252	–	–	–	–	–
002N006E08N002M	NWQL	07/11/2006	20:00	37.7	0.10	0.087	54.6	2.66	265	3.2	13.7
	NWQL	03/26/2007	17:40	34.6	–	0.079	–	–	–	–	–
	NWQL	11/08/2007	13:05	34.5	–	0.089	–	–	–	–	–
002N006E08N003M	NWQL	07/11/2006	15:00	19.9	0.11	<0.002	34.7	5.28	174	2.5	2.9
	NWQL	03/26/2007	18:00	19.1	–	0.032	–	–	–	–	–
	NWQL	11/08/2007	13:30	18.1	–	0.036	–	–	–	–	–
002N006E11H004M	NWQL	05/04/2005	10:00	18.6	–	–	–	–	–	–	–
	NWQL	05/27/2005	13:00	9.95	0.14	0.035	56.2	0.34	254	4.4	20.7
002N006E11H005M	NWQL	05/28/2005	13:00	5.59	0.14	0.030	68.9	7.46	180	4.0	9.6
002N006E11H006M	NWQL	05/28/2005	15:00	8.80	E0.09	E0.001	63.9	37.3	325	E1.4	3.0
002N006E11H007M	NWQL	05/27/2005	15:00	3.88	0.11	E0.001	64.5	13.8	263	E1.4	2.9
002N006E11H008M	NWQL	01/23/2006	11:00	3.47	0.23	0.025	63.9	4.63	155	4.5	4.7

Table 12. Field measurements and water-quality data for water from selected multiple-well monitoring sites, Eastern San Joaquin Groundwater Subbasin, California, 2004–7.—Continued

[Site locations are shown in figure 2. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Data analyzed by U.S. Geological Survey National Water Quality Laboratory in Arvada, Colorado (NWQL), and the U.S. Geological Survey Laboratory in San Diego, California (SD). Dissolved oxygen, specific conductance, and pH were analyzed in the field. **Abbreviations**: A, average value; E, estimated value; FET, fixed end-point titration; hh:mm, hour:minute; INC, incremental titration; mg/L, milligrams per liter; mm/dd/yyyy; month/day/year; µS/cm, microsiemens per centimeter at 25° Celsius; °C, degrees Celsius; –, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Chloride, filtered (mg/L as Cl) (00940)	Fluoride, filtered (mg/L as F) (00950)	Iodide, filtered (mg/L as I) (71865)	Silica, filtered (mg/L as SiO_2) (00955)	Sulfate, filtered (mg/L as SO_4) (00945)	Residue on evaporation, dried at 180 °C, filtered (mg/L) (70300)	Aluminum, filtered (µg/L as Al) (01106)	Arsenic, filtered (µg/L as As) (01000)
002N006E11H010MLYS	NWQL	01/28/2006	11:30	6.60	–	–	45.9	8.05	–	–	3.0
	NWQL	01/28/2006	11:30	–	–	–	–	–	–	–	–
002N006E12H002M	NWQL	08/21/2007	17:00	5.43	E0.09	<0.002	61.0	7.25	194	2.2	3.9
002N006E12H003M	NWQL	08/21/2007	13:10	9.84	0.10	E0.002	61.1	20.7	263	E1.4	2.6
002N006E20E001M	NWQL	04/28/2004	18:00	60.4	<0.17	0.138	53.9	<0.18	406	E1.6	42.8
	NWQL	03/27/2007	11:15	60.0	–	0.125	–	–	–	–	–
	NWQL	11/07/2007	07:20	59.9	–	0.137	–	–	–	–	–
002N006E20E002M	NWQL	04/28/2004	16:30	28.9	<0.17	0.073	55.8	0.18	307	E1.4	21.7
	NWQL	03/27/2007	12:55	27.2	–	0.065	–	–	–	–	–
	NWQL	11/07/2007	09:45	25.8	–	0.073	–	–	–	–	–
002N006E20E003M	NWQL	04/27/2004	18:00	10.0	<0.17	0.039	45.0	0.96	232	<1.6	0.9
	NWQL	03/27/2007	14:20	9.50	–	0.036	–	–	–	–	–
	NWQL	11/07/2007	08:35	9.97	–	0.041	–	–	–	–	–
002N006E24P001M	SD	07/28/2004	16:11	5.50	–	–	–	11.0	–	–	–
	NWQL	07/28/2004	18:00	5.30	<0.17	0.008	53.5	7.08	199	<1.6	3.7
	SD	07/28/2004	18:01	4.70	–	–	–	7.40	–	–	–
	NWQL	02/01/2005	12:30	5.02	E0.09	0.004	60.5	7.70	186	E0.9	3.9
002N006E24P002M	NWQL	07/28/2004	16:10	5.63	<0.17	0.002	60.5	10.9	220	<1.6	3.7
	NWQL	02/02/2005	11:00	4.76	0.10	–	66.7	9.45	194	<1.6	4.2
002N006E24P003M	NWQL	07/26/2004	15:30	6.10	<0.17	0.003	62.9	19.3	247	<1.6	3.1
	SD	07/26/2004	15:31	A5.60	–	–	–	A20.0	–	–	–
	NWQL	02/03/2005	11:30	5.72	0.12	–	68.8	20.1	235	E0.9	3.3
002N006E29H001M	NWQL	07/12/2006	15:30	38.1	0.12	0.090	58.9	0.27	400	3.7	48.2
	NWQL	07/21/2006	10:00	28.1	–	0.074	–	–	–	–	–
	NWQL	07/21/2006	10:01	47.2	–	0.068	–	–	–	–	–
	NWQL	11/07/2007	12:10	38.5	–	0.099	–	–	–	–	–
002N006E29H002M	NWQL	07/12/2006	17:15	13.5	0.15	0.038	54.1	1.63	356	4.5	43.5
	NWQL	11/07/2007	12:55	12.7	–	0.041	–	–	–	–	–
002N006E29H003M	NWQL	07/12/2006	12:10	5.59	0.16	0.035	42.9	1.00	213	4.4	7.6
	NWQL	11/07/2007	13:40	5.37	–	0.028	–	–	–	–	–
002N007E07K006M	NWQL	07/11/2007	14:00	5.26	0.11	0.002	60.4	7.25	184	E1.1	3.3
002N007E07K007M	NWQL	07/11/2007	13:10	10.6	0.12	0.003	61.1	41.9	329	<1.6	1.7

Table 12. Field measurements and water-quality data for water from selected multiple-well monitoring sites, Eastern San Joaquin Groundwater Subbasin, California, 2004–7.—Continued

[Site locations are shown in figure 2. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Data analyzed by U.S. Geological Survey National Water Quality Laboratory in Arvada, Colorado (NWQL), and the U.S. Geological Survey Laboratory in San Diego, California (SD). Dissolved oxygen, specific conductance, and pH were analyzed in the field. **Abbreviations**: A, average value; E, estimated value; FET, fixed end-point titration; hh:mm, hour:minute; INC, incremental titration; mg/L, milligrams per liter; mm/dd/yyyy; month/day/year; µS/cm, microsiemens per centimeter at 25° Celsius; °C, degrees Celsius; –, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Barium, filtered (µg/L as Ba) (01005)	Boron, filtered (µg/L as B) (01020)	Chromium, filtered (µg/L as Cr) (01030)	Iron, filtered (µg/L as Fe) (01046)	Lithium, filtered (µg/L as Li) (01130)	Manganese, filtered (µg/L as Mn) (01056)	Strontium, filtered (µg/L as Sr) (01080)
001N006E04J003M	NWQL	01/25/2006	14:30	182	1,090	–	28	5	165	196
	NWQL	08/08/2006	15:00	199	1,140	–	41	5	187	222
	NWQL	03/28/2007	10:10	202	1,120	–	–	–	–	–
	NWQL	10/24/2007	16:35	205	1,160	–	–	–	–	–
001N006E04J004M	NWQL	01/27/2006	16:40	290	761	–	82	12	352	380
	NWQL	08/09/2006	11:50	282	739	–	89	12	367	397
	NWQL	03/28/2007	11:15	211	752	–	–	–	–	–
	NWQL	10/25/2007	10:10	196	785	–	–	–	–	–
001N006E04J005M	NWQL	01/27/2006	14:30	51.6	578	–	26	3	73.5	111
	NWQL	08/10/2006	11:45	42.9	489	–	29	E1	93.3	79.3
	NWQL	03/28/2007	12:25	43.8	484	–	–	–	–	–
	NWQL	10/25/2007	11:15	45.0	497	–	–	–	–	–
001N006E36C003M	NWQL	04/29/2004	14:30	264	514	–	81	5	252	268
	NWQL	03/28/2007	17:15	194	347	–	–	–	–	–
	NWQL	10/25/2007	13:35	236	471	–	–	–	–	–
001N006E36C004M	NWQL	04/29/2004	16:30	75.9	330	–	21	E3	107	107
	NWQL	03/28/2007	18:10	85.2	300	–	–	–	–	–
	NWQL	10/25/2007	15:00	69.1	298	–	–	–	–	–
001N006E36C005M	NWQL	04/30/2004	11:30	224	135	–	<6	E2	38.8	476
	NWQL	03/28/2007	18:55	225	111	–	–	–	–	–
	NWQL	10/25/2007	16:15	221	113	–	–	–	–	–
002N005E01A002M	NWQL	04/28/2005	10:00	3,860	288	–	–	–	–	–
	NWQL	04/30/2005	10:00	394	311	–	–	–	–	–
	NWQL	05/25/2005	16:00	2,140	2,460	–	318	26	762	2,360
	NWQL	07/14/2006	15:15	2,580	2,690	–	406	<100	934	2,670
	NWQL	07/25/2006	10:00	5,370	E62	–	–	–	–	–
	NWQL	07/25/2006	10:01	2,410	87	–	–	–	–	–
	NWQL	07/25/2006	10:02	612	96	–	–	–	–	–
	NWQL	07/31/2006	10:00	–	–	<4.0	–	–	–	–
	NWQL	07/31/2006	10:01	–	–	<4.0	–	–	–	–
	NWQL	07/31/2006	10:02	–	–	<4.0	–	–	–	–
002N005E01A002M	NWQL	03/26/2007	10:45	2,300	2,520	–	–	–	–	–
	NWQL	11/08/2007	07:25	2,290	2,580	–	–	–	–	–

Table 12. Field measurements and water-quality data for water from selected multiple-well monitoring sites, Eastern San Joaquin Groundwater Subbasin, California, 2004–7.—Continued

[Site locations are shown in figure 2. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Data analyzed by U.S. Geological Survey National Water Quality Laboratory in Arvada, Colorado (NWQL), and the U.S. Geological Survey Laboratory in San Diego, California (SD). Dissolved oxygen, specific conductance, and pH were analyzed in the field. **Abbreviations**: A, average value; E, estimated value; FET, fixed end-point titration; hh:mm, hour:minute; INC, incremental titration; mg/L, milligrams per liter; mm/dd/yyyy; month/day/year; µS/cm, microsiemens per centimeter at 25° Celsius; °C, degrees Celsius; –, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Barium, filtered (µg/L as Ba) (01005)	Boron, filtered (µg/L as B) (01020)	Chromium, filtered (µg/L as Cr) (01030)	Iron, filtered (µg/L as Fe) (01046)	Lithium, filtered (µg/L as Li) (01130)	Manganese, filtered (µg/L as Mn) (01056)	Strontium, filtered (µg/L as Sr) (01080)
002N005E01A003M	NWQL	05/26/2005	11:30	1,400	370	–	432	9	765	1,220
	NWQL	07/13/2006	20:05	153	375	–	204	9	596	1,090
	NWQL	03/26/2007	12:00	1,040	380	–	–	–	–	–
	NWQL	11/08/2007	08:25	1,140	379	–	–	–	–	–
002N005E01A004M	NWQL	05/24/2005	14:00	2,540	397	–	340	12	1,520	2,040
	NWQL	07/13/2006	13:00	2,670	338	–	506	11	1,600	2,130
	NWQL	03/26/2007	13:50	2,470	355	–	–	–	–	–
	NWQL	11/08/2007	09:15	2,390	364	–	–	–	–	–
002N005E01A005M	NWQL	05/24/2005	17:20	1,250	167	–	175	11	870	1,430
	NWQL	07/13/2006	16:00	895	112	–	112	8	662	1,720
	NWQL	03/26/2007	14:45	950	125	–	–	–	–	–
	NWQL	11/08/2007	10:00	1,060	130	–	–	–	–	–
002N005E01A006M	NWQL	05/25/2005	17:20	5,510	59	–	<18	9	2,610	6,680
	NWQL	07/14/2006	10:00	3,960	47	–	<30	11	2,210	7,260
	NWQL	03/26/2007	15:35	5,710	50	–	–	–	–	–
	NWQL	11/08/2007	10:30	6,370	37	–	–	–	–	–
002N006E08N001M	NWQL	07/14/2006	20:35	197	334	–	53	3	91.6	190
	NWQL	07/21/2006	10:02	95.0	<70	–	–	–	–	–
	NWQL	07/21/2006	10:03	143	301	–	–	–	–	–
	NWQL	03/26/2007	17:15	237	455	–	–	–	–	–
	NWQL	11/08/2007	12:35	197	348	–	–	–	–	–
002N006E08N002M	NWQL	07/11/2006	20:00	68.7	178	–	9	2	42.1	106
	NWQL	03/26/2007	17:40	128	150	–	–	–	–	–
	NWQL	11/08/2007	13:05	132	148	–	–	–	–	–
002N006E08N003M	NWQL	07/11/2006	15:00	123	33	–	7	2	75.4	305
	NWQL	03/26/2007	18:00	127	35	–	–	–	–	–
	NWQL	11/08/2007	13:30	130	35	–	–	–	–	–
002N006E11H004M	NWQL	05/04/2005	10:00	61.4	531	–	–	–	–	–
	NWQL	05/27/2005	13:00	35.3	1,080	–	E6	E2	32.4	48.8
002N006E11H005M	NWQL	05/28/2005	13:00	31.2	67	–	<6	<2	31.8	145
002N006E11H006M	NWQL	05/28/2005	15:00	126	24	–	<6	2	6.7	549
002N006E11H007M	NWQL	05/27/2005	15:00	100	23	–	<6	2	5.0	418
002N006E11H008M	NWQL	01/23/2006	11:00	43.1	19	–	<6	<2	8.3	177

Table 12. Field measurements and water-quality data for water from selected multiple-well monitoring sites, Eastern San Joaquin Groundwater Subbasin, California, 2004–7.—Continued

[Site locations are shown in figure 2. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Data analyzed by U.S. Geological Survey National Water Quality Laboratory in Arvada, Colorado (NWQL), and the U.S. Geological Survey Laboratory in San Diego, California (SD). Dissolved oxygen, specific conductance, and pH were analyzed in the field. **Abbreviations**: A, average value; E, estimated value; FET, fixed end-point titration; hh:mm, hour:minute; INC, incremental titration; mg/L, milligrams per liter; mm/dd/yyyy; month/day/year; µS/cm, microsiemens per centimeter at 25° Celsius; °C, degrees Celsius; –, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Barium, filtered (µg/L as Ba) (01005)	Boron, filtered (µg/L as B) (01020)	Chromium, filtered (µg/L as Cr) (01030)	Iron, filtered (µg/L as Fe) (01046)	Lithium, filtered (µg/L as Li) (01130)	Manganese, filtered (µg/L as Mn) (01056)	Strontium, filtered (µg/L as Sr) (01080)
002N006E11H010MLYS	NWQL	01/28/2006	11:30	5.0	22	0.13	<6	–	73.8	–
	NWQL	01/28/2006	11:30	–	–	–	–	–	–	–
002N006E12H002M	NWQL	08/21/2007	17:00	59.9	30	–	<6	–	E0.2	224
002N006E12H003M	NWQL	08/21/2007	13:10	89.3	20	–	<6	–	80.7	383
002N006E20E001M	NWQL	04/28/2004	18:00	114	345	–	23	3	82.1	94.3
	NWQL	03/27/2007	11:15	104	1,690	–	–	–	–	–
	NWQL	11/07/2007	07:20	106	1,840	–	–	–	–	–
002N006E20E002M	NWQL	04/28/2004	16:30	79.1	258	–	13	4	66.5	98.6
	NWQL	03/27/2007	12:55	82.0	724	–	–	–	–	–
	NWQL	11/07/2007	09:45	74.6	786	–	–	–	–	–
002N006E20E003M	NWQL	04/27/2004	18:00	166	352	–	20	E3	109	216
	NWQL	03/27/2007	14:20	178	302	–	–	–	–	–
	NWQL	11/07/2007	08:35	179	312	–	–	–	–	–
002N006E24P001M	SD	07/28/2004	16:11	–	–	–	–	–	–	–
	NWQL	07/28/2004	18:00	57.4	32	5.3	100	<3	9	219
	SD	07/28/2004	18:01	–	–	–	–	–	–	–
	NWQL	02/01/2005	12:30	49.0	35	2.7	38	E0.3	9	226
002N006E24P002M	NWQL	07/28/2004	16:10	68.4	27	7.5	<6	<3	<0.8	260
	NWQL	02/02/2005	11:00	61.0	26	7.7	<6	E0.6	–	241
002N006E24P003M	NWQL	07/26/2004	15:30	80.7	24	2.3	<6	<3	<0.8	294
	SD	07/26/2004	15:31	–	–	–	–	–	–	–
	NWQL	02/03/2005	11:30	83.0	22	2.1	<6	1	0.2	321
002N006E29H001M	NWQL	07/12/2006	15:30	46.1	1,980	–	8	2	30.1	53.8
	NWQL	07/21/2006	10:00	328	E41	–	–	–	–	–
	NWQL	07/21/2006	10:01	40.9	799	–	–	–	–	–
	NWQL	11/07/2007	12:10	52.1	2,010	–	–	–	–	–
002N006E29H002M	NWQL	07/12/2006	17:15	23.6	1,640	–	E5	3	13.2	39.9
	NWQL	11/07/2007	12:55	38.9	1,740	–	–	–	–	–
002N006E29H003M	NWQL	07/12/2006	12:10	24.2	266	–	E4	E1	40.5	58.6
	NWQL	11/07/2007	13:40	32.9	291	–	–	–	–	–
002N007E07K006M	NWQL	07/11/2007	14:00	53.2	30	–	<6	–	15.6	202
002N007E07K007M	NWQL	07/11/2007	13:10	89.8	22	–	<6	2	0.7	490

Table 13. Isotopic data for water from selected multiple-well monitoring sites, Eastern San Joaquin Groundwater Subbasin, California, 2004–7.

[Site locations are shown in figure 2. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Deuterium/protium and oxygen-18/16 analyzed at USGS National Research Program, Stable Isotope Laboratory, Reston, Virginia. Carbon age analyzed by University of Waterloo, Isotope Laboratory, Waterloo, Ontario, Canada. Tritium analyzed at University of Miami, Tritium Laboratory, Miami, Florida. Dates sites were drilled given in table 1. **Abbreviations**: hh:mm, hour:minute; mm/dd/yyyy, month/day/year; per mil, parts per thousand; pCi/L, picocuries per liter; –, no data]

State well number	Date (mm/dd/yyyy)	Time (hh:mm)	Carbon-14 counting error, filtered, percent modern (49934)	Carbon-14, filtered, percent modern (49933)	Deuterium/ protium unfiltered, per mil (82082)	Tritium, unfiltered (pCi/L) (07000)	Tritium 2-sigma combined uncertainty, unfiltered (pCi/L) (75985)	Carbon-13/ carbon-12 unfiltered, per mil (82081)	Oxygen-18/ oxygen-16 unfiltered, per mil (82085)
001N006E04J003M	01/25/2006	14:30	–	–	−59.90	–	0.58	–	−8.32
	08/08/2006	15:00	0.13	5.49	−60.89	–	–	−13.81	−8.38
	03/28/2007	10:10	–	–	−62.60	–	–	–	−8.32
	10/24/2007	16:35	–	–	−62.10	–	–	–	−8.34
001N006E04J004M	01/27/2006	16:40	–	–	−59.40	–	0.58	–	−8.37
	08/09/2006	11:50	0.13	7.56	−60.26	–	–	−17.50	−8.36
	03/28/2007	11:15	–	–	−61.40	–	–	–	−8.23
	10/25/2007	10:10	–	–	−61.50	–	–	–	−8.21
001N006E04J005M	01/27/2006	14:30	–	–	−60.70	0.5	0.58	–	−8.31
	08/10/2006	11:45	0.13	9.70	−57.86	–	–	−17.94	−7.99
	03/28/2007	12:25	–	–	−58.40	–	–	–	−7.96
	10/25/2007	11:15	–	–	−58.50	–	–	–	−7.92
001N006E36C003M	04/29/2004	14:30	0.11	2.88	−65.60	–	–	−15.54	−8.64
	03/28/2007	17:15	–	–	−67.00	–	–	–	−8.61
	10/25/2007	13:35	–	–	−65.80	–	–	–	−8.60
001N006E36C004M	04/29/2004	16:30	0.21	7.58	−60.50	–	–	−15.58	−8.06
	03/28/2007	18:10	–	–	−60.60	–	–	–	−8.09
	10/25/2007	15:00	–	–	−60.20	–	–	–	−7.99
001N006E36C005M	04/30/2004	11:30	0.64	95.58	−66.80	–	–	−16.03	−8.93
	03/28/2007	18:55	–	–	−67.40	–	–	–	−8.93
	10/25/2007	16:15	–	–	−66.70	–	–	–	−8.92
002N005E01A002M	04/28/2005	10:00	–	–	−61.20	–	–	–	−7.82
	04/30/2005	10:00	–	–	−66.20	–	–	–	−8.84
	05/25/2005	16:00	0.12	1.52	−62.60	0.1	0.58	−10.90	−8.02
	07/14/2006	15:15	–	–	−59.90	–	–	–	−7.91
	07/25/2006	10:00	–	–	−56.80	–	–	–	−7.40
	07/25/2006	10:01	–	–	−59.00	–	–	–	−7.64
	07/25/2006	10:02	–	–	−60.70	–	–	–	−8.07
	03/26/2007	10:45	–	–	−61.60	–	–	–	−8.00
	11/08/2007	07:25	–	–	−60.80	–	–	–	−7.93
002N005E01A003M	05/26/2005	11:30	0.13	6.57	−62.50	0.0	0.58	−14.70	−8.39
	07/13/2006	20:05	–	–	−61.10	–	–	–	−8.36
	03/26/2007	12:00	–	–	−61.90	–	–	–	−8.41
	11/08/2007	08:25	–	–	−61.60	–	–	–	−8.36
002N005E01A004M	05/24/2005	14:00	0.12	4.57	−61.80	0.0	0.58	−10.80	−8.21
	07/13/2006	13:00	–	–	−58.50	–	–	–	−8.31
	03/26/2007	13:50	–	–	−61.70	–	–	–	−8.21
	11/08/2007	09:15	–	–	−60.40	–	–	–	−8.17
002N005E01A005M	05/24/2005	17:20	0.13	7.47	−61.60	0.2	0.58	−13.50	−8.37
	07/13/2006	16:00	–	–	−60.70	–	–	–	−8.39
	03/26/2007	14:45	–	–	−61.10	–	–	–	−8.31
	11/08/2007	10:00	–	–	−61.00	–	–	–	−8.34

Table 13. Isotopic data for water from selected multiple-well monitoring sites, Eastern San Joaquin Groundwater Subbasin, California, 2004–7.—Continued

[Site locations are shown in figure 2. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Deuterium/protium and oxygen-18/16 analyzed at USGS National Research Program, Stable Isotope Laboratory, Reston, Virginia. Carbon age analyzed by University of Waterloo, Isotope Laboratory, Waterloo, Ontario, Canada. Tritium analyzed at University of Miami, Tritium Laboratory, Miami, Florida. Dates sites were drilled given in table 1. **Abbreviations**: hh:mm, hour:minute; mm/dd/yyyy, month/day/year; per mil, parts per thousand; pCi/L, picocuries per liter; –, no data]

State well number	Date (mm/dd/yyyy)	Time (hh:mm)	Carbon-14 counting error, filtered, percent modern (49934)	Carbon-14, filtered, percent modern (49933)	Deuterium/ protium unfiltered, per mil (82082)	Tritium, unfiltered (pCi/L) (07000)	Tritium 2-sigma combined uncertainty, unfiltered (pCi/L) (75985)	Carbon-13/ carbon-12 unfiltered, per mil (82081)	Oxygen-18/ oxygen-16 unfiltered, per mil (82085)
002N005E01A006M	05/25/2005	17:20	0.40	78.16	−62.90	10.3	0.70	−20.80	−8.23
	07/14/2006	10:00	–	–	−63.20	–	–	–	−8.23
	03/26/2007	15:35	–	–	−63.00	–	–	–	−8.15
	11/08/2007	10:30	–	–	−63.90	–	–	–	−8.12
002N006E08N001M	07/14/2006	20:35	0.20	11.74	−60.00	–0.1	0.58	−16.77	−8.48
	07/21/2006	10:02	–	–	−54.50	–	–	–	−7.33
	07/21/2006	10:03	–	–	−59.10	–	–	–	−8.02
	03/26/2007	17:15	–	–	−62.10	–	–	–	−8.45
	11/08/2007	12:35	–	–	−61.70	–	–	–	−8.43
002N006E08N002M	07/11/2006	20:00	0.15	15.49	−60.40	–0.1	0.58	−17.56	−8.33
	03/26/2007	17:40	–	–	−60.10	–	–	–	−8.31
	11/08/2007	13:05	–	–	−59.40	–	–	–	−8.30
002N006E08N003M	07/11/2006	15:00	0.24	41.00	−60.30	–0.2	0.58	−19.01	−8.30
	03/26/2007	18:00	–	–	−60.40	–	–	–	−8.33
	11/08/2007	13:30	–	–	−59.40	–	–	–	−8.31
002N006E11H004M	05/04/2005	10:00	–	–	−65.40	–	–	–	−8.67
	05/27/2005	13:00	0.19	13.66	−60.60	0.5	0.58	−17.70	−8.46
	05/09/2006	–	–	–	−60.34	–	–	–	−8.37
	09/13/2006	10:10	–	–	−61.19	–	–	–	−8.51
	12/11/2006	11:30	–	–	−60.16	–	–	–	−8.40
	03/27/2007	11:40	–	–	−61.32	–	–	–	−8.45
002N006E11H005M	05/28/2005	13:00	0.27	40.60	−60.30	0.5	0.58	−17.10	−8.49
	05/09/2006	14:10	–	–	−60.37	–	–	–	−8.53
	09/13/2006	11:20	–	–	−61.25	–	–	–	−8.59
	12/11/2006	13:20	–	–	−60.37	–	–	–	−8.60
	03/27/2007	13:30	–	–	−61.28	–	–	–	−8.51
002N006E11H006M	05/28/2005	15:00	0.43	87.05	−67.80	45.8	3.20	−16.60	−9.34
	05/09/2006	12:40	–	–	−70.20	–	–	–	−9.29
	09/13/2006	12:20	–	–	−69.99	–	–	–	−9.36
	12/12/2006	09:30	–	–	−70.36	–	–	–	−9.36
	03/28/2007	10:35	–	–	−69.95	–	–	–	−9.27
002N006E11H007M	05/27/2005	15:00	0.46	96.76	−69.20	46.7	3.20	−16.40	−9.23
	05/09/2006	11:35	–	–	−70.62	–	–	–	−9.32
	09/13/2006	13:20	–	–	−71.15	–	–	–	−9.44
	12/12/2006	09:30	–	–	−71.51	–	–	–	−9.38
	03/28/2007	11:35	–	–	−72.13	–	–	–	−9.37
002N006E11H008M	01/23/2006	11:00	–	–	−70.50	10.9	0.70	–	−9.65
	09/14/2006	08:45	–	–	−66.48	–	–	–	−9.14
	12/13/2006	09:15	–	–	−52.25	–	–	–	−7.47
	03/29/2007	10:00	–	–	−54.62	–	–	–	−7.66
002N006E11H010MLYS	05/18/2006		–		−46.77				−6.84
002N006E11H012MLYS	05/10/2006		–		−73.99				−9.95
002N006E12H002M	08/21/2007	17:00	0.35	59.34	−61.65	0.3	0.58	−16.00	−8.59
002N006E12H003M	08/21/2007	13:10	0.34	74.86	−67.73	5.8	0.58	−16.47	−9.48

Table 13. Isotopic data for water from selected multiple-well monitoring sites, Eastern San Joaquin Groundwater Subbasin, California, 2004–7.—Continued

[Site locations are shown in figure 2. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Deuterium/protium and oxygen-18/16 analyzed at USGS National Research Program, Stable Isotope Laboratory, Reston, Virginia. Carbon age analyzed by University of Waterloo, Isotope Laboratory, Waterloo, Ontario, Canada. Tritium analyzed at University of Miami, Tritium Laboratory, Miami, Florida. Dates sites were drilled given in table 1. **Abbreviations**: hh:mm, hour:minute; mm/dd/yyyy, month/day/year; per mil, parts per thousand; pCi/L, picocuries per liter; –, no data]

State well number	Date (mm/dd/yyyy)	Time (hh:mm)	Carbon-14 counting error, filtered, percent modern (49934)	Carbon-14, filtered, percent modern (49933)	Deuterium/ protium unfiltered, per mil (82082)	Tritium, unfiltered (pCi/L) (07000)	Tritium 2-sigma combined uncertainty, unfiltered (pCi/L) (75985)	Carbon-13/ carbon-12 unfiltered, per mil (82081)	Oxygen-18/ oxygen-16 unfiltered, per mil (82085)
002N006E20E001M	04/28/2004	18:00	0.13	5.31	−62.00	–	–	−11.87	−8.50
	03/27/2007	11:15	–	–	−63.20	–	–	–	−8.55
	11/07/2007	07:20	–	–	−62.50	–	–	–	−8.50
002N006E20E002M	04/28/2004	16:30	0.16	7.80	−61.70	–	–	−16.34	−8.38
	03/27/2007	12:55	–	–	−60.80	–	–	–	−8.36
	11/07/2007	09:45	–	–	−60.00	–	–	–	−8.34
002N006E20E003M	04/27/2004	18:00	0.24	13.54	−59.30	–	–	−20.55	−8.25
	03/27/2007	14:20	–	–	−59.50	–	–	–	−8.17
	11/07/2007	08:35	–	–	−56.90	–	–	–	−8.20
002N006E24P001M	07/28/2004	18:00	–	–	−59.10	1.9	0.58	–	−8.50
	02/01/2005	12:30	0.35	66.38	−60.50	2.6	0.60	−16.04	−8.46
002N006E24P002M	07/28/2004	16:10	0.27	54.24	−60.60	8.8	0.58	−22.05	−8.51
	02/02/2005	11:00	0.41	79.10	−60.60	6.1	1.00	−16.24	−8.49
002N006E24P003M	07/26/2004	15:30	0.44	107.1	−59.60	33.6	1.92	−16.70	−8.27
	02/03/2005	11:30	0.50	110.0	−59.30	33.3	1.90	−15.66	−8.17
002N006E29H001M	07/12/2006	15:30	0.11	4.16	−63.50	0.1	0.58	−12.04	−8.66
	07/21/2006	10:00	–	–	−44.50	–	–	–	−5.00
	07/21/2006	10:01	–	–	−63.50	–	–	–	−8.42
	11/07/2007	12:10	–	–	−64.20	–	–	–	−8.58
002N006E29H002M	07/12/2006	17:15	0.14	5.63	−63.40	–0.3	0.58	−12.41	−8.58
	11/07/2007	12:55	–	–	−63.30	–	–	–	−8.60
002N006E29H003M	07/12/2006	12:10	0.15	16.36	−58.10	–0.1	0.58	−18.11	−8.22
	11/07/2007	13:40	–	–	−59.30	–	–	–	−8.14
002N007E07K006M	07/11/2007	14:00	0.27	58.10	−60.80	0.0	0.58	−15.76	−8.75
002N007E07K007M	07/11/2007	13:10	0.35	82.83	−69.94	13.4	0.90	−17.84	−9.74

Table 14. Nutrient data for water from selected wells, Eastern San Joaquin Groundwater Subbasin, California, 2003–7.

[Site locations are shown in figure 48. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Samples analyzed by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD). **Abbreviations**: E, estimated value; hh:mm, hour:minute; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; N, nitrogen; –, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Ammonia plus organic nitrogen, filtered (mg/L as N) (00623)	Ammonia, filtered (mg/L as N) (00608)	Nitrate plus nitrite, filtered (mg/L as N) (00631)	Nitrite, filtered (mg/L as N) (00613)	Total nitrogen (nitrate + nitrite + ammonia + organic-nitrogen), filtered (mg/L as N) (62854)	Ortho-phosphate, filtered (mg/L as P) (00671)	Phosphorus, filtered (mg/L as P) (00666)
001N006E04P002M	NWQL	11/18/2005	11:00	0.11	0.040	<0.06	<0.06	<0.008	E0.010	E0.02
	SD	11/18/2005	11:01	–	–	–	<0.06	<0.030	<0.500	–
001N006E11P003M	NWQL	11/15/2005	10:00	0.14	0.070	<0.06	<0.06	<0.008	0.080	0.08
	SD	11/15/2005	10:01	–	–	–	<0.06	<0.030	<0.500	–
	NWQL	08/03/2006	12:20	0.36	0.091	<0.06	<0.06	<0.002	0.099	0.08
001N006E12A001M	NWQL	11/16/2005	14:00	E0.09	<0.040	15.4	15.4	<0.008	0.020	E0.02
	SD	11/16/2005	14:01	–	–	–	15.4	E0.010	<5	–
	NWQL	07/10/2007	13:30	<0.10	<0.020	10.1	10.1	<0.002	0.041	E0.03
001N006E12N001M	NWQL	11/19/2005	10:00	0.22	0.120	<0.06	<0.06	<0.008	0.030	E0.03
	SD	11/19/2005	10:01	–	–	–	<0.06	<0.030	<0.500	–
	NWQL	08/04/2006	11:10	E0.10	0.110	<0.06	<0.06	<0.002	0.045	E0.03
001N006E13B003M	NWQL	08/11/2004	12:00	E0.08	E0.040	0.07	0.07	<0.008	E0.010	<0.04
	SD	08/11/2004	12:01	–	–	–	0.06	<0.030	<2	–
	NWQL	08/02/2006	12:10	<0.10	0.049	0.17	0.17	<0.002	0.036	<0.04
001N006E22J001M	NWQL	08/10/2004	16:00	0.17	0.110	<0.06	<0.06	<0.008	0.040	0.05
	SD	08/10/2004	16:01	–	–	–	<0.06	<0.030	<2	–
001N006E34A003M	NWQL	08/14/2006	15:00	0.18	0.085	3.65	3.63	0.024	0.018	<0.04
001N006E35G002M	NWQL	08/15/2006	10:00	E0.06	0.010	11.9	11.8	0.107	0.034	E0.03
001N007E18D001M	NWQL	11/15/2005	14:30	E0.05	<0.040	<0.06	<0.06	<0.008	0.020	E0.03
	SD	11/15/2005	14:31	–	–	–	<0.06	<0.030	<0.500	–
001N007E31F001M	NWQL	07/29/2004	15:30	<0.10	<0.040	1.04	1.04	<0.008	0.060	0.05
	SD	07/29/2004	15:31	–	–	–	1.00	<0.030	<0.500	–
001N008E15J001M	NWQL	08/29/2005	13:50	<0.10	<0.040	15.5	15.5	<0.008	0.060	0.07
001S006E23C003M	NWQL	08/15/2006	14:00	E0.05	E0.008	<0.06	<0.06	<0.002	0.034	<0.04
001S006E25M003M	NWQL	08/09/2004	16:00	0.10	<0.040	4.10	4.10	<0.008	0.020	E0.03
	SD	08/09/2004	16:01	–	–	–	A4	<0.030	<0.500	–
	NWQL	04/02/2008	09:50	–	<0.020	3.52	3.52	<0.002	0.034	–
001S006E25M004M	NWQL	08/09/2004	14:00	E0.09	<0.040	2.48	2.48	<0.008	0.030	E0.03
	SD	08/09/2004	14:01	–	–	–	2.43	<0.030	<0.500	–
001S008E13M001M	NWQL	08/30/2005	11:20	0.12	<0.040	8.69	8.69	<0.008	0.020	E0.03
002N006E06B001M	NWQL	05/27/2004	13:30	E0.10	<0.040	9.64	9.64	<0.008	0.020	E0.03
	NWQL	08/02/2006	18:00	E0.07	<.010	3.77	3.77	<0.002	0.040	<0.04

Table 14. Nutrient data for water from selected wells, Eastern San Joaquin Groundwater Subbasin, California, 2003–7.—Continued

[Site locations are shown in figure 48. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Samples analyzed by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD). **Abbreviations**: E, estimated value; hh:mm, hour:minute; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; N, nitrogen; –, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Ammonia plus organic nitrogen, filtered (mg/L as N) (00623)	Ammonia, filtered (mg/L as N) (00608)	Nitrate plus nitrite, filtered (mg/L as N) (00631)	Nitrite, filtered (mg/L as N) (00613)	Total nitrogen (nitrate + nitrite + ammonia + organic-nitrogen), filtered (mg/L as N) (62854)	Ortho-phosphate, filtered (mg/L as P) (00671)	Phosphorus, filtered (mg/L as P) (00666)
002N006E06C003M	NWQL	07/27/2004	16:10	E0.08	<0.040	2.02	2.00	0.015	<0.020	<0.04
	SD	07/27/2004	16:11	–	–	–	1.94	E0.020	<5	–
002N006E08Q002M	NWQL	08/11/2004	15:30	0.10	<0.040	12.4	12.4	<0.008	0.030	E0.03
	SD	08/11/2004	15:31	–	–	–	11.5	<0.030	<2	–
002N007E10P001M	NWQL	01/10/2005	14:00	–	<0.040	0.54	0.54	<0.008	0.025	–
002N008E16L001M	NWQL	01/13/2005	10:30	–	<0.040	0.91	0.91	<0.008	0.046	–
002S007E20J001M	NWQL	10/30/2003	14:30	–	<0.040	12.4	12.4	<0.008	0.021	–
	NWQL	01/23/2004	11:50	–	<0.040	12.9	12.9	<0.008	0.022	–
	NWQL	04/20/2004	11:40	–	<0.040	13.0	13.0	<0.008	0.020	–
	NWQL	08/05/2004	11:20	–	<0.040	14.3	14.3	<0.008	0.019	–
	NWQL	08/01/2006	12:30	–	E0.007	13.2	13.2	<0.002	0.034	–
	NWQL	07/30/2008	10:20	–	<0.020	12.4	12.4	<0.002	0.044	–
003N005E03J002M	NWQL	08/30/2005	17:20	0.36	<0.040	11.9	11.9	<0.008	0.020	E0.03
003N006E14R005M	NWQL	04/02/2008	13:10	–	<0.020	2.77	2.77	<0.002	0.039	–
003N006E18R001M	NWQL	07/12/2007	15:00	0.20	<0.020	25.1	25.1	<0.002	0.067	0.04
003N006E24N001M	NWQL	11/18/2004	10:30	E0.10	<0.040	1.10	1.10	<0.008	0.030	E0.03
003N006E30K001M	NWQL	11/18/2004	09:15	0.15	<0.040	20.3	20.3	<0.008	0.030	E0.03
	NWQL	07/09/2007	13:20	0.11	<0.020	14.8	14.8	<0.002	0.056	E0.03
003N009E36G001M	NWQL	01/11/2005	10:50	–	<0.040	3.31	3.31	<0.008	0.044	–
004N005E06J001M	NWQL	08/31/2005	11:40	0.23	0.200	<0.06	<0.06	<0.008	0.050	0.05

Table 15. Field measurements and water-quality data for water from selected wells, Eastern San Joaquin Groundwater Subbasin, California, 2003–7.

[Site locations are shown in figure 48. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD), except for dissolved oxygen, specific conductance, and pH, which were measured in the field. **Abbreviations**: E, estimated value; FET, fixed end-point titration; hh:mm, hour:minute; INC, incremental titration; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25°C; °C, degrees Celsius;–, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Dissolved oxygen, unfiltered (mg/L) (00300)	pH, unfiltered, field, standard units (00400)	pH, unfiltered, laboratory, standard units (00403)	Specific conductance, unfiltered, laboratory (µS/cm) (90095)	Specific conductance, unfiltered, field (µS/cm) (00095)	Calcium, filtered (mg/L as Ca) (00915)	Magnesium, filtered (mg/L as Mg) (00925)
001N006E04P002M	NWQL	11/18/2005	11:00	0.3	7.7	7.7	1,780	1,770	35.4	20.3
	SD	11/18/2005	11:01	–	–	–	–	–	–	–
001N006E11P003M	NWQL	11/15/2005	10:00	–	7.8	7.7	979	983	31.3	14.8
	SD	11/15/2005	10:01	–	–	–	–	–	–	–
	NWQL	08/03/2006	12:20	0.4	7.7	7.6	1,010	1,020	35.6	16.5
001N006E12A001M	NWQL	11/16/2005	14:00	2.9	7.2	7.3	1,360	1,350	135	64.3
	SD	11/16/2005	14:01	–	–	–	–	–	–	–
	NWQL	07/10/2007	13:30	2.8	7.2	7.4	1,200	1,210	110	51.0
001N006E12N001M	NWQL	11/19/2005	10:00	0.6	7.4	7.3	2,430	2,350	155	81.6
	SD	11/19/2005	10:01	–	–	–	–	–	–	–
	NWQL	08/04/2006	11:10	0.2	7.6	7.1	2,010	2,060	136	67.2
001N006E13B003M	NWQL	08/04/2004	13:25	–	–	–	1,670	–	–	–
	NWQL	08/11/2004	12:00	0.3	7.6	7.4	1,690	1,620	150	63.3
	SD	08/11/2004	12:01	–	–	–	–	–	–	–
	NWQL	08/02/2006	12:10	0.6	7.6	7.5	1,730	1,730	160	65.8
001N006E22J001M	NWQL	08/10/2004	16:00	0.0	7.8	E7.4	1,450	1,440	76.3	29.1
	SD	08/10/2004	16:01	–	–	–	–	–	–	–
001N006E26N003M	NWQL	10/18/2004	13:30	–	8.5	–	852	902	–	–
001N006E27R002M	NWQL	10/18/2004	10:45	–	–	–	3,340	–	–	–
001N006E34A003M	NWQL	10/18/2004	11:00	–	8.1	–	5,690	5,780	–	–
	NWQL	08/14/2006	15:00	0.3	7.6	7.4	5,720	5,610	430	135
001N006E35G002M	NWQL	10/18/2004	11:30	–	8.1	–	2,610	2,740	–	–
001N006E35N001M	NWQL	10/18/2004	13:00	–	8.3	–	1,500	1,530	–	–
001N007E05A001M	NWQL	02/08/2005	09:10	–	–	7.5	267	290	26.3	12.5
001N007E18D001M	NWQL	11/15/2005	14:30	0.1	7.6	7.5	1,220	1,180	103	40.6
	NWQL	11/15/2005	14:31	–	–	–	–	–	–	–
001N007E26H003M	NWQL	09/01/2004	09:45	–	–	–	444	–	–	–
001N007E27P003M	NWQL	01/12/2005	12:10	–	–	–	613	637	–	–
001N007E31F001M	NWQL	07/29/2004	15:30	–	7.9	7.7	524	549	40.6	14.6
	SD	07/29/2004	15:31	–	–	–	–	–	–	–
	NWQL	01/12/2005	09:30	–	–	7.5	515	541	41.4	15.0
001N008E10C001M	NWQL	08/02/2004	13:45	–	–	–	207	–	–	–

Table 15. Field measurements and water-quality data for water from selected wells, Eastern San Joaquin Groundwater Subbasin, California, 2003–7.—Continued

[Site locations are shown in figure 48. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD), except for dissolved oxygen, specific conductance, and pH, which were measured in the field. **Abbreviations**: E, estimated value; FET, fixed end-point titration; hh:mm, hour:minute; INC, incremental titration; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25°C; °C, degrees Celsius;–, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Dissolved oxygen, unfiltered (mg/L) (00300)	pH, unfiltered, field, standard units (00400)	pH, unfiltered, laboratory, standard units (00403)	Specific conductance, unfiltered, laboratory (µS/cm) (90095)	Specific conductance, unfiltered, field (µS/cm) (00095)	Calcium, filtered (mg/L as Ca) (00915)	Magnesium, filtered (mg/L as Mg) (00925)
001N008E15J001M	NWQL	08/29/2005	13:50	5.4	6.9	7.2	736	750	69.4	41.5
001N009E17N001M	NWQL	02/15/2005	08:10	–	–	7.6	199	211	14.8	8.22
001S006E23C003M	NWQL	08/04/2004	12:10	–	–	–	2,140	–	–	–
	NWQL	08/15/2006	14:00	0.2	7.4	7.6	2,260	2,180	202	44.4
001S006E25M003M	NWQL	08/09/2004	16:00	–	7.8	7.6	610	627	64.0	15.7
	SD	08/09/2004	16:01	–	–	–	–	–	–	–
	NWQL	10/18/2004	12:30	–	8.4	–	675	726	–	–
	NWQL	12/22/2004	09:10	–	–	–	675	–	–	–
	NWQL	01/04/2005	09:10	–	–	–	–	663	–	–
	NWQL	04/02/2008	09:50	0.4	7.7	7.9	619	603	60.3	14.0
001S006E25M004M	NWQL	08/09/2004	14:00	–	7.9	7.7	453	470	42.2	8.75
	SD	08/09/2004	14:01	–	–	–	–	–	–	–
	NWQL	10/18/2004	12:00	–	8.5	–	442	476	–	–
001S006E36B001M	NWQL	10/18/2004	09:00	–	8.5	–	370	411	–	–
001S007E27P001M	NWQL	01/04/2005	12:30	–	–	–	425	444	–	–
001S008E12L001M	NWQL	02/14/2005	11:20	–	–	7.6	200	208	13.7	7.89
001S008E13M001M	NWQL	08/31/2004	11:45	–	–	–	1,090	–	–	–
	NWQL	08/30/2005	11:20	4.1	7.2	7.3	1,180	1,180	127	67.0
001S009E11J001M	NWQL	07/28/2004	10:40	–	–	–	204	–	–	–
001S009E33P001M	NWQL	08/31/2004	10:25	–	–	–	379	–	–	–
001S009E33R001M	NWQL	01/11/2005	10:10	–	–	7.3	197	203	13.1	7.57
001S010E19P001M	NWQL	01/11/2005	13:30	–	–	–	–	487	–	–
001S010E27M001M	NWQL	02/14/2005	14:40	–	–	7.6	198	204	14.3	8.76
002N006E04E001M	NWQL	10/25/2004	13:20	–	8.4	–	402	434	–	–
002N006E06B001M	NWQL	05/27/2004	13:30	–	7.4	7.5	2,850	2,980	326	131
	NWQL	08/02/2006	18:00	0.4	7.5	7.5	1,840	1,940	194	80.9
002N006E06C003M	NWQL	07/27/2004	16:10	0.3	7.5	7.5	1,360	1,390	125	52.1
	SD	07/27/2004	16:11	–	–	–	–	–	–	–
002N006E08C001M	NWQL	10/25/2004	13:35	–	8.4	–	304	331	–	–
002N006E08Q002M	NWQL	08/11/2004	15:30	2.2	7.4	7.3	927	925	107	40.3
	SD	08/11/2004	15:31	–	–	–	–	–	–	–
	NWQL	10/19/2004	10:30	–	8.1	–	867	915	–	–

Table 15. Field measurements and water-quality data for water from selected wells, Eastern San Joaquin Groundwater Subbasin, California, 2003–7.—Continued

[Site locations are shown in figure 48. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD), except for dissolved oxygen, specific conductance, and pH, which were measured in the field. **Abbreviations**: E, estimated value; FET, fixed end-point titration; hh:mm, hour:minute; INC, incremental titration; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25°C; °C, degrees Celsius;–, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Dissolved oxygen, unfiltered (mg/L) (00300)	pH, unfiltered, field, standard units (00400)	pH, unfiltered, laboratory, standard units (00403)	Specific conductance, unfiltered, laboratory (µS/cm) (90095)	Specific conductance, unfiltered, field (µS/cm) (00095)	Calcium, filtered (mg/L as Ca) (00915)	Magnesium, filtered (mg/L as Mg) (00925)
002N006E16C002M	NWQL	07/27/2004	11:55	–	–	–	734	–	–	–
002N006E16D003M	NWQL	10/25/2004	14:25	–	8.2	–	882	903	–	–
002N006E17A001M	NWQL	10/25/2004	11:30	–	8.2	–	695	753	–	–
002N006E17G001M	NWQL	10/25/2004	15:10	–	–	–	284	310	–	–
002N006E17J001M	NWQL	01/25/2005	09:10	–	–	7.7	573	607	63.9	22.0
002N006E19L001M	NWQL	10/19/2004	10:00	–	8.6	–	957	990	–	–
002N006E29M001M	NWQL	10/18/2004	09:30	–	8.2	–	483	532	–	–
002N007E06P002M	NWQL	01/12/2005	13:30	–	–	7.6	463	483	47.7	26.1
002N007E07D002M	NWQL	10/27/2004	13:40	–	8.3	–	356	383	–	–
002N007E07Q001M	NWQL	07/27/2004	13:30	–	–	–	330	–	–	–
002N007E10P001M	NWQL	01/10/2005	14:00	6.6	7.8	7.6	235	240	20.4	11.3
002N007E25M001M	NWQL	09/01/2004	10:32	–	–	–	205	–	–	–
002N008E13G001M	NWQL	08/02/2004	13:25	–	–	–	200	–	–	–
002N008E15L001M	NWQL	01/13/2005	13:50	–	–	7.2	199	198	19.1	7.86
002N008E16L001M	NWQL	01/13/2005	10:30	5.8	7.5	E6.9	251	768	24.8	11.8
002S007E09L001M	NWQL	01/04/2005	11:10	–	–	–	319	323	–	–
002S007E20J001M	NWQL	10/30/2003	14:30	0.4	7.5	7.8	487	516	55.0	14.8
	NWQL	01/23/2004	11:50	0.4	7.9	7.7	473	489	56.6	14.7
	NWQL	04/20/2004	11:40	0.4	7.7	7.9	456	508	56.4	15.2
	NWQL	08/05/2004	11:20	0.4	7.6	7.6	526	556	60.2	15.9
	NWQL	08/01/2006	12:30	0.4	7.5	7.9	519	519	55.3	15.2
	NWQL	07/30/2008	10:20	0.4	7.7	7.8	512	512	53.3	14.6
002S007E24R002M	NWQL	08/04/2004	10:10	–	–	–	946	–	–	–
002S008E02C001M	NWQL	08/04/2004	08:50	–	–	–	468	–	–	–
002S008E20J002M	NWQL	08/04/2004	09:40	–	–	–	529	–	–	–
002S009E12R001M	NWQL	07/28/2004	09:30	–	–	–	152	–	–	–
002S009E20D001M	NWQL	01/11/2005	08:40	–	–	–	322	335	–	–
003N005E03J002M	NWQL	08/30/2005	17:20	–	7.0	7.1	1,590	1,630	139	59.8
003N006E14R005M	NWQL	01/10/2005	13:30	–	–	7.4	319	340	28.1	13.2
	NWQL	04/02/2008	13:10	5.9	7.5	7.7	354	348	30.1	13.0
003N006E18R001M	NWQL	07/12/2007	15:00	7.5	7.2	7.3	1,700	1,700	128	52.6
003N006E24N001M	NWQL	11/18/2004	10:30	2.5	7.4	7.3	1,140	1,120	107	50.1
003N006E30K001M	NWQL	11/18/2004	09:15	5.1	7.2	7.3	1,200	1,170	118	46.1

Table 15. Field measurements and water-quality data for water from selected wells, Eastern San Joaquin Groundwater Subbasin, California, 2003–7.—Continued

[Site locations are shown in figure 48. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD), except for dissolved oxygen, specific conductance, and pH, which were measured in the field. **Abbreviations**: E, estimated value; FET, fixed end-point titration; hh:mm, hour:minute; INC, incremental titration; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25°C; °C, degrees Celsius;–, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Dissolved oxygen, unfiltered (mg/L) (00300)	pH, unfiltered, field, standard units (00400)	pH, unfiltered, laboratory, standard units (00403)	Specific conductance, unfiltered, laboratory (µS/cm) (90095)	Specific conductance, unfiltered, field (µS/cm) (00095)	Calcium, filtered (mg/L as Ca) (00915)	Magnesium, filtered (mg/L as Mg) (00925)
	NWQL	07/09/2007	13:20	8.0	7.3	7.3	1,430	1,440	122	48.6
003N008E19B002M	NWQL	02/09/2005	13:30	–	–	7.4	198	219	15.2	8.87
003N008E20P001M	NWQL	08/02/2004	13:00	–	–	–	209	–	–	–
003N009E06N001M	NWQL	08/02/2004	12:40	–	–	–	136	–	–	–
003N009E36G001M	NWQL	01/11/2005	10:50	5.6	6.8	6.8	355	369	37.6	15.9
003S007E03Q001M	NWQL	01/04/2005	15:50	–	–	–	332	352	–	–
004N005E03P001M	NWQL	01/13/2005	09:30	–	–	–	440	463	–	–
004N005E06J001M	NWQL	08/31/2005	11:40	–	7.6	7.3	2,760	2,710	132	110
004N005ES6R001M	NWQL	01/13/2005	14:30	–	–	7.8	286	298	23.6	9.27
004N008E29E004M	NWQL	08/05/2004	11:40	–	–	–	395	–	–	–
004N008E31G001M	NWQL	01/10/2005	11:20	–	–	–	206	214	–	–
004N008E34G002M	NWQL	01/25/2005	16:50	–	–	7.3	186	195	12.8	6.55
004N009E17E002M	NWQL	08/02/2004	12:20	–	–	–	259	–	–	–
004N010E13C001M	NWQL	01/27/2005	09:50	–	–	7.2	380	389	22.3	22.4

Table 15. Field measurements and water-quality data for water from selected wells, Eastern San Joaquin Groundwater Subbasin, California, 2003–7.—Continued

[Site locations are shown in figure 48. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD), except for dissolved oxygen, specific conductance, and pH, which were measured in the field. **Abbreviations**: E, estimated value; FET, fixed end-point titration; hh:mm, hour:minute; INC, incremental titration; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25°C; °C, degrees Celsius;–, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Potassium, filtered (mg/L as K) (00935)	Sodium, filtered (mg/L as Na) (00930)	Alkalinity, filtered, FET field (mg/L as $CaCO_3$) (39036)	Alkalinity, filtered, FET laboratory (mg/L as $CaCO_3$) (29801)	Alkalinity, filtered, INC field (mg/L as $CaCO_3$) (39086)	Bicarbonate, filtered, FET field (mg/L as HCO_3) (29804)	Bicarbonate, filtered, INC field (mg/L as HCO_3) (00453)	Bromide, filtered (mg/L as Br) (71870)
001N006E04P002M	NWQL	11/18/2005	11:00	2.72	300	140	133	146	3	3	1.63
	SD	11/18/2005	11:01	–	–	–	–	–	–	–	1.50
001N006E11P003M	NWQL	11/15/2005	10:00	1.48	140	100	94	102	124	123	0.87
	SD	11/15/2005	10:01	–	–	–	–	–	–	–	0.80
	NWQL	08/03/2006	12:20	1.58	140	99	100	99	119	119	0.86
001N006E12A001M	NWQL	11/16/2005	14:00	5.33	51.2	320	290	318	385	387	0.57
	SD	11/16/2005	14:01	–	–	–	–	–	–	–	0.40
	NWQL	07/10/2007	13:30	5.11	46.4	230	240	237	285	288	0.61
001N006E12N001M	NWQL	11/19/2005	10:00	5.57	184	71	64	72	86	87	2.81
	SD	11/19/2005	10:01	–	–	–	–	–	–	–	3.00
	NWQL	08/04/2006	11:10	4.29	140	83	83	83	101	101	2.40
001N006E13B003M	NWQL	08/04/2004	13:25	–	–	–	–	–	–	–	1.79
	NWQL	08/11/2004	12:00	4.30	60.1	110	111	110	135	134	1.88
	SD	08/11/2004	12:01	–	–	–	–	–	–	–	<0.30
	NWQL	08/02/2006	12:10	4.29	67.5	110	115	114	138	138	1.83
001N006E22J001M	NWQL	08/10/2004	16:00	2.82	178	140	141	141	172	172	1.59
	SD	08/10/2004	16:01	–	–	–	–	–	–	–	<0.30
001N006E26N003M	NWQL	10/18/2004	13:30	–	–	–	–	–	–	–	0.74
001N006E27R002M	NWQL	10/18/2004	10:45	–	–	–	–	–	–	–	2.98
001N006E34A003M	NWQL	10/18/2004	11:00	–	–	–	–	–	–	–	5.70
	NWQL	08/14/2006	15:00	5.85	408	140	150	141	171	171	5.83
001N006E35G002M	NWQL	10/18/2004	11:30	–	–	–	–	–	–	–	2.13
001N006E35N001M	NWQL	10/18/2004	13:00	–	–	–	–	–	–	–	1.35
001N007E05A001M	NWQL	02/08/2005	09:10	5.71	15.3	–	127	–	–	–	0.06
001N007E18D001M	NWQL	11/15/2005	14:30	3.89	58.9	100	95	102	124	124	1.16
	NWQL	11/15/2005	14:31	–	–	–	–	–	–	–	1.10
001N007E26H003M	NWQL	09/01/2004	09:45	–	–	–	–	–	–	–	0.13
001N007E27P003M	NWQL	01/12/2005	12:10	–	–	–	–	–	–	–	0.21
001N007E31F001M	NWQL	07/29/2004	15:30	2.72	50.5	–	166	165	–	200	0.20
	SD	07/29/2004	15:31	–	–	–	–	–	–	–	E0.20
	NWQL	01/12/2005	09:30	2.76	53.2	–	167	–	–	–	0.11
001N008E10C001M	NWQL	08/02/2004	13:45	–	–	–	–	–	–	–	0.05

Table 15. Field measurements and water-quality data for water from selected wells, Eastern San Joaquin Groundwater Subbasin, California, 2003–7.—Continued

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State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Potassium, filtered (mg/L as K) (00935)	Sodium, filtered (mg/L as Na) (00930)	Alkalinity, filtered, FET field (mg/L as $CaCO_3$) (39036)	Alkalinity, filtered, FET laboratory (mg/L as $CaCO_3$) (29801)	Alkalinity, filtered, INC field (mg/L as $CaCO_3$) (39086)	Bicarbonate, filtered, FET field (mg/L as HCO_3) (29804)	Bicarbonate, filtered, INC field (mg/L as HCO_3) (00453)	Bromide, filtered (mg/L as Br) (71870)
001N008E15J001M	NWQL	08/29/2005	13:50	2.69	29.4	260	222	265	322	322	0.13
001N009E17N001M	NWQL	02/15/2005	08:10	3.57	12.7	–	72	–	–	–	0.06
001S006E23C003M	NWQL	08/04/2004	12:10	–	–	–	–	–	–	–	1.76
	NWQL	08/15/2006	14:00	5.86	131	160	170	164	197	200	1.74
001S006E25M003M	NWQL	08/09/2004	16:00	4.13	43.5	180	181	180	221	220	0.19
	SD	08/09/2004	16:01	–	–	–	–	–	–	–	E0.10
	NWQL	10/18/2004	12:30	–	–	–	–	–	–	–	0.18
	NWQL	12/22/2004	09:10	–	–	–	–	–	–	–	0.18
	NWQL	01/04/2005	09:10	–	–	–	–	–	–	–	–
	NWQL	04/02/2008	09:50	4.08	45.7	–	182	–	–	–	0.20
001S006E25M004M	NWQL	08/09/2004	14:00	3.32	41.7	160	161	158	194	193	0.13
	SD	08/09/2004	14:01	–	–	–	–	–	–	–	E0.20
	NWQL	10/18/2004	12:00	–	–	–	–	–	–	–	0.17
001S006E36B001M	NWQL	10/18/2004	09:00	–	–	–	–	–	–	–	0.11
001S007E27P001M	NWQL	01/04/2005	12:30	–	–	–	–	–	–	–	0.13
001S008E12L001M	NWQL	02/14/2005	11:20	3.13	16.1	–	73	–	–	–	0.06
001S008E13M001M	NWQL	08/31/2004	11:45	–	–	–	–	–	–	–	0.16
	NWQL	08/30/2005	11:20	6.40	47.0	460	273	466	562	566	0.13
001S009E11J001M	NWQL	07/28/2004	10:40	–	–	–	–	–	–	–	0.06
001S009E33P001M	NWQL	08/31/2004	10:25	–	–	–	–	–	–	–	0.05
001S009E33R001M	NWQL	01/11/2005	10:10	3.25	16.2	–	75	–	–	–	0.03
001S010E19P001M	NWQL	01/11/2005	13:30	–	–	–	–	–	–	–	–
001S010E27M001M	NWQL	02/14/2005	14:40	2.64	15.3	–	85	–	–	–	0.06
002N006E04E001M	NWQL	10/25/2004	13:20	–	–	–	–	–	–	–	0.07
002N006E06B001M	NWQL	05/27/2004	13:30	6.49	67.6	220	176	219	269	265	2.31
	NWQL	08/02/2006	18:00	4.72	51.9	230	233	230	279	279	1.36
002N006E06C003M	NWQL	07/27/2004	16:10	4.07	60.9	–	180	209	–	254	1.13
	SD	07/27/2004	16:11	–	–	–	–	–	–	–	<0.30
002N006E08C001M	NWQL	10/25/2004	13:35	–	–	–	–	–	–	–	0.03
002N006E08Q002M	NWQL	08/11/2004	15:30	4.27	39.2	320	245	314	386	387	0.21
	SD	08/11/2004	15:31	–	–	–	–	–	–	–	<0.30
	NWQL	10/19/2004	10:30	–	–	–	–	–	–	–	0.19

Table 15. Field measurements and water-quality data for water from selected wells, Eastern San Joaquin Groundwater Subbasin, California, 2003–7.—Continued

[Site locations are shown in figure 48. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD), except for dissolved oxygen, specific conductance, and pH, which were measured in the field. **Abbreviations**: E, estimated value; FET, fixed end-point titration; hh:mm, hour:minute; INC, incremental titration; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25°C; °C, degrees Celsius;–, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Potassium, filtered (mg/L as K) (00935)	Sodium, filtered (mg/L as Na) (00930)	Alkalinity, filtered, FET field (mg/L as $CaCO_3$) (39036)	Alkalinity, filtered, FET laboratory (mg/L as $CaCO_3$) (29801)	Alkalinity, filtered, INC field (mg/L as $CaCO_3$) (39086)	Bicarbonate, filtered, FET field (mg/L as HCO_3) (29804)	Bicarbonate, filtered, INC field (mg/L as HCO_3) (00453)	Bromide, filtered (mg/L as Br) (71870)
002N006E16C002M	NWQL	07/27/2004	11:55	–	–	–	–	–	–	–	0.17
002N006E16D003M	NWQL	10/25/2004	14:25	–	–	–	–	–	–	–	0.16
002N006E17A001M	NWQL	10/25/2004	11:30	–	–	–	–	–	–	–	0.12
002N006E17G001M	NWQL	10/25/2004	15:10	–	–	–	–	–	–	–	0.09
002N006E17J001M	NWQL	01/25/2005	09:10	3.76	25.8	–	198	–	–	–	0.20
002N006E19L001M	NWQL	10/19/2004	10:00	–	–	–	–	–	–	–	0.57
002N006E29M001M	NWQL	10/18/2004	09:30	–	–	–	–	–	–	–	0.20
002N007E06P002M	NWQL	01/12/2005	13:30	4.92	17.5	–	210	–	–	–	0.10
002N007E07D002M	NWQL	10/27/2004	13:40	–	–	–	–	–	–	–	0.10
002N007E07Q001M	NWQL	07/27/2004	13:30	–	–	–	–	–	–	–	0.04
002N007E10P001M	NWQL	01/10/2005	14:00	5.28	12.2	–	117	–	–	–	0.03
002N007E25M001M	NWQL	09/01/2004	10:32	–	–	–	–	–	–	–	0.03
002N008E13G001M	NWQL	08/02/2004	13:25	–	–	–	–	–	–	–	0.02
002N008E15L001M	NWQL	01/13/2005	13:50	4.41	10.5	–	94	–	–	–	0.04
002N008E16L001M	NWQL	01/13/2005	10:30	3.52	12.0	–	125	–	–	–	0.06
002S007E09L001M	NWQL	01/04/2005	11:10	–	–	–	–	–	–	–	0.06
002S007E20J001M	NWQL	10/30/2003	14:30	3.33	28.9	–	–	–	–	–	0.15
	NWQL	01/23/2004	11:50	3.21	27.1	–	–	–	–	–	0.15
	NWQL	04/20/2004	11:40	3.42	28.0	–	–	–	–	–	0.15
	NWQL	08/05/2004	11:20	3.34	27.3	–	–	–	–	–	0.17
	NWQL	08/01/2006	12:30	3.21	27.4	–	–	155	–	–	0.15
	NWQL	07/30/2008	10:20	3.42	27.6	–	–	–	–	–	0.16
002S007E24R002M	NWQL	08/04/2004	10:10	–	–	–	–	–	–	–	0.26
002S008E02C001M	NWQL	08/04/2004	08:50	–	–	–	–	–	–	–	0.19
002S008E20J002M	NWQL	08/04/2004	09:40	–	–	–	–	–	–	–	0.11
002S009E12R001M	NWQL	07/28/2004	09:30	–	–	–	–	–	–	–	0.05
002S009E20D001M	NWQL	01/11/2005	08:40	–	–	–	–	–	–	–	0.06
003N005E03J002M	NWQL	08/30/2005	17:20	1.47	138	530	270	533	642	649	0.62
003N006E14R005M	NWQL	01/10/2005	13:30	7.42	19.2	–	130	–	–	–	0.08
	NWQL	04/02/2008	13:10	7.43	19.2	–	134	–	–	–	0.06
003N006E18R001M	NWQL	07/12/2007	15:00	1.99	166	500	503	500	606	608	0.51
003N006E24N001M	NWQL	11/18/2004	10:30	4.55	79.3	470	467	466	566	567	0.32

Table 15. Field measurements and water-quality data for water from selected wells, Eastern San Joaquin Groundwater Subbasin, California, 2003–7.—Continued

[Site locations are shown in figure 48. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD), except for dissolved oxygen, specific conductance, and pH, which were measured in the field. **Abbreviations**: E, estimated value; FET, fixed end-point titration; hh:mm, hour:minute; INC, incremental titration; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25°C; °C, degrees Celsius;–, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Potassium, filtered (mg/L as K) (00935)	Sodium, filtered (mg/L as Na) (00930)	Alkalinity, filtered, FET field (mg/L as $CaCO_3$) (39036)	Alkalinity, filtered, FET laboratory (mg/L as $CaCO_3$) (29801)	Alkalinity, filtered, INC field (mg/L as $CaCO_3$) (39086)	Bicarbonate, filtered, FET field (mg/L as HCO_3) (29804)	Bicarbonate, filtered, INC field (mg/L as HCO_3) (00453)	Bromide, filtered (mg/L as Br) (71870)
003N006E30K001M	NWQL	11/18/2004	09:15	2.58	80.9	370	376	372	451	453	0.36
	NWQL	07/09/2007	13:20	3.42	125	510	512	512	619	622	0.38
003N008E19B002M	NWQL	02/09/2005	13:30	3.21	16.8	–	96	–	–	–	0.03
003N008E20P001M	NWQL	08/02/2004	13:00	–	–	–	–	–	–	–	0.04
003N009E06N001M	NWQL	08/02/2004	12:40	–	–	–	–	–	–	–	0.03
003N009E36G001M	NWQL	01/11/2005	10:50	2.42	12.0	–	136	–	–	–	0.10
003S007E03Q001M	NWQL	01/04/2005	15:50	–	–	–	–	–	–	–	0.08
004N005E03P001M	NWQL	01/13/2005	09:30	–	–	–	–	–	–	–	0.11
004N005E06J001M	NWQL	08/31/2005	11:40	1.52	224	230	229	231	279	280	0.96
004N005ES6R001M	NWQL	01/13/2005	14:30	2.06	27.6	–	132	–	–	–	0.08
004N008E29E004M	NWQL	08/05/2004	11:40	–	–	–	–	–	–	–	0.12
004N008E31G001M	NWQL	01/10/2005	11:20	–	–	–	–	–	–	–	0.08
004N008E34G002M	NWQL	01/25/2005	16:50	6.66	15.1	–	80	–	–	–	0.07
004N009E17E002M	NWQL	08/02/2004	12:20	–	–	–	–	–	–	–	0.11
004N010E13C001M	NWQL	01/27/2005	09:50	2.62	27.2	–	157	–	–	–	0.10

Table 15. Field measurements and water-quality data for water from selected wells, Eastern San Joaquin Groundwater Subbasin, California, 2003–7.—Continued

[Site locations are shown in figure 48. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD), except for dissolved oxygen, specific conductance, and pH, which were measured in the field. **Abbreviations**: E, estimated value; FET, fixed end-point titration; hh:mm, hour:minute; INC, incremental titration; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25°C; °C, degrees Celsius;–, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Chloride, filtered (mg/L as Cl) (00940)	Fluoride, filtered (mg/L as F) (00950)	Iodide, filtered (mg/L as I) (71865)	Silica, filtered (mg/L as SiO_2) (00955)	Sulfate, filtered (mg/L as SO_4) (00945)	Residue on evaporation, dried at 180°C, filtered (mg/L) (70300)	Aluminum, filtered (µg/L as Al) (01106)
001N006E04P002M	NWQL	11/18/2005	11:00	490	E0.06	0.858	61.3	<0.90	995	<1.6
	SD	11/18/2005	11:01	480	–	–	–	<3.00	–	–
001N006E11P003M	NWQL	11/15/2005	10:00	243	E0.06	0.361	54.3	<0.18	562	E1.0
	SD	11/15/2005	10:01	240	–	–	–	<3.00	–	–
	NWQL	08/03/2006	12:20	252	E0.06	0.350	54.1	E0.11	614	E0.9
001N006E12A001M	NWQL	11/16/2005	14:00	187	E0.10	0.006	63.9	46.2	805	<1.6
	SD	11/16/2005	14:01	190	–	–	–	50.0	–	–
	NWQL	07/10/2007	13:30	198	E0.10	0.039	61.9	31.8	709	<1.6
001N006E12N001M	NWQL	11/19/2005	10:00	732	<0.10	0.912	54.6	<0.90	1,340	<1.6
	SD	11/19/2005	10:01	730	–	–	–	<3.00	–	–
	NWQL	08/04/2006	11:10	587	<0.10	0.850	53.5	<0.90	1,560	<1.6
001N006E13B003M	NWQL	08/04/2004	13:25	472	–	0.554	–	–	–	–
	NWQL	08/11/2004	12:00	463	<0.17	0.562	42.1	7.08	1,060	1.7
	SD	08/11/2004	12:01	430	–	–	–	E6.50	–	–
	NWQL	08/02/2006	12:10	476	E0.08	0.484	46.0	6.01	1,070	<1.6
001N006E22J001M	NWQL	08/10/2004	16:00	402	<0.17	0.679	45.6	3.54	876	E0.9
	SD	08/10/2004	16:01	380	–	–	–	<12.0	–	–
001N006E26N003M	NWQL	10/18/2004	13:30	151	–	0.104	–	–	–	–
001N006E27R002M	NWQL	10/18/2004	10:45	927	–	0.062	–	–	–	–
001N006E34A003M	NWQL	10/18/2004	11:00	1,860	–	0.360	–	–	–	–
	NWQL	08/14/2006	15:00	1,780	<0.10	0.320	25.4	42.5	4,370	11.9
001N006E35G002M	NWQL	10/18/2004	11:30	741	–	0.095	–	–	–	–
001N006E35N001M	NWQL	10/18/2004	13:00	379	–	0.309	–	–	–	–
001N007E05A001M	NWQL	02/08/2005	09:10	6.18	0.14	–	66.2	12.1	224	E1.1
001N007E18D001M	NWQL	11/15/2005	14:30	308	E0.06	0.256	41.3	5.13	762	<1.6
	NWQL	11/15/2005	14:31	310	–	–	–	4.20	–	–
001N007E26H003M	NWQL	09/01/2004	09:45	41.1	–	0.011	–	–	–	–
001N007E27P003M	NWQL	01/12/2005	12:10	54.5	–	0.010	–	–	–	–
001N007E31F001M	NWQL	07/29/2004	15:30	62.2	<0.17	0.008	49.6	19.1	359	<1.6
	SD	07/29/2004	15:31	59.0	–	–	–	19.0	–	–
	NWQL	01/12/2005	09:30	58.5	0.10	0.006	53.9	18.8	339	E1.4
001N008E10C001M	NWQL	08/02/2004	13:45	10.5	–	0.002	–	–	–	–

Table 15. Field measurements and water-quality data for water from selected wells, Eastern San Joaquin Groundwater Subbasin, California, 2003–7.—Continued

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State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Chloride, filtered (mg/L as Cl) (00940)	Fluoride, filtered (mg/L as F) (00950)	Iodide, filtered (mg/L as I) (71865)	Silica, filtered (mg/L as SiO_2) (00955)	Sulfate, filtered (mg/L as SO_4) (00945)	Residue on evaporation, dried at 180°C, filtered (mg/L) (70300)	Aluminum, filtered (µg/L as Al) (01106)
001N008E15J001M	NWQL	08/29/2005	13:50	31.4	0.13	0.003	69.7	24.9	490	<1.6
001N009E17N001M	NWQL	02/15/2005	08:10	9.31	0.16	–	78.5	7.91	188	E1.4
001S006E23C003M	NWQL	08/04/2004	12:10	610	–	0.392	–	–	–	–
	NWQL	08/15/2006	14:00	601	E0.07	0.707	46.0	26.7	1,750	E1.0
001S006E25M003M	NWQL	08/09/2004	16:00	71.3	<0.17	0.046	48.9	19.4	374	6.6
	SD	08/09/2004	16:01	A70.0	–	–	–	A18.0	–	–
	NWQL	10/18/2004	12:30	80.8	–	0.048	–	–	–	–
	NWQL	12/22/2004	09:10	79.1	–	0.059	–	–	–	–
	NWQL	01/04/2005	09:10	–	–	–	–	–	–	–
	NWQL	04/02/2008	09:50	63.5	0.14	0.032	48.2	20.6	391	<1.6
001S006E25M004M	NWQL	08/09/2004	14:00	40.4	<0.17	0.041	49.8	14.4	312	E0.8
	SD	08/09/2004	14:01	38.0	–	–	–	14.0	–	–
	NWQL	10/18/2004	12:00	39.6	–	0.033	–	–	–	–
001S006E36B001M	NWQL	10/18/2004	09:00	18.5	–	0.044	–	–	–	–
001S007E27P001M	NWQL	01/04/2005	12:30	10.3	–	0.032	–	–	–	–
001S008E12L001M	NWQL	02/14/2005	11:20	10.2	0.18	–	80.7	11.2	194	E1.0
001S008E13M001M	NWQL	08/31/2004	11:45	78.9	–	0.009	–	–	–	–
	NWQL	08/30/2005	11:20	78.5	0.13	0.006	71.4	47.2	743	<1.6
001S009E11J001M	NWQL	07/28/2004	10:40	14.6	–	0.002	–	–	–	–
001S009E33P001M	NWQL	08/31/2004	10:25	7.37	–	0.007	–	–	–	–
001S009E33R001M	NWQL	01/11/2005	10:10	7.57	0.27	0.002	82.5	2.93	190	E1.0
001S010E19P001M	NWQL	01/11/2005	13:30	–	–	–	–	–	–	–
001S010E27M001M	NWQL	02/14/2005	14:40	8.38	0.28	–	76.0	5.07	185	E1.3
002N006E04E001M	NWQL	10/25/2004	13:20	20.5	–	0.004	–	–	–	–
002N006E06B001M	NWQL	05/27/2004	13:30	811	<0.17	0.248	50.2	20.7	2,350	<3.2
	NWQL	08/02/2006	18:00	445	E0.06	0.163	50.9	14.6	1,420	<1.6
002N006E06C003M	NWQL	07/27/2004	16:10	316	<0.17	0.256	39.9	14.0	955	<1.6
	SD	07/27/2004	16:11	290	–	–	–	E15.0	–	–
002N006E08C001M	NWQL	10/25/2004	13:35	9.74	–	0.017	–	–	–	–
002N006E08Q002M	NWQL	08/11/2004	15:30	67.7	<0.17	0.009	56.9	52.1	495	<1.6
	SD	08/11/2004	15:31	62.0	–	–	–	49.0	–	–
	NWQL	10/19/2004	10:30	63.1	–	0.006	–	–	–	–

Table 15. Field measurements and water-quality data for water from selected wells, Eastern San Joaquin Groundwater Subbasin, California, 2003–7.—Continued

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State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Chloride, filtered (mg/L as Cl) (00940)	Fluoride, filtered (mg/L as F) (00950)	Iodide, filtered (mg/L as I) (71865)	Silica, filtered (mg/L as SiO_2) (00955)	Sulfate, filtered (mg/L as SO_4) (00945)	Residue on evaporation, dried at 180°C, filtered (mg/L) (70300)	Aluminum, filtered (µg/L as Al) (01106)
002N006E16C002M	NWQL	07/27/2004	11:55	62.6	–	0.009	–	–	–	–
002N006E16D003M	NWQL	10/25/2004	14:25	59.1	–	0.010	–	–	–	–
002N006E17A001M	NWQL	10/25/2004	11:30	33.7	–	0.006	–	–	–	–
002N006E17G001M	NWQL	10/25/2004	15:10	12.9	–	0.025	–	–	–	–
002N006E17J001M	NWQL	01/25/2005	09:10	48.6	0.10	0.048	48.3	30.9	355	E0.8
002N006E19L001M	NWQL	10/19/2004	10:00	160	–	0.237	–	–	–	–
002N006E29M001M	NWQL	10/18/2004	09:30	59.1	–	0.094	–	–	–	–
002N007E06P002M	NWQL	01/12/2005	13:30	12.8	0.12	–	67.0	18.7	323	E1.0
002N007E07D002M	NWQL	10/27/2004	13:40	4.93	–	0.002	–	–	–	–
002N007E07Q001M	NWQL	07/27/2004	13:30	13.4	–	0.002	–	–	–	–
002N007E10P001M	NWQL	01/10/2005	14:00	4.26	0.13	–	70.9	6.05	192	1.7
002N007E25M001M	NWQL	09/01/2004	10:32	4.72	–	0.002	–	–	–	–
002N008E13G001M	NWQL	08/02/2004	13:25	4.86	–	E0.001	–	–	–	–
002N008E15L001M	NWQL	01/13/2005	13:50	3.69	0.13	–	70.3	3.61	177	E0.8
002N008E16L001M	NWQL	01/13/2005	10:30	4.05	0.15	–	68.0	3.63	200	E1.0
002S007E09L001M	NWQL	01/04/2005	11:10	17.2	–	0.105	–	–	–	–
002S007E20J001M	NWQL	10/30/2003	14:30	15.5	<0.17	–	52.2	33.4	360	–
	NWQL	01/23/2004	11:50	15.7	<0.17	–	51.9	32.1	349	–
	NWQL	04/20/2004	11:40	15.8	<0.17	–	51.1	30.6	369	–
	NWQL	08/05/2004	11:20	16.8	<0.17	–	53.2	39.3	382	<1.6
	NWQL	08/01/2006	12:30	15.4	E0.08	–	51.2	34.2	367	E0.8
	NWQL	07/30/2008	10:20	16.2	E0.10	–	46.8	33.9	364	<1.6
002S007E24R002M	NWQL	08/04/2004	10:10	53.9	–	0.011	–	–	–	–
002S008E02C001M	NWQL	08/04/2004	08:50	6.03	–	0.011	–	–	–	–
002S008E20J002M	NWQL	08/04/2004	09:40	50.4	–	0.018	–	–	–	–
002S009E12R001M	NWQL	07/28/2004	09:30	2.44	–	E0.001	–	–	–	–

Table 15. Field measurements and water-quality data for water from selected wells, Eastern San Joaquin Groundwater Subbasin, California, 2003–7.—Continued

[Site locations are shown in figure 48. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD), except for dissolved oxygen, specific conductance, and pH, which were measured in the field. **Abbreviations**: E, estimated value; FET, fixed end-point titration; hh:mm, hour:minute; INC, incremental titration; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25°C; °C, degrees Celsius;–, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Chloride, filtered (mg/L as Cl) (00940)	Fluoride, filtered (mg/L as F) (00950)	Iodide, filtered (mg/L as I) (71865)	Silica, filtered (mg/L as SiO_2) (00955)	Sulfate, filtered (mg/L as SO_4) (00945)	Residue on evaporation, dried at 180°C, filtered (mg/L) (70300)	Aluminum, filtered (µg/L as Al) (01106)
002S009E20D001M	NWQL	01/11/2005	08:40	11.4	–	0.006	–	–	–	–
003N005E03J002M	NWQL	08/30/2005	17:20	166	0.11	0.915	58.2	32.9	967	<1.6
003N006E14R005M	NWQL	01/10/2005	13:30	13.5	0.13	0.004	67.2	13.6	243	E1.0
	NWQL	04/02/2008	13:10	14.3	0.14	E0.002	61.2	14.4	250	<1.6
003N006E18R001M	NWQL	07/12/2007	15:00	157	0.22	0.010	59.4	81.6	1,070	E0.9
003N006E24N001M	NWQL	11/18/2004	10:30	108	E.09	0.189	57.3	14.7	689	E0.9
003N006E30K001M	NWQL	11/18/2004	09:15	107	0.11	0.007	63.3	56.5	760	<1.6
	NWQL	07/09/2007	13:20	114	0.11	0.009	58.1	49.3	879	E0.8
003N008E19B002M	NWQL	02/09/2005	13:30	5.63	0.20	<0.002	84.2	5.72	198	E0.9
003N008E20P001M	NWQL	08/02/2004	13:00	8.47	–	0.002	–	–	–	–
003N009E06N001M	NWQL	08/02/2004	12:40	7.04	–	E0.001	–	–	–	–
003N009E36G001M	NWQL	01/11/2005	10:50	9.50	0.12	–	53.3	27.9	257	<1.6
003S007E03Q001M	NWQL	01/04/2005	15:50	6.78	–	0.005	–	–	–	–
004N005E03P001M	NWQL	01/13/2005	09:30	26.2	–	0.052	–	–	–	–
004N005E06J001M	NWQL	08/31/2005	11:40	763	E0.08	0.398	31.4	<0.90	1,570	<3.2
004N005ES6R001M	NWQL	01/13/2005	14:30	13.1	0.12	0.025	51.0	6.34	204	E1.5
004N008E29E004M	NWQL	08/05/2004	11:40	26.4	–	0.004	–	–	–	–
004N008E31G001M	NWQL	01/10/2005	11:20	10.5	–	0.004	–	–	–	–
004N008E34G002M	NWQL	01/25/2005	16:50	10.8	0.27	0.012	88.4	1.4	181	E0.8
004N009E17E002M	NWQL	08/02/2004	12:20	16.4	–	0.002	–	–	–	–
004N010E13C001M	NWQL	01/27/2005	09:50	18.0	0.22	0.012	59.2	10.8	259	<1.6

Table 15. Field measurements and water-quality data for water from selected wells, Eastern San Joaquin Groundwater Subbasin, California, 2003–7.—Continued

[Site locations are shown in figure 48. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD), except for dissolved oxygen, specific conductance, and pH, which were measured in the field. **Abbreviations**: E, estimated value; FET, fixed end-point titration; hh:mm, hour:minute; INC, incremental titration; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25°C; °C, degrees Celsius;–, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Arsenic, filtered (µg/L as As) (01000)	Barium, filtered (µg/L as Ba) (01005)	Boron, filtered (µg/L as B) (01020)	Chromium, filtered (µg/L as Cr) (01030)	Iron, filtered (µg/L as Fe) (01046)	Lithium, filtered (µg/L as Li) (01130)	Manganese, filtered (µg/L as Mn) (01056)	Strontium, filtered (µg/L as Sr) (01080)
001N006E04P002M	NWQL	11/18/2005	11:00	62.9	386	1,050	–	1960	6.0	329	439
	SD	11/18/2005	11:01	–	–	–	–	–	–	–	–
001N006E11P003M	NWQL	11/15/2005	10:00	27.8	240	301	–	236	4.0	426	314
	SD	11/15/2005	10:01	–	–	–	–	–	–	–	–
	NWQL	08/03/2006	12:20	27.9	238	302	–	241	5.0	448	339
001N006E12A001M	NWQL	11/16/2005	14:00	3.9	308	67	–	<6	3.0	2.8	1,330
	SD	11/16/2005	14:01	–	–	–	–	–	–	–	–
	NWQL	07/10/2007	13:30	5.4	269	56	–	E3	4.0	7.8	1,060
001N006E12N001M	NWQL	11/19/2005	10:00	22.7	1,110	204	–	1340	8.0	1,900	1,730
	SD	11/19/2005	10:01	–	–	–	–	–	–	–	–
	NWQL	08/04/2006	11:10	20.2	922	162	–	974	6.0	1,440	1,490
001N006E13B003M	NWQL	08/04/2004	13:25	–	1,390	87	–	–	–	–	–
	NWQL	08/11/2004	12:00	18.1	1,140	79	<0.80	790	3.0	1,150	1,700
	SD	08/11/2004	12:01	–	–	–	–	–	–	–	–
	NWQL	08/02/2006	12:10	18.0	1,100	83	–	689	4.0	1,090	1,760
001N006E22J001M	NWQL	08/10/2004	16:00	27.8	490	562	<0.80	179	4.0	558	830
	SD	08/10/2004	16:01	–	–	–	–	–	–	–	–
001N006E26N003M	NWQL	10/18/2004	13:30	–	444	202	–	–	–	–	–
001N006E27R002M	NWQL	10/18/2004	10:45	–	1,050	528	–	–	–	–	–
001N006E34A003M	NWQL	10/18/2004	11:00	–	964	351	–	–	–	–	–
	NWQL	08/14/2006	15:00	37.4	734	333	–	242	7.0	2,250	4,970
001N006E35G002M	NWQL	10/18/2004	11:30	–	861	234	–	–	–	–	–
001N006E35N001M	NWQL	10/18/2004	13:00	–	645	300	–	–	–	–	–
001N007E05A001M	NWQL	02/08/2005	09:10	6.5	116	37	1.0	13	1.3	6.5	267
001N007E18D001M	NWQL	11/15/2005	14:30	15.4	685	80	–	142	3.0	661	1,190
	NWQL	11/15/2005	14:31	–	–	–	–	–	–	–	–
001N007E26H003M	NWQL	09/01/2004	09:45	–	138	101	–	–	–	–	–
001N007E27P003M	NWQL	01/12/2005	12:10	–	260	129	–	–	–	–	–
001N007E31F001M	NWQL	07/29/2004	15:30	13.2	200	196	E0.50	25	E3.0	114	408
	SD	07/29/2004	15:31	–	–	–	–	–	–	–	–
	NWQL	01/12/2005	09:30	13.9	210	201	E0.40	13	2.6	87.9	401
001N008E10C001M	NWQL	08/02/2004	13:45	–	71	26	–	–	–	–	–

Table 15. Field measurements and water-quality data for water from selected wells, Eastern San Joaquin Groundwater Subbasin, California, 2003–7.—Continued

[Site locations are shown in figure 48. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD), except for dissolved oxygen, specific conductance, and pH, which were measured in the field. **Abbreviations**: E, estimated value; FET, fixed end-point titration; hh:mm, hour:minute; INC, incremental titration; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25°C; °C, degrees Celsius;–, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Arsenic, filtered (µg/L as As) (01000)	Barium, filtered (µg/L as Ba) (01005)	Boron, filtered (µg/L as B) (01020)	Chromium, filtered (µg/L as Cr) (01030)	Iron, filtered (µg/L as Fe) (01046)	Lithium, filtered (µg/L as Li) (01130)	Manganese, filtered (µg/L as Mn) (01056)	Strontium, filtered (µg/L as Sr) (01080)
001N008E15J001M	NWQL	08/29/2005	13:50	1.8	230	44	–	<6	E2.0	<0.6	780
001N009E17N001M	NWQL	02/15/2005	08:10	2.0	78	48	2.3	<6	5.1	–	169
001S006E23C003M	NWQL	08/04/2004	12:10	–	891	260	–	–	–	–	–
	NWQL	08/15/2006	14:00	4.9	800	234	–	<18	E5.0	606	2,030
001S006E25M003M	NWQL	08/09/2004	16:00	18.7	300	150	3.6	<6	4.0	E0.6	642
	SD	08/09/2004	16:01	–	–	–	–	–	–	–	–
	NWQL	10/18/2004	12:30	–	355	148	–	–	–	–	–
	NWQL	12/22/2004	09:10	–	339	146	–	–	–	–	–
	NWQL	01/04/2005	09:10	–	–	–	–	–	–	–	–
	NWQL	04/02/2008	09:50	17.8	294	152	3.0	<8	3.6	0.3	553
001S006E25M004M	NWQL	08/09/2004	14:00	24.4	196	157	4.8	<6	3.0	E0.5	421
	SD	08/09/2004	14:01	–	–	–	–	–	–	–	–
	NWQL	10/18/2004	12:00	–	199	158	–	–	–	–	–
001S006E36B001M	NWQL	10/18/2004	09:00	–	181	153	–	–	–	–	–
001S007E27P001M	NWQL	01/04/2005	12:30	–	152	174	–	–	–	–	–
001S008E12L001M	NWQL	02/14/2005	11:20	2.1	64	122	4.3	<6	2.6	2.2	163
001S008E13M001M	NWQL	08/31/2004	11:45	–	388	80	–	–	–	–	–
	NWQL	08/30/2005	11:20	1.7	416	89	–	E4	3.0	<0.6	1,440
001S009E11J001M	NWQL	07/28/2004	10:40	–	70	67	–	–	–	–	–
001S009E33P001M	NWQL	08/31/2004	10:25	–	125	44	–	–	–	–	–
001S009E33R001M	NWQL	01/11/2005	10:10	3.3	68	65	4.3	<6	1.2	0.4	169
001S010E19P001M	NWQL	01/11/2005	13:30	–	–	–	–	–	–	–	–
001S010E27M001M	NWQL	02/14/2005	14:40	2.8	83	50	1.4	E4	4.1	0.3	183
002N006E04E001M	NWQL	10/25/2004	13:20	–	188	27	–	–	–	–	–
002N006E06B001M	NWQL	05/27/2004	13:30	1.9	1,420	37	–	<19	<9.0	6.0	3,600
	NWQL	08/02/2006	18:00	2.8	776	29	–	E6	2.0	5.2	2,260
002N006E06C003M	NWQL	07/27/2004	16:10	1.0	810	30	<0.80	1110	<9.0	135	1,490
	SD	07/27/2004	16:11	–	–	–	–	–	–	–	–
002N006E08C001M	NWQL	10/25/2004	13:35	–	107	54	–	–	–	–	–
002N006E08Q002M	NWQL	08/11/2004	15:30	3.6	408	64	5.9	<6	E2.0	<0.8	1,270
	SD	08/11/2004	15:31	–	–	–	–	–	–	–	–
	NWQL	10/19/2004	10:30	–	402	61	–	–	–	–	–

Table 15. Field measurements and water-quality data for water from selected wells, Eastern San Joaquin Groundwater Subbasin, California, 2003–7.—Continued

[Site locations are shown in figure 48. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD), except for dissolved oxygen, specific conductance, and pH, which were measured in the field. **Abbreviations**: E, estimated value; FET, fixed end-point titration; hh:mm, hour:minute; INC, incremental titration; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25°C; °C, degrees Celsius;–, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Arsenic, filtered (µg/L as As) (01000)	Barium, filtered (µg/L as Ba) (01005)	Boron, filtered (µg/L as B) (01020)	Chromium, filtered (µg/L as Cr) (01030)	Iron, filtered (µg/L as Fe) (01046)	Lithium, filtered (µg/L as Li) (01130)	Manganese, filtered (µg/L as Mn) (01056)	Strontium, filtered (µg/L as Sr) (01080)
002N006E16C002M	NWQL	07/27/2004	11:55	–	266	26	–	–	–	–	–
002N006E16D003M	NWQL	10/25/2004	14:25	–	335	39	–	–	–	–	–
002N006E17A001M	NWQL	10/25/2004	11:30	–	206	57	–	–	–	–	–
002N006E17G001M	NWQL	10/25/2004	15:10	–	173	34	–	–	–	–	–
002N006E17J001M	NWQL	01/25/2005	09:10	4.8	282	35	<0.80	<6	1.8	19.0	799
002N006E19L001M	NWQL	10/19/2004	10:00	–	248	405	–	–	–	–	–
002N006E29M001M	NWQL	10/18/2004	09:30	–	123	281	–	–	–	–	–
002N007E06P002M	NWQL	01/12/2005	13:30	2.5	141	22	5.6	E5	1.4	0.4	589
002N007E07D002M	NWQL	10/27/2004	13:40	–	108	24	–	–	–	–	–
002N007E07Q001M	NWQL	07/27/2004	13:30	–	92	22	–	–	–	–	–
002N007E10P001M	NWQL	01/10/2005	14:00	1.9	69	24	3.9	E4	E0.40	0.8	252
002N007E25M001M	NWQL	09/01/2004	10:32	–	71	30	–	–	–	–	–
002N008E13G001M	NWQL	08/02/2004	13:25	–	64	16	–	–	–	–	–
002N008E15L001M	NWQL	01/13/2005	13:50	1.2	83	22	2.9	14	2.6	1.2	179
002N008E16L001M	NWQL	01/13/2005	10:30	1.2	85	21	4.9	6	1.6	0.4	240
002S007E09L001M	NWQL	01/04/2005	11:10	–	116	186	–	–	–	–	–
002S007E20J001M	NWQL	10/30/2003	14:30	–	–	–	–	<6	–	<0.8	–
	NWQL	01/23/2004	11:50	–	–	–	–	<6	–	<0.8	–
	NWQL	04/20/2004	11:40	–	–	–	–	<6	–	<0.8	–
	NWQL	08/05/2004	11:20	13.1	153	73	7.3	<6	3.6	<0.2	636
	NWQL	08/01/2006	12:30	13.0	150	86	7.3	<6	4.2	<0.2	553
	NWQL	07/30/2008	10:20	13.3	148	81	7.1	<8	3.5	<0.2	600
002S007E24R002M	NWQL	08/04/2004	10:10	–	249	145	–	–	–	–	–
002S008E02C001M	NWQL	08/04/2004	08:50	–	111	39	–	–	–	–	–
002S008E20J002M	NWQL	08/04/2004	09:40	–	150	67	–	–	–	–	–
002S009E12R001M	NWQL	07/28/2004	09:30	–	30	20	–	–	–	–	–
002S009E20D001M	NWQL	01/11/2005	08:40	–	146	103	–	–	–	–	–
003N005E03J002M	NWQL	08/30/2005	17:20	2.7	369	149	–	<6	5.0	52.5	1,650
003N006E14R005M	NWQL	01/10/2005	13:30	4.5	97	34	4.6	<6	0.8	<0.2	340
	NWQL	04/02/2008	13:10	4.3	96	32	5.4	<8	E0.80	<0.2	329
003N006E18R001M	NWQL	07/12/2007	15:00	3.0	287	128	–	9	7.0	0.3	1,390
003N006E24N001M	NWQL	11/18/2004	10:30	14.5	203	120	–	51	3.0	926	1,230

Table 15. Field measurements and water-quality data for water from selected wells, Eastern San Joaquin Groundwater Subbasin, California, 2003–7.—Continued

[Site locations are shown in figure 48. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD), except for dissolved oxygen, specific conductance, and pH, which were measured in the field. **Abbreviations**: E, estimated value; FET, fixed end-point titration; hh:mm, hour:minute; INC, incremental titration; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25°C; °C, degrees Celsius;–, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Arsenic, filtered (µg/L as As) (01000)	Barium, filtered (µg/L as Ba) (01005)	Boron, filtered (µg/L as B) (01020)	Chromium, filtered (µg/L as Cr) (01030)	Iron, filtered (µg/L as Fe) (01046)	Lithium, filtered (µg/L as Li) (01130)	Manganese, filtered (µg/L as Mn) (01056)	Strontium, filtered (µg/L as Sr) (01080)
003N006E30K001M	NWQL	11/18/2004	09:15	2.9	247	87	–	<6	5.0	<0.6	1,360
	NWQL	07/09/2007	13:20	3.7	416	128	–	E5	4.0	0.2	1,360
003N008E19B002M	NWQL	02/09/2005	13:30	1.9	45	18	2.7	E3	1.1	<0.2	193
003N008E20P001M	NWQL	08/02/2004	13:00	–	49	16	–	–	–	–	–
003N009E06N001M	NWQL	08/02/2004	12:40	–	28	11	–	–	–	–	–
003N009E36G001M	NWQL	01/11/2005	10:50	0.70	101	37	1.1	<6	E0.60	–	331
003S007E03Q001M	NWQL	01/04/2005	15:50	–	64	25	–	–	–	–	–
004N005E03P001M	NWQL	01/13/2005	09:30	–	95	629	–	–	–	–	–
004N005E06J001M	NWQL	08/31/2005	11:40	3.9	801	393	–	851	<10	711	1,760
004N005ES6R001M	NWQL	01/13/2005	14:30	24.9	175	41	<0.80	65	0.7	187	265
004N008E29E004M	NWQL	08/05/2004	11:40	–	114	16	–	–	–	–	–
004N008E31G001M	NWQL	01/10/2005	11:20	–	59	27	–	–	–	–	–
004N008E34G002M	NWQL	01/25/2005	16:50	3.3	53	18	<0.80	E3	13.6	2.6	153
004N009E17E002M	NWQL	08/02/2004	12:20	–	97	18	–	–	–	–	–
004N010E13C001M	NWQL	01/27/2005	09:50	1.7	98	222	<0.80	E5	49.8	0.4	434

Table 16. Isotopic data for water from selected wells, Eastern San Joaquin Groundwater Subbasin, California, 2003–7.

[Site locations are shown in figure 48. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Deuterium/protium and oxygen-18/16 analyzed by USGS National Research Program, Stable Isotope Laboratory, Reston, Virginia. Carbon age analyzed by University of Waterloo, Isotope Laboratory, Waterloo, Ontario, Canada. Tritium analyzed by University of Miami, Tritium Laboratory, Miami, Florida. Dates sites were drilled given in table 1. **Abbreviations**: hh:mm, hour:minute; mm/dd/yyyy, month/day/year; pCi/L, picocuries per liter; –, no data]

State well number	Date (mm/dd/yyyy)	Time (hh:mm)	Carbon-14 counting error, filtered, percent modern (49934)	Carbon-14, filtered, percent modern (49933)	Deuterium/ protium unfiltered, per mil (82082)	Tritium, unfiltered (pCi/L) (07000)	Tritium 2-sigma combined uncertainty, unfiltered (pCi/L) (75985)	Carbon-13/ carbon-12 unfiltered, per mil (82081)	Oxygen-18/ oxygen-16 unfiltered, per mil (82085)
001N006E04P002M	11/18/2005	11:00	–	–	–61.30	–	–	–	–8.41
001N006E11P003M	11/15/2005	10:00	–	–	–55.10	–	–	–	–7.38
	08/03/2006	12:20	–	–	–54.69	–	–	–	–7.44
001N006E12A001M	11/16/2005	14:00	–	–	–54.00	–	–	–	–7.43
	07/10/2007	13:30	0.32	72.43	–54.87	2.3	0.58	–21.14	–7.56
001N006E12N001M	11/19/2005	10:00	–	–	–54.60	–	–	–	–7.43
	08/04/2006	11:10	–	–	–53.57	–	–	–	–7.46
001N006E13B003M	08/04/2004	13:25	–	–	–53.40	–	–	–	–7.21
	08/11/2004	12:00	–	–	–53.20	0.6	0.64	–	–7.17
	08/02/2006	12:10	–	–	–52.53	–	–	–	–7.26
001N006E22J001M	08/10/2004	16:00	–	–	–64.70	2.1	0.58	–	–8.51
001N006E26N003M	10/18/2004	13:30	–	–	–66.50	–	–	–	–8.87
001N006E27R002M	10/18/2004	10:45	–	–	–61.40	–	–	–	–8.01
001N006E34A003M	10/18/2004	11:00	–	–	–61.00	–	–	–	–8.06
	08/14/2006	15:00	–	–	–61.03	–	–	–	–7.94
001N006E35G002M	10/18/2004	11:30	–	–	–54.30	–	–	–	–7.29
	08/15/2006	10:00	–	–	–54.90	–	–	–	–7.21
001N006E35N001M	10/18/2004	13:00	–	–	–62.20	–	–	–	–8.38
001N007E05A001M	02/08/2005	09:10	–	–	–56.40	16.3	1.30	–	–7.59
001N007E18D001M	11/15/2005	14:30	–	–	–52.30	–	–	–	–7.16
001N007E26H003M	09/01/2004	09:45	–	–	–49.30	–	–	–	–6.65
001N007E27P003M	01/12/2005	12:10	–	–	–49.50	3.5	0.60	–	–6.70
001N007E31F001M	07/29/2004	15:30	–	–	–62.90	9.4	0.64	–	–8.43
	01/12/2005	09:30	–	–	–62.70	9.9	1.00	–	–8.49
001N008E10C001M	08/02/2004	13:45	–	–	–53.70	–	–	–	–7.33
001N008E15J001M	08/29/2005	13:50	–	–	–48.40	–	–	–	–6.65
001N009E17N001M	02/15/2005	08:10	–	–	–48.80	–0.3	1.00	–	–6.43
001S006E23C003M	08/04/2004	12:10	–	–	–61.10	–	–	–	–7.94
	08/15/2006	14:00	–	–	–58.59	–	–	–	–7.93
001S006E25M003M	08/09/2004	16:00	–	–	–61.90	14.2	0.96	–	–8.40
	10/18/2004	12:30	–	–	–67.40	–	–	–	–9.32
	01/04/2005	09:10	–	–	–67.60	20.5	1.30	–	–9.31
	04/02/2008	09:50	0.36	74.56	–63.20	–	–	–15.67	–8.42
001S006E25M004M	08/09/2004	14:00	–	–	–61.40	15.0	0.96	–	–8.27
	10/18/2004	12:00	–	–	–61.50	–	–	–	–8.37
001S006E36B001M	10/18/2004	09:00	–	–	–60.60	–	–	–	–8.37
001S007E27P001M	01/04/2005	12:30	–	–	–60.30	12.2	1.00	–	–8.15
001S008E12L001M	02/14/2005	11:20	–	–	–49.90	–	0.60	–	–6.63
001S008E13M001M	08/31/2004	11:45	–	–	–50.60	–	–	–	–6.85
	08/30/2005	11:20	–	–	–52.60	–	–	–	–6.91
001S009E11J001M	07/28/2004	10:40	–	–	–50.40	–	–	–	–6.58
001S009E33P001M	08/31/2004	10:25	–	–	–67.00	–	–	–	–9.08
001S009E33R001M	01/11/2005	10:10	–	–	–52.70	1.0	0.60	–	–7.40
001S010E19P001M	01/11/2005	13:30	–	–	–77.50	37.4	1.90	–	–10.60
001S010E27M001M	02/14/2005	14:40	–	–	–65.60	3.2	0.60	–	–8.90

Table 16. Isotopic data for water from selected wells, Eastern San Joaquin Groundwater Subbasin, California, 2003–7. —Continued

[Site locations are shown in figure 48. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Deuterium/protium and oxygen-18/16 analyzed by USGS National Research Program, Stable Isotope Laboratory, Reston, Virginia. Carbon age analyzed by University of Waterloo, Isotope Laboratory, Waterloo, Ontario, Canada. Tritium analyzed by University of Miami, Tritium Laboratory, Miami, Florida. Dates sites were drilled given in table 1. **Abbreviations**: hh:mm, hour:minute; mm/dd/yyyy, month/day/year; pCi/L, picocuries per liter; –, no data]

State well number	Date (mm/dd/yyyy)	Time (hh:mm)	Carbon-14 counting error, filtered, percent modern (49934)	Carbon-14, filtered, percent modern (49933)	Deuterium/ protium unfiltered, per mil (82082)	Tritium, unfiltered (pCi/L) (07000)	Tritium 2-sigma combined uncertainty, unfiltered (pCi/L) (75985)	Carbon-13/ carbon-12 unfiltered, per mil (82081)	Oxygen-18/ oxygen-16 unfiltered, per mil (82085)
002N006E04E001M	10/25/2004	13:20	–	–	–59.50	–	–	–	–8.56
002N006E06B001M	05/27/2004	13:30	0.54	84.88	–	–	–	–19.28	–
	08/02/2006	18:00	–	–	–55.70	–	–	–	–6.98
002N006E06C003M	07/27/2004	16:10	0.87	85.88	–54.10	11.8	0.77	–18.67	–6.29
002N006E08C001M	10/25/2004	13:35	–	–	–67.90	–	–	–	–8.95
002N006E08Q002M	08/11/2004	15:30	–	–	–55.30	11.9	0.77	–	–7.64
	10/19/2004	10:30	–	–	–54.10	–	–	–	–7.67
002N006E16C002M	07/27/2004	11:55	–	–	–60.30	–	–	–	–8.19
002N006E16D003M	10/25/2004	14:25	–	–	–56.90	–	–	–	–7.86
002N006E17A001M	10/25/2004	11:30	–	–	–56.90	–	–	–	–7.98
002N006E17G001M	10/25/2004	15:10	–	–	–58.80	–	–	–	–8.38
002N006E17J001M	01/25/2005	09:10	–	–	–58.80	3.8	1.00	–	–8.08
002N006E19L001M	10/19/2004	10:00	–	–	–54.10	–	–	–	–6.95
002N006E29M001M	10/18/2004	09:30	–	–	–60.20	–	–	–	–8.26
002N007E06P002M	01/12/2005	13:30	–	–	–68.80	33.9	1.90	–	–9.51
002N007E07D002M	10/27/2004	13:40	–	–	–74.30	–	–	–	–10.38
002N007E07Q001M	07/27/2004	13:30	–	–	–64.20	–	–	–	–8.88
002N007E10P001M	01/10/2005	14:00	0.37	71.46	–60.60	0.3	0.60	–16.49	–8.70
002N007E25M001M	09/01/2004	10:32	–	–	–59.00	–	–	–	–8.22
002N008E13G001M	08/02/2004	13:25	–	–	–57.10	–	–	–	–7.87
002N008E15L001M	01/13/2005	13:50	–	–	–59.20	0.3	0.60	–	–8.44
002N008E16L001M	01/13/2005	10:30	0.59	91.68	–60.50	–	0.60	–17.51	–8.58
002S007E09L001M	01/04/2005	11:10	–	–	–53.60	1.0	0.60	–	–7.13
002S007E24R002M	08/04/2004	10:10	–	–	–66.90	–	–	–	–8.95
002S008E02C001M	08/04/2004	08:50	–	–	–79.60	–	–	–	–10.87
002S008E20J002M	08/04/2004	09:40	–	–	–71.50	–	–	–	–9.77
002S009E12R001M	07/28/2004	09:30	–	–	–80.60	–	–	–	–10.99
002S009E20D001M	01/11/2005	08:40	–	–	–71.40	26.6	1.90	–	–9.85
003N005E03J002M	08/30/2005	17:20	–	–	–67.70	–	–	–	–8.98
003N006E14R005M	01/10/2005	13:30	–	–	–63.50	7.4	1.00	–	–8.86
	04/02/2008	13:10	0.38	80.44	–65.80	4.5	–	–15.20	–8.94
003N006E18R001M	07/12/2007	15:00	0.44	113.30	–56.19	6.1	0.58	–14.49	–7.73
003N006E24N001M	11/18/2004	10:30	–	–	–60.70	–	–	–	–8.02
003N006E30K001M	11/18/2004	09:15	–	–	–55.90	–	–	–	–7.76
	07/09/2007	13:20	0.44	110.30	–56.66	8.0	0.58	–14.78	–7.70
003N008E19B002M	02/09/2005	13:30	–	–	–57.80	–0.3	1.00	–	–8.05
003N008E20P001M	08/02/2004	13:00	–	–	–56.20	–	–	–	–7.75
003N009E06N001M	08/02/2004	12:40	–	–	–49.80	–	–	–	–6.32
003N009E36G001M	01/11/2005	10:50	0.52	116.70	–54.40	14.1	1.00	–15.73	–7.55
003S007E03Q001M	01/04/2005	15:50	–	–	–81.10	14.1	1.00	–	–11.21
004N005E03P001M	01/13/2005	09:30	–	–	–74.60	1.6	0.60	–	–10.13
004N005E06J001M	08/31/2005	11:40	–	–	–71.20	–	–	–	–9.79
004N005ES6R001M	01/13/2005	14:30	–	–	–69.60	1.3	0.60	–	–9.36

Table 16. Isotopic data for water from selected wells, Eastern San Joaquin Groundwater Subbasin, California, 2003–7. —Continued

[Site locations are shown in figure 48. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Deuterium/protium and oxygen-18/16 analyzed by USGS National Research Program, Stable Isotope Laboratory, Reston, Virginia. Carbon age analyzed by University of Waterloo, Isotope Laboratory, Waterloo, Ontario, Canada. Tritium analyzed by University of Miami, Tritium Laboratory, Miami, Florida. Dates sites were drilled given in table 1. **Abbreviations**: hh:mm, hour:minute; mm/dd/yyyy, month/day/year; pCi/L, picocuries per liter; –, no data]

State well number	Date (mm/dd/yyyy)	Time (hh:mm)	Carbon-14 counting error, filtered, percent modern (49934)	Carbon-14, filtered, percent modern (49933)	Deuterium/ protium unfiltered, per mil (82082)	Tritium, unfiltered (pCi/L) (07000)	Tritium 2-sigma combined uncertainty, unfiltered (pCi/L) (75985)	Carbon-13/ carbon-12 unfiltered, per mil (82081)	Oxygen-18/ oxygen-16 unfiltered, per mil (82085)
004N008E29E004M	08/05/2004	11:40	–	–	–65.10	–	–	–	–8.92
004N008E31G001M	01/10/2005	11:20	–	–	–52.30	–	0.60	–	–7.10
004N008E34G002M	01/25/2005	16:50	–	–	–51.20	–	0.60	–	–6.93
004N009E17E002M	08/02/2004	12:20	–	–	–66.00	–	–	–	–8.91
004N010E13C001M	01/27/2005	09:50	–	–	–55.50	2.9	0.60	–	–7.58

Table 17. Sampling-well sites, Eastern San Joaquin Groundwater Subbasin, California

[State well number, see well-numbering diagram in text. Site locations are shown in figure 48. **Abbreviations**: ft, feet; LSD, land surface datum; NAVD 88, North American Vertical Datum of 1988; USGS ID, U.S. Geological Survey identification number: the unique number for each site in USGS National Water Information System (NWIS) database; –, no data]

State well number	USGS ID	Altitude of land surface (ft above NAVD 88)	Depth of well (ft below LSD)	Depth to top of screen interval (ft below LSD)	Depth to bottom of screen interval (ft below LSD)
001N006E04P002M	375731121192101	5	550	475	525
001N006E11P003M	375622121154101	14	494	–	–
001N006E12A001M	375717121154101	22	530	200	510
001N006E12N001M	375636121161601	18	520	201	500
001N006E13B003M	375621121154001	–	340	200	340
001N006E22J001M	375507121173501	9	259	120	256
001N006E26N003M	375400121173001	16	–	–	–
001N006E27R002M	375353121173801	16	–	–	–
001N006E34A003M	375342121175101	16	–	–	–
001N006E35G002M	375329121165101	15	125	115	125
001N006E35N001M	375315121171901	15	–	–	–
001N007E05A001M	375808121132301	32	427	196	419
001N007E18D001M	375624121151901	23	450	209	426
001N007E26H003M	375422121095301	50	160	160	–
001N007E27P003M	375400121110001	37	365	130	345
001N007E31F001M	375326121145901	21	425	199	415
001N008E10C001M	375718121050501	–	204	204	–
001N008E15J001M	375602121043101	82	164	154	164
001N009E17N001M	375500121000001	98	–	–	–
001S006E23C003M	375027121170701	12	–	–	–
001S006E25M003M	374900121160001	26	270	180	265
001S006E25M004M	374908121155901	26	270	215	265
001S006E36B001M	374838121153701	25	210	110	210
001S007E27P001M	374800121110001	40	360	100	350
001S008E12L001M	375100121020001	90	390	290	390
001S008E13M001M	375053121030601	87	120	120	–
001S009E11J001M	375142120564001	–	164	164	–
001S009E33P001M	374756120591701	119	152	152	–
001S009E33R001M	374700120580001	124	610	280	600
001S010E19P001M	374900120540001	149	175	130	175
001S010E27M001M	374900120520001	195	–	–	–
002N006E04E001M	380308121194001	17	252	152	248
002N006E06B001M	380321121214001	8	–	–	–
002N006E06C003M	380319121215401	6.5	60	–	–
002N006E08C001M	380230121203801	10	114	114	–
002N006E08Q002M	380152121202201	16	–	–	–
002N006E16C002M	380130121193101	–	104	104	–
002N006E16D003M	380127121194501	12	190	190	–
002N006E17A001M	380140121195401	12	190	190	–
002N006E17G001M	380123121201601	13	390	281	382
002N006E17J001M	380107121195201	9	268	170	236
002N006E19L001M	380017121214201	7	252	100	217
002N006E29M001M	375928121205201	7	–	–	–
002N007E06P002M	380245121151701	36	300	162	288
002N007E07D002M	380224121152801	35	210	156	206
002N007E07Q001M	380154121145301	–	212	212	–
002N007E10P001M	381500121110001	52	466	–	–
002N007E25M001M	375929121094701	–	298	298	–
002N008E13G001M	380136121025301	–	200	200	–

Table 17. Sampling-well sites, Eastern San Joaquin Groundwater Subbasin, California.—Continued

[State well number, see well-numbering diagram in text. Site locations are shown in figure 48. **Abbreviations**: ft, feet; LSD, land surface datum; NAVD 88, North American Vertical Datum of 1988; USGS ID, U.S. Geological Survey identification number: the unique number for each site in USGS National Water Information System (NWIS) database; –, no data]

State well number	USGS ID	Altitude of land surface (ft above NAVD 88)	Depth of well (ft below LSD)	Depth to top of screen interval (ft below LSD)	Depth to bottom of screen interval (ft below LSD)
002N008E15L001M	380118121052001	87	619	–	–
002N008E16L001M	380113121062801	80	270	190	270
002S007E09L001M	374600121120001	37	350	138	340
002S007E20J001M	374448121130701	34	175	155	175
002S007E24R002M	374424121083301	56	98	98	–
002S008E02C001M	374749121035001	–	76	76	–
002S008E20J002M	374444121062201	–	140	182	310
002S009E12R001M	374610120552801	–	280	280	–
002S009E20D001M	374500121000001	73	–	–	–
003N005E03J002M	380815121243001	7	–	–	–
003N006E14R005M	380606121164501	38	403	200	395
003N006E18R001M	380610121211001	19	120	–	–
003N006E24N001M	380518121230201	8	–	–	–
003N006E30K001M	380446121213001	12	53	–	–
003N008E19B002M	380608121081801	88	164	–	–
003N008E20P001M	380531121073001	90	184	184	–
003N009E06N001M	380808121015801	–	334	344	–
003N009E36G001M	380419120555101	170	–	–	–
003S007E03Q001M	374100121110001	40	–	–	–
004N005E03P001M	381300121250001	10	245	135	–
004N005E06J001M	381332121280501	4	120	–	–
004N005E06R001M	380800121220001	18	212	–	–
004N008E29E004M	381018121075501	95	216	216	–
004N008E31G001M	380918121081301	100	535	–	–
004N008E34G002M	380925121045501	190	208	–	–
004N009E17E002M	381210121010201	185	156	156	–
004N010E13C001M	381200120490001	720	310	100	310

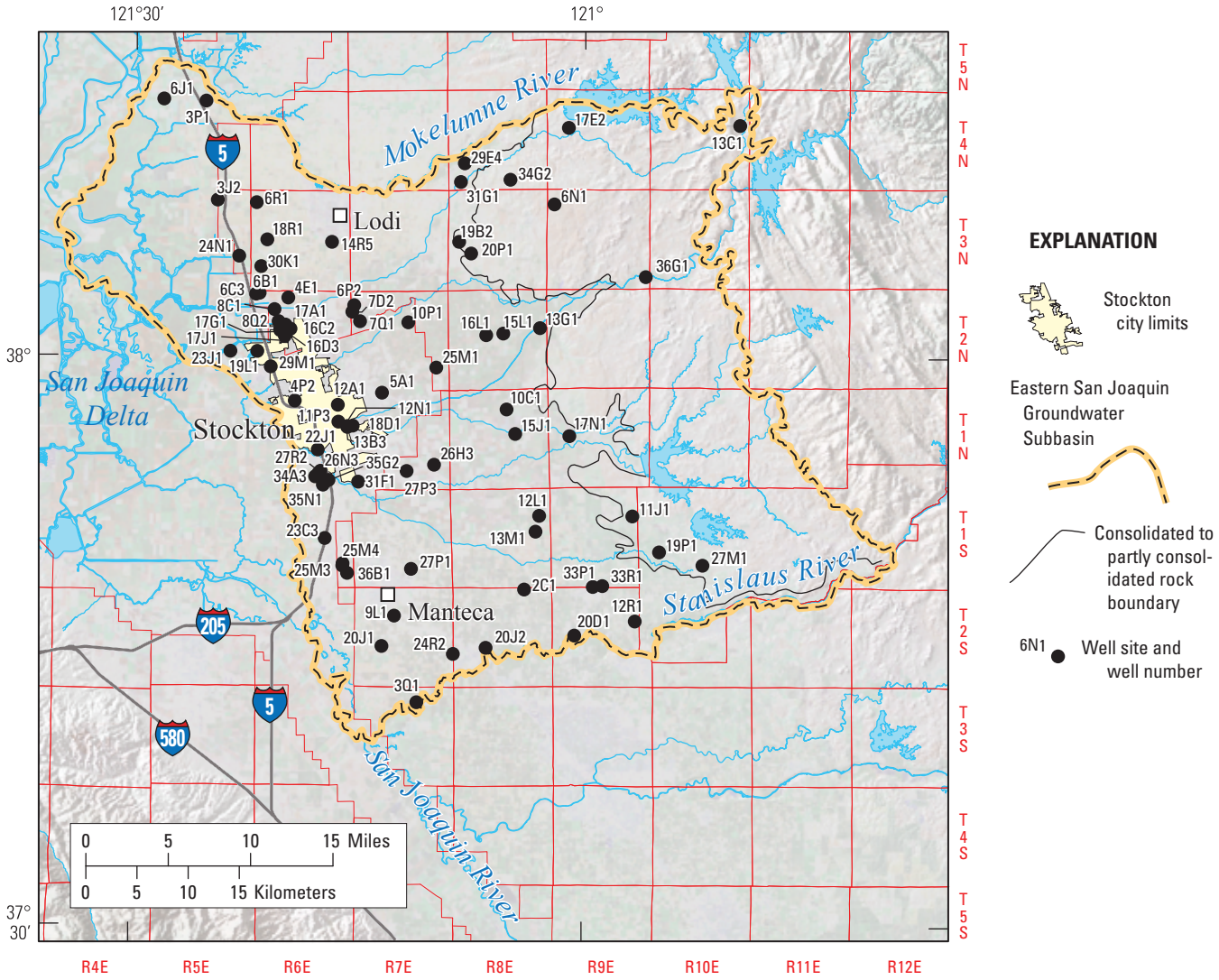


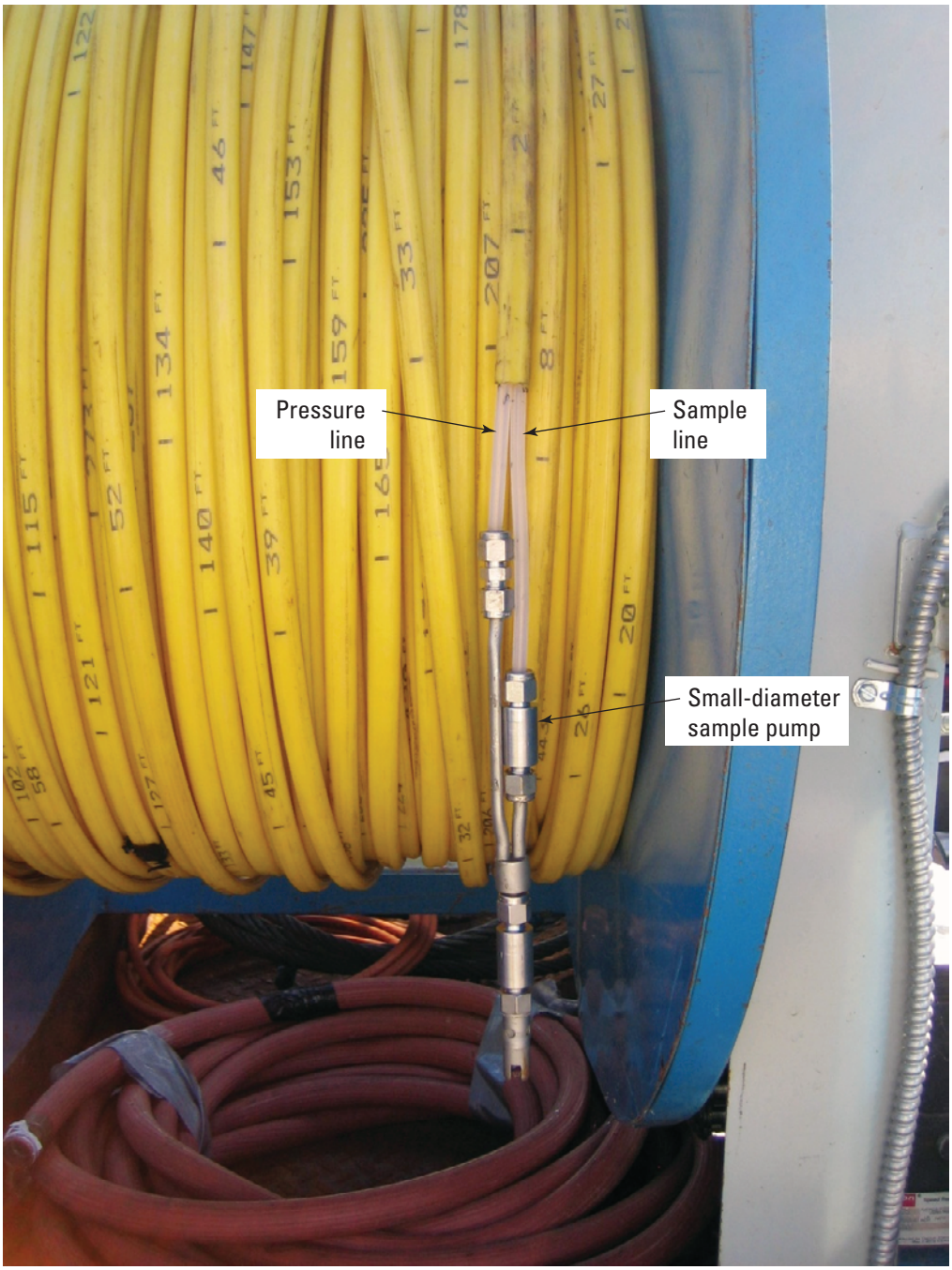
Figure 48. Location of the study area and public-supply and private well sampling sites, Eastern San Joaquin Groundwater Subbasin, California.

Depth-Dependent Samples

Depth-dependent sampling allows for sampling of well at certain discrete sampling intervals instead of sampling a bulk sample from the whole well screen interval. A small-diameter, commercially available, gas-displacement pump was used to collect samples within selected wells under pumping conditions (Izbicki, 2004; fig. 49). The sample pump consists of a series of one-way flow valves connected to the surface by two 0.3-cm-diameter Teflon tubes bonded together into a single hose (fig. 50). One tube serves as a pressure line, and the other serves as the sample line. The pump, hose, and weights are less than 1 inch in diameter and are designed for use in wells having limited access. After the pump is lowered to the sample depth within the well, water enters the pump, filling both tubes to the water level in the well. The pressure line is pressurized using compressed gas, and water is displaced from this tube into the sample line. A one-way flow valve at the pump intake prevents the displaced water from flowing back into the well. Once the water is in the sample line, another one-way valve prevents the water from flowing back toward the sample pump after pressure is released. Pressure is alternatively applied and released until a column of water is forced to the surface. The process is repeated at several depths within the well to complete a point profile of water quality with depth.

Photograph by Loren Metzger, U.S. Geological Survey, 2008.

Figure 49. Depth-dependent sampling, City of Stockton well 001N007E31C001M (SSS–5), Stockton, California, March 26, 2008.



Photograph by Loren Metzger, U.S. Geological Survey, 2008.

Figure 50. Hose-reel with small diameter sample pump used for depth-dependent water-quality sampling, March 26, 2008.

If the concentration of a constituent at the first sample depth (C_1) and the second sample depth (C_2) in a profile within a well are known, and the flow rate of water at the two sample depths (Q_1 and Q_2, respectively) are known on the basis of well-bore flow data discussed previously, the concentration in water entering the well from the aquifer in the intervening interval (C_a) can be calculated according to the following equation (Izbicki and others, 1999):

$$[(C_1Q_1C_2Q_2)/Q_a] = C_a \quad (2)$$

where

$Q_a = (Q_1 - Q_2)$, and

Q_a is the quantity of water entering the well between the two sample depths. This calculation assumes conservation of mass and conservative (simple, non-reactive) mixing.

Measured nutrient, water-chemistry, and isotopic data for depth-dependent sampling sites are provided in tables 18, 19, and 20, respectively. Calculated depth-dependent concentrations of selected constituents entering the well between sample interval, were determined by using the above equation.. Associated geophysical logs, well-construction data, depth-dependent water-quality data, and the calculated concentrations of selected constituents entering the well between sample intervals are shown in figures 22–33. Construction data for sampled depth-dependent wells are provided in table 21.

Core and Cuttings Samples

Pore-Water samples

Core material collected from fine-grained deposits during drilling at selected multiple-well sites was squeezed in a hydraulic press (Manheim and others, 1994) to extract pore water. These data were used to assess the source of high-chloride water in interstitial pore fluids in fine-grained deposits that could not be sampled by wells. Extracted pore water was filtered as it discharged from the press and was analyzed for pH and specific conductance. Extracted pore water was then shipped to the NWQL in Denver for analysis for chloride, bromide, iodide, boron, and barium and for the stable isotopes of oxygen and hydrogen ($\delta^{18}O$ and δD, respectively) according to methods in table 10. Results of analysis are given in table 22.

Acid Extractions from Core and Cutting Material

Trace elements were extracted from selected core material and cuttings, collected at selected multiple-well sites, at the USGS San Diego Laboratory by using the method described by Izbicki, Ball, and others (2008), which was modified from Chao and Sanzolone (1989). Samples were processed by mixing 10 grams of oven-dried core material or drill cuttings with 50 mL of 4–N HNO_3 solution and were then shaken for 24 hours in a wrist shaker. The solid material was then separated from the supernate by centrifugation, and the remaining solution was filtered through a 0.45 µm pore-sized filter. Samples were shipped to the NWQL in Denver for analysis for arsenic, chromium, iron, manganese, vanadium, and uranium by ICP–MS (table 10). Results are presented in table 23.

These data were used to assess the possible source of high-concentration of selected trace metals that may be found within water in interstitial pore fluids in fine-grained deposits that could not be sampled by wells.

Accessing Data

Users of the data presented in this report are encouraged to access information through the USGS National Water Information System Web page (NWISWeb) available at http://waterdata.usgs.gov/nwis/.

NWISWeb serves as an interface to a database network of site information and real-time, groundwater, surface-water, and water-quality data collected from locations throughout the United States and elsewhere. Data are updated from the database network on a regularly scheduled basis.

Data are retrieved by category and geographic area and can be selectively refined by specific location or parameter field. NWISWeb can output water-level and water-quality graphs, site maps, and data tables (in HTML and ASCII format) and develop site-selection lists.

Post-publication updates to data presented in this report are made to the USGS NWIS and are available online through NWISWeb. Additional geophysical logs, sample collection notes, and other information not contained in NWIS are kept on file at the USGS office in San Diego, California. Formal requests for specific data should be made to the USGS California Water Science Center, CSUS Campus, Placer Hall, 6000 J Street, Room 4000, Sacramento, CA 95819–6129, http://ca.water.usgs.gov.

Table 18. Nutrient data for water from selected depth-dependent wells, Eastern San Joaquin Groundwater Subbasin, California, 2004–8.

[Site locations are shown in figure 20. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Samples analyzed by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD). Sample depth in feet below land surface. **Abbreviations**: E, estimated value; ft, feet; hh:mm, hour: minute; LSD, land surface datum; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; NAVD 88; North American Vertical Datum of 1988; –, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Altitude of land surface (ft above NAVD 88)	Depth to top of sample interval (ft below LSD) (72015)	Depth to bottom of sample interval (ft below LSD) (72016)	Ammonia plus organic nitrogen, filtered (mg/L as N) (00623)	Ammonia, filtered (mg/L as N) (00608)
001N007E08H002M	NWQL	02/24/2005	12:00	32	275	507	E0.06	<0.040
	NWQL	02/24/2005	12:30	32	470	507	0.58	<0.040
001N007E20N001M	SD	08/04/2004	10:01	26	282	390	–	–
	SD	08/04/2004	12:01	26	312	390	–	–
	NWQL	08/04/2004	13:15	26	360	390	<0.10	E0.020
	SD	08/04/2004	13:16	26	360	390	–	–
	NWQL	08/04/2004	13:30	26	158	390	<0.10	<0.040
	SD	08/04/2004	13:31	26	158	390	–	–
	NWQL	07/15/2005	09:30	26	158	390	E0.08	<0.040
	NWQL	07/15/2005	17:30	26	160	390	0.52	<0.040
001N007E28F001M	NWQL	07/19/2005	13:00	33	255	611	0.14	<0.040
	SD	07/19/2005	13:01	33	255	611	–	–
	NWQL	07/19/2005	13:15	33	580	611	E0.10	<0.040
	SD	07/19/2005	13:16	33	580	611	–	–
	NWQL	07/19/2005	16:00	33	515	611	0.12	<0.040
	SD	07/19/2005	16:01	33	515	611	–	–
	NWQL	07/20/2005	09:30	33	460	611	0.27	<0.040
	SD	07/20/2005	09:31	33	460	611	–	–
	NWQL	07/20/2005	11:15	33	400	611	0.28	<0.040
	SD	07/20/2005	11:16	33	400	611	–	–
	NWQL	07/20/2005	14:00	33	250	611	0.26	<0.040
	SD	07/20/2005	14:01	33	250	611	–	–
001N007E31C001M	NWQL	07/29/2004	13:10	21	199	415	0.10	<0.040
	SD	07/29/2004	13:11	21	199	415	–	–
	NWQL	03/26/2008	11:00	21	199	415	<0.14	<0.020
	NWQL	03/26/2008	11:15	21	210	415	<0.14	<0.020
	NWQL	03/26/2008	13:30	21	250	415	<0.14	<0.020
	NWQL	03/26/2008	15:00	21	310	415	<0.14	<0.020
	NWQL	03/26/2008	17:30	21	360	415	<0.14	<0.020
	NWQL	03/26/2008	18:30	21	390	415	E0.08	0.05
002N006E01Q001M	NWQL	08/09/2006	09:30	34	157	362	E0.08	<0.010
	NWQL	08/09/2006	13:45	34	360	362	E0.07	E0.008
002N006E04Q001M	NWQL	07/13/2005	10:45	18	192	398	<0.10	<0.040
	NWQL	07/13/2005	11:30	18	375	398	0.26	<0.040
	NWQL	07/13/2005	16:30	18	350	398	0.29	<0.040
	NWQL	07/14/2005	09:00	18	250	398	E0.06	<0.040
	NWQL	07/14/2005	12:00	18	220	398	0.23	<0.040
002N006E05F001M	NWQL	08/03/2004	13:30	12	156	350	<0.10	<0.040
	SD	08/03/2004	13:31	12	156	350	–	–
	SD	08/03/2004	14:16	12	255	350	–	–
	SD	08/03/2004	15:16	12	275	350	–	–
	SD	08/03/2004	16:01	12	320	350	–	–
	NWQL	08/03/2004	17:15	12	340	350	E.06	E0.030
	SD	08/03/2004	17:16	12	340	350	–	–

Table 18. Nutrient data for water from selected depth-dependent wells, Eastern San Joaquin Groundwater Subbasin, California, 2004–8.—Continued

[Site locations are shown in figure 20. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Samples analyzed by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD). Sample depth in feet below land surface. **Abbreviations**: E, estimated value; ft, feet; hh:mm, hour: minute; LSD, land surface datum; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; NAVD 88; North American Vertical Datum of 1988; –, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Altitude of land surface (ft above NAVD 88)	Depth to top of sample interval (ft below LSD) (72015)	Depth to bottom of sample interval (ft below LSD) (72016)	Ammonia plus organic nitrogen, filtered (mg/L as N) (00623)	Ammonia, filtered (mg/L as N) (00608)
002N006E11H003M	NWQL	06/19/2007	12:00	27	260	495	<0.10	<0.020
	NWQL	06/20/2007	14:20	27	481	495	<0.10	<0.020
002N006E12J001M	NWQL	08/08/2006	11:00	35	240	445	E0.06	E0.007
	NWQL	08/08/2006	17:20	35	425	445	E0.06	E0.009
002N006E24P004M	NWQL	08/05/2004	09:30	25	200	520	<0.10	<0.040
	SD	08/05/2004	09:31	25	200	520	–	–
	SD	08/05/2004	11:01	25	244	520	–	–
	SD	08/05/2004	12:01	25	278	520	–	–
	SD	08/05/2004	14:01	25	300	520	–	–
	SD	08/05/2004	15:01	25	316	520	–	–
	SD	08/05/2004	16:31	25	400	520	–	–
	NWQL	08/05/2004	17:45	25	506	520	<0.10	<0.040
	SD	08/05/2004	17:46	25	506	520	–	–
	NWQL	01/27/2005	09:00	25	400	520	–	<0.040
	NWQL	01/27/2005	13:00	25	275	520	–	<0.040
	NWQL	01/28/2005	08:30	25	200	520	–	<0.040
002N006E27L001M	NWQL	02/16/2005	15:00	15	–	495	–	<0.040
	NWQL	02/17/2005	11:30	15	–	495	–	<0.040
	NWQL	02/17/2005	19:00	15	–	495	–	<0.040
	NWQL	02/18/2005	10:00	15	–	495	–	<0.040

Table 18. Nutrient data for water from selected depth-dependent wells, Eastern San Joaquin Groundwater Subbasin, California, 2004–8.—Continued

[Site locations are shown in figure 20. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Samples analyzed by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD). Sample depth in feet below land surface. **Abbreviations**: E, estimated value; ft, feet; hh:mm, hour: minute; LSD, land surface datum; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; NAVD 88; North American Vertical Datum of 1988; –, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Nitrate plus nitrite, filtered (mg/L as N) (00631)	Nitrate, filtered (mg/L as N) (00618)	Nitrite, filtered (mg/L as N) (00613)	Orthophosphate, filtered (mg/L as P) (00671)	Phosphorus, filtered (mg/L as P) (00666)
001N007E08H002M	NWQL	02/24/2005	12:00	11.3	11.2	0.110	0.060	0.06
	NWQL	02/24/2005	12:30	13.1	12.9	0.255	0.020	0.04
	SD	08/04/2004	10:01	–	0.29	<0.030	<0.500	–
	SD	08/04/2004	12:01	–	<0.06	<0.030	<0.500	–
	NWQL	08/04/2004	13:15	<0.06	<0.06	<0.008	0.110	0.10
	SD	08/04/2004	13:16	–	<0.06	<0.030	<0.500	–
	NWQL	08/04/2004	13:30	3.48	3.48	<0.008	0.050	0.04
	SD	08/04/2004	13:31	–	3.38	<0.030	E0.300	–
	NWQL	07/15/2005	09:30	3.49	3.49	<0.008	0.030	0.05
	NWQL	07/15/2005	17:30	7.91	7.91	<0.008	<0.020	E0.03
001N007E28F001M	NWQL	07/19/2005	13:00	4.19	4.19	<0.008	0.030	E0.04
	SD	07/19/2005	13:01	–	4.18	<0.100	<2	–
	NWQL	07/19/2005	13:15	<0.06	<0.06	<0.008	0.040	0.05
	SD	07/19/2005	13:16	–	<0.06	<0.030	<0.500	–
	NWQL	07/19/2005	16:00	1.89	1.89	<0.008	0.030	0.04
	SD	07/19/2005	16:01	–	1.75	<0.030	<0.500	–
	NWQL	07/20/2005	09:30	<0.06	<0.06	<0.008	0.040	0.07
	SD	07/20/2005	09:31	–	<0.06	<0.030	<0.500	–
	NWQL	07/20/2005	11:15	<0.06	<0.06	<0.008	0.030	0.05
	SD	07/20/2005	11:16	–	<0.06	<0.030	<0.500	–
	NWQL	07/20/2005	14:00	<0.06	<0.06	<0.008	0.030	0.05
	SD	07/20/2005	14:01	–	<0.06	<0.030	<0.500	–
001N007E31C001M	NWQL	07/29/2004	13:10	2.92	2.92	<0.008	0.030	E0.02
	SD	07/29/2004	13:11	–	2.88	<0.030	<1	–
	NWQL	03/26/2008	11:00	3.25	3.24	0.012	0.033	E0.03
	NWQL	03/26/2008	11:15	2.04	2.02	0.016	0.031	E0.02
	NWQL	03/26/2008	13:30	3.12	3.07	0.050	0.028	E0.02
	NWQL	03/26/2008	15:00	3.31	3.27	0.045	0.026	E0.02
	NWQL	03/26/2008	17:30	4.32	4.27	0.056	0.026	<0.04
	NWQL	03/26/2008	18:30	2.92	2.76	0.154	0.016	<0.04
002N006E01Q001M	NWQL	08/09/2006	09:30	4.57	4.57	<0.002	0.050	E0.02
	NWQL	08/09/2006	13:45	4.16	4.16	<0.002	0.050	E0.02
002N006E04Q001M	NWQL	07/13/2005	10:45	2.18	2.18	<0.008	E0.010	E0.03
	NWQL	07/13/2005	11:30	<0.06	<0.06	<0.008	<0.020	E0.02
	NWQL	07/13/2005	16:30	<0.06	<0.06	<0.008	E0.010	E0.02
	NWQL	07/14/2005	09:00	0.52	0.52	<0.008	E0.020	E0.03
	NWQL	07/14/2005	12:00	1.80	1.80	<0.008	E0.010	E0.03
002N006E05F001M	NWQL	08/03/2004	13:30	2.54	E2.54	E0.005	0.030	E0.02
	SD	08/03/2004	13:31	–	2.49	<0.030	<1	–
	SD	08/03/2004	14:16	–	<0.06	<0.030	<0.500	–
	SD	08/03/2004	15:16	–	<0.06	<0.030	<0.500	–
	SD	08/03/2004	16:01	–	<0.06	<0.030	<0.500	–
	NWQL	08/03/2004	17:15	<0.06	<0.06	<0.008	0.040	E0.04
	SD	08/03/2004	17:16	–	<0.06	<0.030	<0.500	–

Table 18. Nutrient data for water from selected depth-dependent wells, Eastern San Joaquin Groundwater Subbasin, California, 2004–8.—Continued

[Site locations are shown in figure 20. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Samples analyzed by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD). Sample depth in feet below land surface. **Abbreviations**: E, estimated value; ft, feet; hh:mm, hour: minute; LSD, land surface datum; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; NAVD 88; North American Vertical Datum of 1988; –, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Nitrate plus nitrite, filtered (mg/L as N) (00631)	Nitrate, filtered (mg/L as N) (00618)	Nitrite, filtered (mg/L as N) (00613)	Orthophosphate, filtered (mg/L as P) (00671)	Phosphorus, filtered (mg/L as P) (00666)
002N006E11H003M	NWQL	06/19/2007	12:00	2.04	2.04	<0.002	0.037	E0.04
	NWQL	06/20/2007	14:20	1.55	1.55	<0.002	0.038	0.04
002N006E12J001M	NWQL	08/08/2006	11:00	0.77	0.77	<0.002	0.047	E0.02
	NWQL	08/08/2006	17:20	0.46	0.46	<0.002	0.048	<0.04
002N006E24P004M	NWQL	08/05/2004	09:30	1.51	1.51	<0.008	0.040	E0.03
	SD	08/05/2004	09:31	–	1.51	<0.030	<0.500	–
	SD	08/05/2004	11:01	–	1.29	<0.030	<0.500	–
	SD	08/05/2004	12:01	–	1.09	<0.030	<0.500	–
	SD	08/05/2004	14:01	–	1.30	<0.030	<0.500	–
	SD	08/05/2004	15:01	–	0.74	<0.030	<0.500	–
	SD	08/05/2004	16:31	–	0.74	<0.030	<0.500	–
	NWQL	08/05/2004	17:45	1.05	1.05	<0.008	0.070	0.07
	SD	08/05/2004	17:46	–	1.00	<0.030	<0.500	–
	NWQL	01/27/2005	09:00	0.69	0.69	<0.008	0.034	–
	NWQL	01/27/2005	13:00	0.95	0.95	<0.008	0.034	–
	NWQL	01/28/2005	08:30	1.37	1.37	<0.008	0.033	–
002N006E27L001M	NWQL	02/16/2005	15:00	E0.04	E0.04	<0.008	0.034	–
	NWQL	02/17/2005	11:30	<0.06	<0.06	<0.008	0.044	–
	NWQL	02/17/2005	19:00	<0.06	<0.06	<0.008	0.050	–
	NWQL	02/18/2005	10:00	E0.05	E0.05	<0.008	0.054	–

Table 19. Field measurements and water-quality for water from selected depth-dependent wells, Eastern San Joaquin Groundwater Subbasin, California, 2004–8.

[Site locations are shown in figure 20. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD). Dissolved oxygen, specific conductance, and pH were measured in the field. **Abbreviations**: A, average value; E, estimated value; FET, fixed end-point titration; ft, feet; hh:mm, hour:minute; INC, incremental titration; LSD, land surface datum; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; NAVD 88, North American Vertical Datum of 1988; °C, degrees Celsius; µS/cm, microsiemens per centimeter at 25°C; °C, degrees Celsius; µg/L, micrograms per liter; –, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Altitude of land surface (ft above NAVD 88)	Depth to top of sample interval (ft below LSD) (72015)	Depth to bottom of sample interval (ft below LSD) (72016)	Dissolved oxygen, unfiltered (mg/L) (00300)	pH, unfiltered, field standard units (00400)	pH, unfiltered, laboratory standard units (00403)	Specific conductance, unfiltered, laboratory (µS/cm) (90095)	Specific conductance, unfiltered, field (µS/cm) (00095)
001N007E08H002M	NWQL	02/24/2005	12:00	32	275	507	0.5	7.6	7.5	700	722
	NWQL	02/24/2005	12:30	32	470	507	–	7.7	7.7	783	806
	NWQL	02/24/2005	14:45	32	445	507	–	7.7	–	–	806
	NWQL	02/24/2005	16:00	32	395	507	–	7.7	–	–	795
	NWQL	02/24/2005	17:30	32	370	507	–	7.8	–	–	775
	NWQL	02/24/2005	18:20	32	295	507	–	7.7	–	–	630
001N007E20N001M	NWQL	08/04/2004	10:00	26	282	390	–	8.3	–	–	262
	SD	08/04/2004	10:01	26	282	390	–	–	–	–	–
	NWQL	08/04/2004	12:00	26	312	390	–	8.0	–	–	256
	SD	08/04/2004	12:01	26	312	390	–	–	–	–	–
	NWQL	08/04/2004	13:15	26	360	390	–	8.1	8.0	275	283
	SD	08/04/2004	13:16	26	360	390	–	–	–	–	–
	NWQL	08/04/2004	13:30	26	158	390	2.3	7.7	7.7	479	494
	SD	08/04/2004	13:31	26	158	390	–	–	–	–	–
	NWQL	07/15/2005	09:30	26	158	390	2.8	7.7	7.8	493	506
	NWQL	07/15/2005	11:30	26	182	390	–	9.8	–	–	322
	NWQL	07/15/2005	17:30	26	160	390	–	8.2	–	–	807
001N007E28F001M	NWQL	07/19/2005	13:00	33	255	611	3.0	7.5	7.7	510	529
	SD	07/19/2005	13:01	33	255	611	–	–	–	–	–
	NWQL	07/19/2005	13:15	33	580	611	1.6	8.1	8.2	330	343
	SD	07/19/2005	13:16	33	580	611	–	–	–	–	–
	NWQL	07/19/2005	16:00	33	515	611	1.1	7.8	–	–	421
	SD	07/19/2005	16:01	33	515	611	–	–	–	–	–
	NWQL	07/20/2005	09:30	33	460	611	1.5	8.0	–	–	315
	SD	07/20/2005	09:31	33	460	611	–	–	–	–	–
	NWQL	07/20/2005	11:15	33	400	611	2.2	8.0	–	–	313
	SD	07/20/2005	11:16	33	400	611	–	–	–	–	–
	NWQL	07/20/2005	14:00	33	250	611	2.0	8.0	–	–	323
	SD	07/20/2005	14:01	33	250	611	–	–	–	–	–
001N007E31C001M	NWQL	07/29/2004	13:10	21	199	415	–	7.7	7.5	554	576
	SD	07/29/2004	13:11	21	199	415	–	–	–	–	–

Table 19. Field measurements and water-quality for water from selected depth-dependent wells, Eastern San Joaquin Groundwater Subbasin, California, 2004–8.—Continued

[Site locations are shown in figure 20. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD). Dissolved oxygen, specific conductance, and pH were measured in the field. **Abbreviations**: A, average value; E, estimated value; FET, fixed end-point titration; ft, feet; hh:mm, hour:minute; INC, incremental titration; LSD, land surface datum; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; NAVD 88, North American Vertical Datum of 1988; °C, degrees Celsius; µS/cm, microsiemens per centimeter at 25°C; °C, degrees Celsius; µg/L, micrograms per liter; –, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Altitude of land surface (ft above NAVD 88)	Depth to top of sample interval (ft below LSD) (72015)	Depth to bottom of sample interval (ft below LSD) (72016)	Dissolved oxygen, unfiltered (mg/L) (00300)	pH, unfiltered, field standard units (00400)	pH, unfiltered, laboratory standard units (00403)	Specific conductance, unfiltered, laboratory (µS/cm) (90095)	Specific conductance, unfiltered, field (µS/cm) (00095)
001N007E31C001M	NWQL	03/26/2008	11:00	21	199	415	1.1	7.9	7.7	657	647
	NWQL	03/26/2008	11:15	21	210	415	0.4	8.1	–	–	631
	NWQL	03/26/2008	13:30	21	250	415	0.4	8.1	–	–	592
	NWQL	03/26/2008	15:00	21	310	415	0.5	8.0	–	–	612
	NWQL	03/26/2008	17:30	21	360	415	0.6	8.1	–	–	627
	NWQL	03/26/2008	18:30	21	390	415	0.3	8.0	7.8	632	621
002N006E01Q001M	NWQL	08/09/2006	09:30	34	157	362	3.4	7.5	7.7	564	558
	NWQL	08/09/2006	11:00	34	305	362	1.2	7.7	–	–	379
	NWQL	08/09/2006	12:30	34	335	362	1.4	7.8	–	–	359
	NWQL	08/09/2006	13:45	34	360	362	1.4	7.9	8.2	509	496
002N006E04Q001M	NWQL	07/13/2005	10:45	18	192	398	0.5	7.8	7.9	337	349
	NWQL	07/13/2005	11:30	18	375	398	2.0	8.1	8.2	222	232
	NWQL	07/13/2005	16:30	18	350	398	–	8.2	–	–	231
	NWQL	07/14/2005	09:00	18	250	398	–	8.0	–	–	250
	NWQL	07/14/2005	12:00	18	220	398	–	8.0	–	–	315
	NWQL	07/21/2005	15:00	18	220	398	–	7.9	–	–	316
	NWQL	07/21/2005	16:30	18	192	398	–	7.9	–	–	354
	NWQL	07/22/2005	10:00	18	–	398	–	8.0	–	–	246
	NWQL	07/22/2005	14:00	18	350	398	–	8.1	–	–	219
	NWQL	07/22/2005	17:30	18	375	398	–	8.1	–	–	224
002N006E05F001M	NWQL	08/03/2004	13:30	12	156	350	<0.2	7.8	7.9	381	389
	SD	08/03/2004	13:31	12	156	350	–	–	–	–	–
	NWQL	08/03/2004	14:15	12	255	350	–	8.2	–	–	228
	SD	08/03/2004	14:16	12	255	350	–	–	–	–	–
	NWQL	08/03/2004	15:15	12	275	350	–	8.2	–	–	225
	SD	08/03/2004	15:16	12	275	350	–	–	–	–	–
	NWQL	08/03/2004	16:00	12	320	350	–	8.2	–	–	263
	SD	08/03/2004	16:01	12	320	350	–	–	–	–	–
	NWQL	08/03/2004	17:15	12	340	350	–	–	7.9	246	266
	SD	08/03/2004	17:16	12	340	350	–	–	–	–	–
	NWQL	01/12/2005	13:50	12	–	350	–	–	7.6	254	252

Table 19. Field measurements and water-quality for water from selected depth-dependent wells, Eastern San Joaquin Groundwater Subbasin, California, 2004–8.—Continued

[Site locations are shown in figure 20. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD). Dissolved oxygen, specific conductance, and pH were measured in the field. **Abbreviations**: A, average value; E, estimated value; FET, fixed end-point titration; ft, feet; hh:mm, hour:minute; INC, incremental titration; LSD, land surface datum; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; NAVD 88, North American Vertical Datum of 1988; °C, degrees Celsius; µS/cm, microsiemens per centimeter at 25°C; °C, degrees Celsius; µg/L, micrograms per liter; –, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Altitude of land surface (ft above NAVD 88)	Depth to top of sample interval (ft below LSD) (72015)	Depth to bottom of sample interval (ft below LSD) (72016)	Dissolved oxygen, unfiltered (mg/L) (00300)	pH, unfiltered, field standard units (00400)	pH, unfiltered, laboratory standard units (00403)	Specific conductance, unfiltered, laboratory (µS/cm) (90095)	Specific conductance, unfiltered, field (µS/cm) (00095)
002N006E11H003M	NWQL	06/19/2007	12:00	27	260	495	4.5	7.6	7.3	508	498
	NWQL	06/19/2007	14:40	27	315	495	2.4	7.8	–	–	489
	NWQL	06/19/2007	17:50	27	350	495	2.3	7.6	–	–	434
	NWQL	06/20/2007	09:30	27	420	495	1.8	7.6	–	–	485
	NWQL	06/20/2007	11:30	27	450	495	1.1	7.7	–	–	476
	NWQL	06/20/2007	14:20	27	481	495	0.7	7.7	7.7	477	474
002N006E12J001M	NWQL	08/08/2006	11:00	35	240	445	3.2	7.9	7.7	327	327
	NWQL	08/08/2006	13:20	35	300	445	1.5	8.0	–	–	360
	NWQL	08/08/2006	15:00	35	330	445	1.4	8.1	–	–	248
	NWQL	08/08/2006	16:00	35	375	445	1.8	8.2	–	–	235
	NWQL	08/08/2006	17:20	35	425	445	1.7	8.2	7.8	244	248
002N006E24P004M	NWQL	08/05/2004	09:30	25	200	520	3.0	7.4	7.7	349	370
	SD	08/05/2004	09:31	25	200	520	–	–	–	–	–
	NWQL	08/05/2004	09:45	25	200	520	–	7.8	–	–	340
	NWQL	08/05/2004	11:00	25	244	520	–	–	–	–	339
	SD	08/05/2004	11:01	25	244	520	–	–	–	–	–
	NWQL	08/05/2004	12:00	25	278	520	–	–	–	–	331
	SD	08/05/2004	12:01	25	278	520	–	–	–	–	–
	NWQL	08/05/2004	14:00	25	300	520	–	–	–	–	371
	SD	08/05/2004	14:01	25	300	520	–	–	–	–	–
	NWQL	08/05/2004	15:00	25	316	520	–	–	–	–	289
	SD	08/05/2004	15:01	25	316	520	–	–	–	–	–
	NWQL	08/05/2004	16:30	25	400	520	–	–	–	–	272
	SD	08/05/2004	16:31	25	400	520	–	–	–	–	–
	NWQL	08/05/2004	17:45	25	506	520	–	–	7.8	286	305
	SD	08/05/2004	17:46	25	506	520	–	–	–	–	–
	NWQL	01/26/2005	12:50	25	500	520	–	–	7.7	349	393
	NWQL	01/27/2005	09:00	25	400	520	–	–	7.8	255	260
	NWQL	01/27/2005	13:00	25	275	520	–	–	E7.6	299	298
	NWQL	01/28/2005	08:30	25	200	520	3.9	7.6	7.7	331	352

Table 19. Field measurements and water-quality for water from selected depth-dependent wells, Eastern San Joaquin Groundwater Subbasin, California, 2004–8.—Continued

[Site locations are shown in figure 20. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD). Dissolved oxygen, specific conductance, and pH were measured in the field. **Abbreviations**: A, average value; E, estimated value; FET, fixed end-point titration; ft, feet; hh:mm, hour:minute; INC, incremental titration; LSD, land surface datum; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; NAVD 88, North American Vertical Datum of 1988; °C, degrees Celsius; µS/cm, microsiemens per centimeter at 25°C; °C, degrees Celsius; µg/L, micrograms per liter; –, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Altitude of land surface (ft above NAVD 88)	Depth to top of sample interval (ft below LSD) (72015)	Depth to bottom of sample interval (ft below LSD) (72016)	Dissolved oxygen, unfiltered (mg/L) (00300)	pH, unfiltered, field standard units (00400)	pH, unfiltered, laboratory standard units (00403)	Specific conductance, unfiltered, laboratory (µS/cm) (90095)	Specific conductance, unfiltered, field (µS/cm) (00095)
002N006E27L001M	NWQL	02/16/2005	15:00	15	–	495	–	7.9	7.6	454	488
	NWQL	02/16/2005	17:00	15	360	495	–	7.9	–	–	483
	NWQL	02/16/2005	18:00	15	325	495	–	7.9	–	–	483
	NWQL	02/17/2005	11:30	15	–	495	–	7.9	7.8	428	467
	NWQL	02/17/2005	19:00	15	–	495	–	8.1	7.7	415	451
	NWQL	02/18/2005	10:00	15	–	495	3.4	7.7	7.6	438	468

Table 19. Field measurements and water-quality for water from selected depth-dependent wells, Eastern San Joaquin Groundwater Subbasin, California, 2004–8.—Continued

[Site locations are shown in figure 20. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD). Dissolved oxygen, specific conductance, and pH were measured in the field. **Abbreviations**: A, average value; E, estimated value; FET, fixed end-point titration; ft, feet; hh:mm, hour:minute; INC, incremental titration; LSD, land surface datum; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; NAVD 88, North American Vertical Datum of 1988; °C, degrees Celsius; µS/cm, microsiemens per centimeter at 25°C; °C, degrees Celsius; µg/L, micrograms per liter; –, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Temperature (°C) (00010)	Calcium, filtered (mg/L as Ca) (00915)	Magnesium, filtered (mg/L as Mg) (00925)	Potassium, filtered (mg/L as K) (00935)	Sodium, filtered (mg/L as Na) (00930)	Alkalinity, filtered, FET field (mg/L as $CaCO_3$) (39036)	Alkalinity, filtered, FET laboratory (mg/L as $CaCO_3$) (29801)	Alkalinity, filtered, INC field (mg/L as $CaCO_3$) (39086)
001N007E08H002M	NWQL	02/24/2005	12:00	19.3	66.1	32.7	4.56	45.7	240	250	246
	NWQL	02/24/2005	12:30	19.3	77.9	38.2	5.01	45.1	270	275	270
	NWQL	02/24/2005	14:45	–	75.9	36.9	4.79	45.5	270	–	269
	NWQL	02/24/2005	16:00	–	73.1	35.7	4.78	46.4	270	–	267
	NWQL	02/24/2005	17:30	–	69.2	33.8	4.67	48.2	260	–	264
	NWQL	02/24/2005	18:20	19.3	51.1	25.4	3.68	47.4	220	–	217
001N007E20N001M	NWQL	08/04/2004	10:00	–	5.96	2.89	1.49	46.0	120	–	120
	SD	08/04/2004	10:01	–	–	–	–	–	–	–	–
	NWQL	08/04/2004	12:00	–	5.34	2.63	1.48	47.3	120	–	118
	SD	08/04/2004	12:01	–	–	–	–	–	–	–	–
	NWQL	08/04/2004	13:15	–	4.37	2.18	1.73	56.3	130	128	127
	SD	08/04/2004	13:16	–	–	–	–	–	–	–	–
	NWQL	08/04/2004	13:30	19.1	40.3	18.8	2.98	32.4	160	153	155
	SD	08/04/2004	13:31	–	–	–	–	–	–	–	–
	NWQL	07/15/2005	09:30	19.5	42.2	19.6	3.08	30.3	150	152	–
	NWQL	07/15/2005	11:30	36.7	–	–	–	–	–	–	–
	NWQL	07/15/2005	17:30	–	78.3	39.3	3.98	33.6	240	–	–
001N007E28F001M	NWQL	07/19/2005	13:00	–	43.9	21.5	4.00	32.0	–	161	159
	SD	07/19/2005	13:01	–	–	–	–	–	–	–	–
	NWQL	07/19/2005	13:15	–	11.8	5.06	2.62	54.4	–	135	129
	SD	07/19/2005	13:16	–	–	–	–	–	–	–	–
	NWQL	07/19/2005	16:00	–	24.0	11.7	2.87	39.5	–	–	136
	SD	07/19/2005	16:01	–	–	–	–	–	–	–	–
	NWQL	07/20/2005	09:30	–	11.7	5.22	2.48	48.3	–	–	119
	SD	07/20/2005	09:31	–	–	–	–	–	–	–	–
	NWQL	07/20/2005	11:15	–	10.3	4.67	2.33	50.3	–	–	120
	SD	07/20/2005	11:16	–	–	–	–	–	–	–	–
	NWQL	07/20/2005	14:00	–	15.0	5.89	2.16	44.3	–	–	122
	SD	07/20/2005	14:01	–	–	–	–	–	–	–	–
001N007E31C001M	NWQL	07/29/2004	13:10	19.5	48.9	19.0	3.62	35.5	–	155	151
	SD	07/29/2004	13:11	–	–	–	–	–	–	–	–

Table 19. Field measurements and water-quality for water from selected depth-dependent wells, Eastern San Joaquin Groundwater Subbasin, California, 2004–8.—Continued

[Site locations are shown in figure 20. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD). Dissolved oxygen, specific conductance, and pH were measured in the field. **Abbreviations**: A, average value; E, estimated value; FET, fixed end-point titration; ft, feet; hh:mm, hour:minute; INC, incremental titration; LSD, land surface datum; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; NAVD 88, North American Vertical Datum of 1988; °C, degrees Celsius; µS/cm, microsiemens per centimeter at 25°C; °C, degrees Celsius; µg/L, micrograms per liter; –, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Temperature (°C) (00010)	Calcium, filtered (mg/L as Ca) (00915)	Magnesium, filtered (mg/L as Mg) (00925)	Potassium, filtered (mg/L as K) (00935)	Sodium, filtered (mg/L as Na) (00930)	Alkalinity, filtered, FET field (mg/L as $CaCO_3$) (39036)	Alkalinity, filtered, FET laboratory (mg/L as $CaCO_3$) (29801)	Alkalinity, filtered, INC field (mg/L as $CaCO_3$) (39086)
001N007E31C001M	NWQL	03/26/2008	11:00	18.1	57.1	22.7	4.23	35.8	160	164	158
	NWQL	03/26/2008	11:15	–	55.4	21.6	4.05	37.2	150	–	152
	NWQL	03/26/2008	13:30	–	53.5	21.4	4.27	34.3	160	–	162
	NWQL	03/26/2008	15:00	–	54.8	22.1	4.30	33.9	170	–	168
	NWQL	03/26/2008	17:30	–	57.8	23.4	4.41	32.6	170	–	173
	NWQL	03/26/2008	18:30	–	57.1	23.6	4.46	33.9	170	177	168
002N006E01Q001M	NWQL	08/09/2006	09:30	18.8	55.7	28.8	5.21	17.9	220	229	222
	NWQL	08/09/2006	11:00	–	32.6	17.4	4.97	12.8	150	–	152
	NWQL	08/09/2006	12:30	–	31.5	16.9	4.97	12.5	150	–	145
	NWQL	08/09/2006	13:45	–	47.6	25.9	6.34	16.5	210	204	207
002N006E04Q001M	NWQL	07/13/2005	10:45	20.5	37.1	12.4	4.62	15.9	140	150	–
	NWQL	07/13/2005	11:30	–	21.5	5.82	3.49	17.4	100	107	–
	NWQL	07/13/2005	16:30	–	21.2	5.64	3.29	16.4	100	–	–
	NWQL	07/14/2005	09:00	–	23.8	6.86	3.95	15.9	100	–	–
	NWQL	07/14/2005	12:00	–	32.6	10.9	4.59	16.4	120	–	–
	NWQL	07/21/2005	15:00	20.5	–	–	–	–	–	–	–
	NWQL	07/21/2005	16:30	20.5	–	–	–	–	–	–	–
	NWQL	07/22/2005	10:00	20.5	–	–	–	–	–	–	–
	NWQL	07/22/2005	14:00	20.5	–	–	–	–	–	–	–
	NWQL	07/22/2005	17:30	20.5	–	–	–	–	–	–	–
002N006E05F001M	NWQL	08/03/2004	13:30	19.7	42.9	13.6	4.71	18.2	160	158	160
	SD	08/03/2004	13:31	–	–	–	–	–	–	–	–
	NWQL	08/03/2004	14:15	–	18.5	6.15	3.50	18.3	100	–	98
	SD	08/03/2004	14:16	–	–	–	–	–	–	–	–
	NWQL	08/03/2004	15:15	–	17.8	5.89	3.31	18.0	98	–	97
	SD	08/03/2004	15:16	–	–	–	–	–	–	–	–
	NWQL	08/03/2004	16:00	–	18.6	6.73	4.73	22.0	98	–	97
	SD	08/03/2004	16:01	–	–	–	–	–	–	–	–
	NWQL	08/03/2004	17:15	–	18.8	7.12	5.43	24.0	99	97	97
	SD	08/03/2004	17:16	–	–	–	–	–	–	–	–
	NWQL	01/12/2005	13:50	20.1	23.4	7.70	4.34	19.8	–	110	–

Table 19. Field measurements and water-quality for water from selected depth-dependent wells, Eastern San Joaquin Groundwater Subbasin, California, 2004–8.—Continued

[Site locations are shown in figure 20. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD). Dissolved oxygen, specific conductance, and pH were measured in the field. **Abbreviations**: A, average value; E, estimated value; FET, fixed end-point titration; ft, feet; hh:mm, hour:minute; INC, incremental titration; LSD, land surface datum; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; NAVD 88, North American Vertical Datum of 1988; °C, degrees Celsius; µS/cm, microsiemens per centimeter at 25°C; °C, degrees Celsius; µg/L, micrograms per liter; –, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Temperature (°C) (00010)	Calcium, filtered (mg/L as Ca) (00915)	Magnesium, filtered (mg/L as Mg) (00925)	Potassium, filtered (mg/L as K) (00935)	Sodium, filtered (mg/L as Na) (00930)	Alkalinity, filtered, FET field (mg/L as $CaCO_3$) (39036)	Alkalinity, filtered, FET laboratory (mg/L as $CaCO_3$) (29801)	Alkalinity, filtered, INC field (mg/L as $CaCO_3$) (39086)
002N006E11H003M	NWQL	06/19/2007	12:00	20.0	51.5	25.6	6.09	17.6	190	211	196
	NWQL	06/19/2007	14:40	–	43.6	21.9	5.80	23.7	180	–	176
	NWQL	06/19/2007	17:50	–	40.9	20.6	5.68	16.0	160	–	164
	NWQL	06/20/2007	09:30	20.0	48.9	24.3	5.81	17.1	190	–	188
	NWQL	06/20/2007	11:30	–	46.1	23.1	5.67	17.0	200	–	198
	NWQL	06/20/2007	14:20	–	46.5	22.9	5.71	18.0	190	200	190
002N006E12J001M	NWQL	08/08/2006	11:00	19.5	28.7	16.5	5.42	12.0	140	143	143
	NWQL	08/08/2006	13:20	–	30.8	17.4	5.54	12.5	140	–	142
	NWQL	08/08/2006	15:00	–	20.2	11.5	5.05	10.6	110	–	106
	NWQL	08/08/2006	16:00	–	18.0	10.7	5.04	10.4	110	–	105
	NWQL	08/08/2006	17:20	–	18.9	11.2	5.29	12.6	110	111	107
002N006E24P004M	NWQL	08/05/2004	09:30	18.6	33.1	18.3	5.79	14.4	160	161	164
	SD	08/05/2004	09:31	–	–	–	–	–	–	–	–
	NWQL	08/05/2004	09:45	–	–	–	–	–	–	–	–
	NWQL	08/05/2004	11:00	–	30.7	17.7	5.81	13.7	160	–	161
	SD	08/05/2004	11:01	–	–	–	–	–	–	–	–
	NWQL	08/05/2004	12:00	–	29.3	16.6	5.78	12.9	150	–	152
	SD	08/05/2004	12:01	–	–	–	–	–	–	–	–
	NWQL	08/05/2004	14:00	–	33.6	19.0	6.16	13.2	180	–	184
	SD	08/05/2004	14:01	–	–	–	–	–	–	–	–
	NWQL	08/05/2004	15:00	–	26.0	14.6	5.61	12.5	130	–	131
	SD	08/05/2004	15:01	–	–	–	–	–	–	–	–
	NWQL	08/05/2004	16:30	–	22.2	12.9	5.27	12.4	120	–	121
	SD	08/05/2004	16:31	–	–	–	–	–	–	–	–
	NWQL	08/05/2004	17:45	–	24.5	13.6	5.26	16.4	130	134	135
	SD	08/05/2004	17:46	–	–	–	–	–	–	–	–
	NWQL	01/26/2005	12:50	–	31.5	18.3	6.06	16.0	–	159	–
	NWQL	01/27/2005	09:00	–	21.1	12.6	5.40	12.1	–	120	–
	NWQL	01/27/2005	13:00	–	26.1	15.2	5.81	12.6	–	142	–
	NWQL	01/28/2005	08:30	18.0	31.3	18.1	6.03	14.3	–	156	–

Table 19. Field measurements and water-quality for water from selected depth-dependent wells, Eastern San Joaquin Groundwater Subbasin, California, 2004–8.—Continued

[Site locations are shown in figure 20. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD). Dissolved oxygen, specific conductance, and pH were measured in the field. **Abbreviations**: A, average value; E, estimated value; FET, fixed end-point titration; ft, feet; hh:mm, hour:minute; INC, incremental titration; LSD, land surface datum; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; NAVD 88, North American Vertical Datum of 1988; °C, degrees Celsius; µS/cm, microsiemens per centimeter at 25°C; °C, degrees Celsius; µg/L, micrograms per liter; –, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Temperature (°C) (00010)	Calcium, filtered (mg/L as Ca) (00915)	Magnesium, filtered (mg/L as Mg) (00925)	Potassium, filtered (mg/L as K) (00935)	Sodium, filtered (mg/L as Na) (00930)	Alkalinity, filtered, FET field (mg/L as $CaCO_3$) (39036)	Alkalinity, filtered, FET laboratory (mg/L as $CaCO_3$) (29801)	Alkalinity, filtered, INC field (mg/L as $CaCO_3$) (39086)
002N006E27L001M	NWQL	02/16/2005	15:00	16.6	42.0	18.7	4.09	28.3	–	202	–
	NWQL	02/16/2005	17:00	14.8	42.9	18.9	4.38	29.0	200	–	195
	NWQL	02/16/2005	18:00	13.7	43.8	19.1	4.42	29.4	200	–	199
	NWQL	02/17/2005	11:30	14.6	41.0	17.9	4.24	28.8	–	191	–
	NWQL	02/17/2005	19:00	15.3	37.3	16.6	4.35	33.0	–	168	–
	NWQL	02/18/2005	10:00	17.8	37.6	16.8	4.77	33.2	–	179	–

Table 19. Field measurements and water-quality for water from selected depth-dependent wells, Eastern San Joaquin Groundwater Subbasin, California, 2004–8.—Continued

[Site locations are shown in figure 20. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD). Dissolved oxygen, specific conductance, and pH were measured in the field. **Abbreviations**: A, average value; E, estimated value; FET, fixed end-point titration; ft, feet; hh:mm, hour:minute; INC, incremental titration; LSD, land surface datum; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; NAVD 88, North American Vertical Datum of 1988; °C, degrees Celsius; µS/cm, microsiemens per centimeter at 25°C; °C, degrees Celsius; µg/L, micrograms per liter; –, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Bicarbonate, filtered, FET field (mg/L as HCO_3) (29804)	Bicarbonate, filtered, INC field (mg/L as HCO_3) (00453)	Bromide, filtered (mg/L as Br) (71870)	Chloride, filtered (mg/L as Cl) (00940)	Fluoride, filtered (mg/L as F) (00950)	Iodide, filtered (mg/L as I) (71865)	Silica, filtered (mg/L as SiO_2) (00955)	Sulfate, filtered (mg/L as SO_4) (00945)	Residue on evaporation, dried at 180°C, filtered (mg/L) (70300)
001N007E08H002M	NWQL	02/24/2005	12:00	296	298	–	–	0.11	–	54.8	–	457
	NWQL	02/24/2005	12:30	327	328	–	55.4	E0.10	–	55.5	34.7	528
	NWQL	02/24/2005	14:45	328	326	0.17	56.6	–	0.032	62.4	35.0	–
	NWQL	02/24/2005	16:00	323	323	0.17	56.4	–	0.035	61.2	34.8	–
	NWQL	02/24/2005	17:30	318	319	0.18	54.9	–	0.034	59.9	34.1	–
	NWQL	02/24/2005	18:20	263	263	0.14	42.6	–	0.031	59.8	24.8	–
001N007E20N001M	NWQL	08/04/2004	10:00	144	143	0.05	12.0	–	0.037	66.0	<0.18	–
	SD	08/04/2004	10:01	–	–	<0.30	11.0	–	–	–	E2.10	–
	NWQL	08/04/2004	12:00	142	142	0.05	11.0	–	0.034	65.9	<0.18	–
	SD	08/04/2004	12:01	–	–	<0.30	11.0	–	–	–	<3.00	–
	NWQL	08/04/2004	13:15	153	153	0.06	14.6	0.17	0.038	64.7	<0.18	218
	SD	08/04/2004	13:16	–	–	<0.30	15.0	–	–	–	<3.00	–
	NWQL	08/04/2004	13:30	189	188	0.08	47.3	<0.17	0.006	60.4	19.7	324
	SD	08/04/2004	13:31	–	–	E0.10	46.0	–	–	–	19.0	–
	NWQL	07/15/2005	09:30	–	–	0.07	48.4	0.13	E0.001	59.8	21.7	336
	NWQL	07/15/2005	11:30	–	–	–	–	–	–	–	–	–
	NWQL	07/15/2005	17:30	–	–	0.21	75.6	–	0.004	59.3	42.7	–
001N007E28F001M	NWQL	07/19/2005	13:00	–	193	0.05	46.8	0.11	E0.002	69.2	23.7	356
	SD	07/19/2005	13:01	–	–	<1	46.0	–	–	–	23.0	–
	NWQL	07/19/2005	13:15	–	153	0.10	28.0	0.11	0.069	70.1	<0.18	256
	SD	07/19/2005	13:16	–	–	<0.30	27.0	–	–	–	<3.00	–
	NWQL	07/19/2005	16:00	–	164	0.05	29.4	–	0.002	60.7	8.70	–
	SD	07/19/2005	16:01	–	–	<0.30	31.0	–	–	–	9.90	–
	NWQL	07/20/2005	09:30	–	143	0.08	21.7	–	0.053	60.4	0.62	–
	SD	07/20/2005	09:31	–	–	<0.30	22.0	–	–	–	<3.00	–
	NWQL	07/20/2005	11:15	–	145	0.08	21.1	–	0.053	60.7	0.23	–
	SD	07/20/2005	11:16	–	–	<0.30	21.0	–	–	–	<3.00	–
	NWQL	07/20/2005	14:00	–	146	0.07	23.4	–	0.043	57.8	3.50	–
	SD	07/20/2005	14:01	–	–	<0.30	24.0	–	–	–	3.30	–
001N007E31C001M	NWQL	07/29/2004	13:10	–	183	0.11	58.5	<0.17	0.006	50.3	38.7	376
	SD	07/29/2004	13:11	–	–	<0.30	57.0	–	–	–	39.0	–

Table 19. Field measurements and water-quality for water from selected depth-dependent wells, Eastern San Joaquin Groundwater Subbasin, California, 2004–8.—Continued

[Site locations are shown in figure 20. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD). Dissolved oxygen, specific conductance, and pH were measured in the field. **Abbreviations**: A, average value; E, estimated value; FET, fixed end-point titration; ft, feet; hh:mm, hour:minute; INC, incremental titration; LSD, land surface datum; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; NAVD 88, North American Vertical Datum of 1988; °C, degrees Celsius; µS/cm, microsiemens per centimeter at 25°C; °C, degrees Celsius; µg/L, micrograms per liter; –, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Bicarbonate, filtered, FET field (mg/L as HCO_3) (29804)	Bicarbonate, filtered, INC field (mg/L as HCO_3) (00453)	Bromide, filtered (mg/L as Br) (71870)	Chloride, filtered (mg/L as Cl) (00940)	Fluoride, filtered (mg/L as F) (00950)	Iodide, filtered (mg/L as I) (71865)	Silica, filtered (mg/L as SiO_2) (00955)	Sulfate, filtered (mg/L as SO_4) (00945)	Residue on evaporation, dried at 180°C, filtered (mg/L) (70300)
001N007E31C001M	NWQL	03/26/2008	11:00	–	–	0.26	76.6	E0.10	0.019	49.5	40.7	393
	NWQL	03/26/2008	11:15	–	–	0.25	77.7	–	0.025	43.2	37.8	–
	NWQL	03/26/2008	13:30	–	–	0.20	56.4	–	0.032	46.4	39.2	–
	NWQL	03/26/2008	15:00	–	–	0.19	56.6	–	0.034	47.5	40.6	–
	NWQL	03/26/2008	17:30	–	–	0.19	57.3	–	0.029	45.8	43.7	–
	NWQL	03/26/2008	18:30	–	–	0.20	60.5	E0.11	0.043	45.5	43.9	397
002N006E01Q001M	NWQL	08/09/2006	09:30	271	269	0.09	20.4	0.10	E0.002	61.5	26.1	369
	NWQL	08/09/2006	11:00	184	183	0.07	12.8	–	<0.002	58.4	14.1	–
	NWQL	08/09/2006	12:30	176	175	0.07	10.8	–	<0.002	59.4	13.3	–
	NWQL	08/09/2006	13:45	245	245	0.09	18.7	E0.09	E.001	61.3	21.7	335
002N006E04Q001M	NWQL	07/13/2005	10:45	–	–	0.05	11.2	E0.10	0.005	55.7	9.45	247
	NWQL	07/13/2005	11:30	–	–	E0.02	5.44	0.10	0.014	43.7	6.34	173
	NWQL	07/13/2005	16:30	–	–	E0.02	5.25	–	0.013	45.7	6.47	–
	NWQL	07/14/2005	09:00	–	–	0.03	7.09	–	0.008	51.0	6.88	–
	NWQL	07/14/2005	12:00	–	–	0.06	11.5	–	0.007	53.5	8.44	–
	NWQL	07/21/2005	15:00	–	–	–	–	–	–	–	–	–
	NWQL	07/21/2005	16:30	–	–	–	–	–	–	–	–	–
	NWQL	07/22/2005	10:00	–	–	–	–	–	–	–	–	–
	NWQL	07/22/2005	14:00	–	–	–	–	–	–	–	–	–
	NWQL	07/22/2005	17:30	–	–	–	–	–	–	–	–	–
002N006E05F001M	NWQL	08/03/2004	13:30	194	194	0.09	17.4	<0.17	0.025	53.1	14.9	268
	SD	08/03/2004	13:31	–	–	E0.10	A57	–	–	–	A39.0	–
	NWQL	08/03/2004	14:15	120	118	0.05	11.3	–	0.031	57.7	1.91	–
	SD	08/03/2004	14:16	–	–	<0.30	12.0	–	–	–	E1.80	–
	NWQL	08/03/2004	15:15	117	117	0.05	10.6	–	0.029	56.4	1.49	–
	SD	08/03/2004	15:16	–	–	<0.30	10.0	–	–	–	E1.60	–
	NWQL	08/03/2004	16:00	118	116	0.09	22.4	–	0.059	57.4	0.51	–
	SD	08/03/2004	16:01	–	–	<0.30	23.0	–	–	–	<3.00	–
	NWQL	08/03/2004	17:15	113	111	0.11	27.8	<0.17	0.062	57.0	E0.10	193
	SD	08/03/2004	17:16	–	–	<0.30	24.0	–	–	–	<3.00	–
	NWQL	01/12/2005	13:50	–	–	0.10	15.5	0.10	0.037	56.0	4.16	189

Table 19. Field measurements and water-quality for water from selected depth-dependent wells, Eastern San Joaquin Groundwater Subbasin, California, 2004–8.—Continued

[Site locations are shown in figure 20. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD). Dissolved oxygen, specific conductance, and pH were measured in the field. **Abbreviations**: A, average value; E, estimated value; FET, fixed end-point titration; ft, feet; hh:mm, hour:minute; INC, incremental titration; LSD, land surface datum; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; NAVD 88, North American Vertical Datum of 1988; °C, degrees Celsius; µS/cm, microsiemens per centimeter at 25°C; °C, degrees Celsius; µg/L, micrograms per liter; –, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Bicarbonate, filtered, FET field (mg/L as HCO_3) (29804)	Bicarbonate, filtered, INC field (mg/L as HCO_3) (00453)	Bromide, filtered (mg/L as Br) (71870)	Chloride, filtered (mg/L as Cl) (00940)	Fluoride, filtered (mg/L as F) (00950)	Iodide, filtered (mg/L as I) (71865)	Silica, filtered (mg/L as SiO_2) (00955)	Sulfate, filtered (mg/L as SO_4) (00945)	Residue on evaporation, dried at 180°C, filtered (mg/L) (70300)
002N006E11H003M	NWQL	06/19/2007	12:00	236	237	0.06	11.8	0.10	0.003	59.2	34.6	349
	NWQL	06/19/2007	14:40	212	212	0.05	20.7	–	0.006	47.6	31.3	–
	NWQL	06/19/2007	17:50	198	199	0.05	12.9	–	E0.002	60.1	26.4	–
	NWQL	06/20/2007	09:30	227	227	0.05	10.8	–	0.003	57.1	34.5	–
	NWQL	06/20/2007	11:30	239	240	0.05	10.6	–	0.003	56.3	33.3	–
	NWQL	06/20/2007	14:20	229	230	0.05	10.5	0.11	0.003	57.0	32.8	316
002N006E12J001M	NWQL	08/08/2006	11:00	175	172	0.03	6.21	E0.09	<0.002	62.4	18.5	235
	NWQL	08/08/2006	13:20	173	170	0.05	10.3	–	<0.002	58.7	24.9	–
	NWQL	08/08/2006	15:00	130	127	0.02	5.56	–	<0.002	60.0	7.45	–
	NWQL	08/08/2006	16:00	127	126	0.02	5.09	–	<0.002	58.8	7.19	–
	NWQL	08/08/2006	17:20	132	128	0.02	5.19	E0.09	<0.002	62.0	9.21	191
002N006E24P004M	NWQL	08/05/2004	09:30	200	199	0.03	7.32	<0.17	0.002	62.0	16.8	251
	SD	08/05/2004	09:31	–	–	<0.30	7.40	–	–	–	18.0	–
	NWQL	08/05/2004	09:45	–	–	–	–	–	–	–	–	–
	NWQL	08/05/2004	11:00	179	179	0.03	6.64	–	0.003	63.8	14.2	–
	SD	08/05/2004	11:01	–	–	<0.30	6.80	–	–	–	15.0	–
	NWQL	08/05/2004	12:00	183	–	0.03	6.40	–	E0.002	62.6	11.9	–
	SD	08/05/2004	12:01	–	–	<0.30	6.20	–	–	–	12.0	–
	NWQL	08/05/2004	14:00	222	222	0.03	7.21	–	E0.001	62.8	15.0	–
	SD	08/05/2004	14:01	–	–	<0.30	7.20	–	–	–	15.0	–
	NWQL	08/05/2004	15:00	157	157	0.03	5.36	–	E0.002	63.0	8.61	–
	SD	08/05/2004	15:01	–	–	<0.30	5.50	–	–	–	9.30	–
	NWQL	08/05/2004	16:30	148	146	0.02	5.14	–	E0.001	63.1	7.77	–
	SD	08/05/2004	16:31	–	–	<0.30	5.10	–	–	–	8.00	–
	NWQL	08/05/2004	17:45	163	164	0.03	5.86	<0.17	0.002	60.7	11.5	216
	SD	08/05/2004	17:46	–	–	<0.30	6.20	–	–	–	12.0	–
	NWQL	01/26/2005	12:50	–	–	0.07	7.03	E0.10	–	63.1	17.3	253
	NWQL	01/27/2005	09:00	–	–	0.04	5.09	0.11	–	62.4	7.99	193
	NWQL	01/27/2005	13:00	–	–	0.07	5.79	E0.10	–	62.2	11.0	223
	NWQL	01/28/2005	08:30	–	–	0.07	6.92	E0.08	–	64.1	16.1	243

Table 19. Field measurements and water-quality for water from selected depth-dependent wells, Eastern San Joaquin Groundwater Subbasin, California, 2004–8.—Continued

[Site locations are shown in figure 20. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD). Dissolved oxygen, specific conductance, and pH were measured in the field. **Abbreviations**: A, average value; E, estimated value; FET, fixed end-point titration; ft, feet; hh:mm, hour:minute; INC, incremental titration; LSD, land surface datum; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; NAVD 88, North American Vertical Datum of 1988; °C, degrees Celsius; µS/cm, microsiemens per centimeter at 25°C; °C, degrees Celsius; µg/L, micrograms per liter; –, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Bicarbonate, filtered, FET field (mg/L as HCO_3) (29804)	Bicarbonate, filtered, INC field (mg/L as HCO_3) (00453)	Bromide, filtered (mg/L as Br) (71870)	Chloride, filtered (mg/L as Cl) (00940)	Fluoride, filtered (mg/L as F) (00950)	Iodide, filtered (mg/L as I) (71865)	Silica, filtered (mg/L as SiO_2) (00955)	Sulfate, filtered (mg/L as SO_4) (00945)	Residue on evaporation, dried at 180°C, filtered (mg/L) (70300)
002N006E27L001M	NWQL	02/16/2005	15:00	–	–	0.06	20.4	0.12	0.033	51.7	23.8	313
	NWQL	02/16/2005	17:00	240	236	0.07	20.2	–	0.038	52.7	24.6	–
	NWQL	02/16/2005	18:00	238	241	0.07	20.3	–	0.037	53.4	24.9	–
	NWQL	02/17/2005	11:30	–	–	0.07	20.6	0.12	0.032	52.4	22.4	294
	NWQL	02/17/2005	19:00	–	–	0.11	21.4	0.18	0.031	51.0	19.1	271
	NWQL	02/18/2005	10:00	–	–	0.10	25.7	E0.10	0.003	49.6	24.7	294

Table 19. Field measurements and water-quality for water from selected depth-dependent wells, Eastern San Joaquin Groundwater Subbasin, California, 2004–8.—Continued

[Site locations are shown in figure 20. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD). Dissolved oxygen, specific conductance, and pH were measured in the field. **Abbreviations**: A, average value; E, estimated value; FET, fixed end-point titration; ft, feet; hh:mm, hour:minute; INC, incremental titration; LSD, land surface datum; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; NAVD 88, North American Vertical Datum of 1988; °C, degrees Celsius; µS/cm, microsiemens per centimeter at 25°C; °C, degrees Celsius; µg/L, micrograms per liter; –, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Aluminum, filtered (µg/L as Al) (01106)	Arsenic, filtered (µg/L as As) (01000)	Barium, filtered (µg/L as Ba) (01005)	Boron, filtered (µg/L as B) (01020)	Chromium, filtered (µg/L as Cr) (01030)	Iron, filtered (µg/L as Fe) (01046)	Lithium, filtered (µg/L as Li) (01130)	Manganese, filtered (µg/L as Mn) (01056)	Strontium, filtered (µg/L as Sr) (01080)
001N007E08H002M	NWQL	02/24/2005	12:00	<1.6	12.6	273	90	–	16	3.0	8.3	673
	NWQL	02/24/2005	12:30	2.1	9.3	326	79	–	13	4.0	1.0	795
	NWQL	02/24/2005	14:45	–	8.9	313	77	<0.80	15	–	0.8	–
	NWQL	02/24/2005	16:00	–	8.7	316	84	E0.40	22	–	1.0	–
	NWQL	02/24/2005	17:30	–	8.4	315	90	<0.80	20	–	1.2	–
	NWQL	02/24/2005	18:20	–	10.7	243	110	<0.80	19	–	10.3	–
001N007E20N001M	NWQL	08/04/2004	10:00	–	14.9	91.4	390	<0.80	13	–	112	–
	SD	08/04/2004	10:01	–	–	–	–	–	–	–	–	–
	NWQL	08/04/2004	12:00	–	14.7	86.5	412	<0.80	E6	–	112	–
	SD	08/04/2004	12:01	–	–	–	–	–	–	–	–	–
	NWQL	08/04/2004	13:15	3.1	15.3	78.5	605	–	8	<3.0	87.3	54.8
	SD	08/04/2004	13:16	–	–	–	–	–	–	–	–	–
	NWQL	08/04/2004	13:30	E1.2	8.8	132	182	–	<6	E2.0	33.3	394
	SD	08/04/2004	13:31	–	–	–	–	–	–	–	–	–
	NWQL	07/15/2005	09:30	E1.3	7.9	128	133	–	E5	E2.0	5.8	405
	NWQL	07/15/2005	11:30	–	–	–	–	–	–	–	–	–
	NWQL	07/15/2005	17:30	–	5.1	200	98	5	E5	–	2.2	–
001N007E28F001M	NWQL	07/19/2005	13:00	E1.3	8.1	145	168	–	E3	E2.0	19.5	408
	SD	07/19/2005	13:01	–	–	–	–	–	–	–	–	–
	NWQL	07/19/2005	13:15	3.8	15.7	118	356	–	E6	E2.0	85.1	132
	SD	07/19/2005	13:16	–	–	–	–	–	–	–	–	–
	NWQL	07/19/2005	16:00	–	12.1	131	230	1.3	15	–	47.8	–
	SD	07/19/2005	16:01	–	–	–	–	–	–	–	–	–
	NWQL	07/20/2005	09:30	–	16.1	121	323	<0.80	E6	–	31.1	–
	SD	07/20/2005	09:31	–	–	–	–	–	–	–	–	–
	NWQL	07/20/2005	11:15	–	15.8	115	330	<0.80	8	–	46.7	–
	SD	07/20/2005	11:16	–	–	–	–	–	–	–	–	–
	NWQL	07/20/2005	14:00	–	15.1	140	245	<0.80	E6	–	98.7	–
	SD	07/20/2005	14:01	–	–	–	–	–	–	–	–	–
001N007E31C001M	NWQL	07/29/2004	13:10	<1.6	8.5	219	130	1.7	E5	E3	41.0	495
	SD	07/29/2004	13:11	–	–	–	–	–	–	–	–	–

Table 19. Field measurements and water-quality for water from selected depth-dependent wells, Eastern San Joaquin Groundwater Subbasin, California, 2004–8.—Continued

[Site locations are shown in figure 20. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD). Dissolved oxygen, specific conductance, and pH were measured in the field. **Abbreviations**: A, average value; E, estimated value; FET, fixed end-point titration; ft, feet; hh:mm, hour:minute; INC, incremental titration; LSD, land surface datum; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; NAVD 88, North American Vertical Datum of 1988; °C, degrees Celsius; µS/cm, microsiemens per centimeter at 25°C; °C, degrees Celsius; µg/L, micrograms per liter; –, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Aluminum, filtered (µg/L as Al) (01106)	Arsenic, filtered (µg/L as As) (01000)	Barium, filtered (µg/L as Ba) (01005)	Boron, filtered (µg/L as B) (01020)	Chromium, filtered (µg/L as Cr) (01030)	Iron, filtered (µg/L as Fe) (01046)	Lithium, filtered (µg/L as Li) (01130)	Manganese, filtered (µg/L as Mn) (01056)	Strontium, filtered (µg/L as Sr) (01080)
001N007E31C001M	NWQL	03/26/2008	11:00	<1.6	6.7	207	122	–	33	3.0	23.8	607
	NWQL	03/26/2008	11:15	–	6.7	211	122	0.18	42	–	50.0	–
	NWQL	03/26/2008	13:30	–	6.0	192	130	0.13	42	–	54.0	–
	NWQL	03/26/2008	15:00	–	5.1	203	128	0.15	43	–	75.0	–
	NWQL	03/26/2008	17:30	–	4.4	204	117	E0.12	39	–	117	–
	NWQL	03/26/2008	18:30	<1.6	2.5	205	124	–	259	4.0	306	596
002N006E01Q001M	NWQL	08/09/2006	09:30	6.5	2.4	160	19	–	E6	E2.0	<0.6	740
	NWQL	08/09/2006	11:00	–	2.7	92.5	19	8.8	<6	–	0.3	–
	NWQL	08/09/2006	12:30	–	2.8	90.1	21	8.5	<6	–	<0.2	–
	NWQL	08/09/2006	13:45	<1.6	2.5	132	21	–	<6	<2.0	<0.6	623
002N006E04Q001M	NWQL	07/13/2005	10:45	E1.2	6.7	173	28	–	<6	2.0	11.1	441
	NWQL	07/13/2005	11:30	2.8	11.5	202	32	–	<6	<2.0	46.8	281
	NWQL	07/13/2005	16:30	–	11.8	222	32	<0.80	7	–	55.0	–
	NWQL	07/14/2005	09:00	–	9.7	184	37	1.3	14	–	28.2	–
	NWQL	07/14/2005	12:00	–	8.1	190	32	4.1	11	–	19.6	–
	NWQL	07/21/2005	15:00	–	–	–	–	–	–	–	–	–
	NWQL	07/21/2005	16:30	–	–	–	–	–	–	–	–	–
	NWQL	07/22/2005	10:00	–	–	–	–	–	–	–	–	–
	NWQL	07/22/2005	14:00	–	–	–	–	–	–	–	–	–
	NWQL	07/22/2005	17:30	–	–	–	–	–	–	–	–	–
002N006E05F001M	NWQL	08/03/2004	13:30	<1.6	5.5	215	33	–	10	E2.0	41.6	519
	SD	08/03/2004	13:31	–	–	–	–	–	–	–	–	–
	NWQL	08/03/2004	14:15	–	6.4	160	46	<0.80	45	–	149	–
	SD	08/03/2004	14:16	–	–	–	–	–	–	–	–	–
	NWQL	08/03/2004	15:15	–	5.4	157	43	<0.80	33	–	136	–
	SD	08/03/2004	15:16	–	–	–	–	–	–	–	–	–
	NWQL	08/03/2004	16:00	–	5.8	186	54	<0.80	79	–	158	–
	SD	08/03/2004	16:01	–	–	–	–	–	–	–	–	–
	NWQL	08/03/2004	17:15	E1.0	6.2	205	64	–	107	<3.0	181	245
	SD	08/03/2004	17:16	–	–	–	–	–	–	–	–	–
	NWQL	01/12/2005	13:50	E0.8	7.0	174	36	<0.80	17	1.5	66.2	304

Table 19. Field measurements and water-quality for water from selected depth-dependent wells, Eastern San Joaquin Groundwater Subbasin, California, 2004–8.—Continued

[Site locations are shown in figure 20. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD). Dissolved oxygen, specific conductance, and pH were measured in the field. **Abbreviations**: A, average value; E, estimated value; FET, fixed end-point titration; ft, feet; hh:mm, hour:minute; INC, incremental titration; LSD, land surface datum; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; NAVD 88, North American Vertical Datum of 1988; °C, degrees Celsius; µS/cm, microsiemens per centimeter at 25°C; °C, degrees Celsius; µg/L, micrograms per liter; –, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Aluminum, filtered (µg/L as Al) (01106)	Arsenic, filtered (µg/L as As) (01000)	Barium, filtered (µg/L as Ba) (01005)	Boron, filtered (µg/L as B) (01020)	Chromium, filtered (µg/L as Cr) (01030)	Iron, filtered (µg/L as Fe) (01046)	Lithium, filtered (µg/L as Li) (01130)	Manganese, filtered (µg/L as Mn) (01056)	Strontium, filtered (µg/L as Sr) (01080)
002N006E11H003M	NWQL	06/19/2007	12:00	4.1	2.7	142	22	–	9	1.0	0.9	653
	NWQL	06/19/2007	14:40	–	1.2	162	36	2.8	75	–	92.0	–
	NWQL	06/19/2007	17:50	–	3.0	119	24	7.0	<6	–	0.4	–
	NWQL	06/20/2007	09:30	–	2.8	136	24	3.9	E4	–	0.6	–
	NWQL	06/20/2007	11:30	–	2.8	130	25	2.9	<6	–	0.8	–
	NWQL	06/20/2007	14:20	E1.3	3.0	131	27	–	<6	1.0	0.5	595
002N006E12J001M	NWQL	08/08/2006	11:00	E1.4	3.0	85.0	25	–	<6	<2.0	<0.6	347
	NWQL	08/08/2006	13:20	–	2.6	90.9	23	7.9	<6	–	0.7	–
	NWQL	08/08/2006	15:00	–	3.4	58.0	27	8.4	<6	–	<0.2	–
	NWQL	08/08/2006	16:00	–	3.7	54.0	30	7.8	<6	–	<0.2	–
	NWQL	08/08/2006	17:20	E1.2	3.8	57.0	38	–	<6	<2.0	<0.6	222
002N006E24P004M	NWQL	08/05/2004	09:30	<1.6	3.2	95.2	31	–	<6	<3.0	<0.8	365
	SD	08/05/2004	09:31	–	–	–	–	–	–	–	–	–
	NWQL	08/05/2004	09:45	–	–	–	–	–	–	–	–	–
	NWQL	08/05/2004	11:00	–	3.2	87.8	31	6.5	<6	–	0.6	–
	SD	08/05/2004	11:01	–	–	–	–	–	–	–	–	–
	NWQL	08/05/2004	12:00	–	3.2	80.1	29	7.5	<6	–	0.3	–
	SD	08/05/2004	12:01	–	–	–	–	–	–	–	–	–
	NWQL	08/05/2004	14:00	–	2.9	93.1	28	6.6	<6	–	0.4	–
	SD	08/05/2004	14:01	–	–	–	–	–	–	–	–	–
	NWQL	08/05/2004	15:00	–	3.4	72.3	29	8.4	<6	–	0.3	–
	SD	08/05/2004	15:01	–	–	–	–	–	–	–	–	–
	NWQL	08/05/2004	16:30	–	3.7	61.2	29	8.9	<6	–	0.3	–
	SD	08/05/2004	16:31	–	–	–	–	–	–	–	–	–
	NWQL	08/05/2004	17:45	<1.6	4.9	73.5	39	–	<6	<3.0	<0.8	271
	SD	08/05/2004	17:46	–	–	–	–	–	–	–	–	–
	NWQL	01/26/2005	12:50	1.7	3.9	88.0	31	6.4	<6	0.7	–	360
	NWQL	01/27/2005	09:00	3.3	3.9	57.0	28	8.3	<6	0.6	–	257
	NWQL	01/27/2005	13:00	E1.6	3.6	71.0	27	7.4	<6	0.6	–	312
	NWQL	01/28/2005	08:30	E0.9	3.3	86.0	26	6.3	<6	0.8	–	352

Table 19. Field measurements and water-quality for water from selected depth-dependent wells, Eastern San Joaquin Groundwater Subbasin, California, 2004–8.—Continued

[Site locations are shown in figure 20. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses by U.S. Geological Survey National Water Quality Laboratory (NWQL) in Arvada, Colorado, and the U.S. Geological Survey Laboratory in San Diego, California (SD). Dissolved oxygen, specific conductance, and pH were measured in the field. **Abbreviations**: A, average value; E, estimated value; FET, fixed end-point titration; ft, feet; hh:mm, hour:minute; INC, incremental titration; LSD, land surface datum; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; NAVD 88, North American Vertical Datum of 1988; °C, degrees Celsius; µS/cm, microsiemens per centimeter at 25°C; °C, degrees Celsius; µg/L, micrograms per liter; –, no data; <, less than value shown]

State well number	Laboratory performing analysis	Date (mm/dd/yyyy)	Time (hh:mm)	Aluminum, filtered (µg/L as Al) (01106)	Arsenic, filtered (µg/L as As) (01000)	Barium, filtered (µg/L as Ba) (01005)	Boron, filtered (µg/L as B) (01020)	Chromium, filtered (µg/L as Cr) (01030)	Iron, filtered (µg/L as Fe) (01046)	Lithium, filtered (µg/L as Li) (01130)	Manganese, filtered (µg/L as Mn) (01056)	Strontium, filtered (µg/L as Sr) (01080)
002N006E27L001M	NWQL	02/16/2005	15:00	9.4	8.2	193	65	<0.80	11	1.2	1.2	441
	NWQL	02/16/2005	17:00	–	8.3	193	63	<0.80	9	–	1.2	–
	NWQL	02/16/2005	18:00	–	8.6	197	62	<0.80	9	–	1.3	–
	NWQL	02/17/2005	11:30	E1.2	8.9	192	70	<0.80	6	1.8	1.2	449
	NWQL	02/17/2005	19:00	E0.9	8.5	181	74	<0.80	7	1.9	1.1	416
	NWQL	02/18/2005	10:00	E1.0	8.0	195	68	<0.80	E4	2.1	0.9	449

Table 20. Isotopic data for water from selected depth-dependent wells, Eastern San Joaquin Groundwater Subbasin, California, 2004–8.

[Site locations are shown in figure 20. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Deuterium/protium and oxygen-18/16 analyzed at USGS National Research Program, Stable Isotope Laboratory, Reston, Virginia. Carbon age data analyzed by University of Waterloo, Isotope Laboratory, Waterloo, Ontario, Canada. Tritium analyzed at University of Miami, Tritium Laboratory, Miami, Florida. Sample depth in feet below land surface. **Abbreviations**: ft, feet; hh:mm, hour:minute; LSD, land surface datum; mm/dd/yyyy, month/day/year; NAVD 88, North American Vertical Datum of 1988; pCi/L, picocuries per liter; –, no data]

State well number	Date (mm/dd/yyyy)	Time (hh:mm)	Altitude of land surface (ft above NAVD 88)	Depth to top of sample interval (ft below LSD) (72015)	Depth to bottom of sample interval (ft below LSD) (72016)	Carbon-14 counting error, filtered, percent modern (49934)	Carbon-14, filtered, percent modern (49933)	Deuterium/ protium unfiltered, per mil (82082)	Tritium, unfiltered (pCi/L) (07000)	Tritium 2-sigma combined uncertainty, unfiltered (pCi/L) (75985)	Carbon-13/ carbon-12 unfiltered, per mil (82081)	Oxygen-18/ oxygen-16 unfiltered, per mil (82085)
001N007E08H002M	02/24/2005	12:00	32	275	507	–	–	–53.20	–	–	–	–7.28
	02/24/2005	12:30	32	470	507	–	–	–53.70	–	–	–	–7.40
	02/24/2005	14:45	32	445	507	–	–	–53.40	–	–	–	–7.44
	02/24/2005	16:00	32	395	507	–	–	–53.30	–	–	–	–7.37
	02/24/2005	17:30	32	370	507	–	–	–53.60	–	–	–	–7.41
	02/24/2005	18:20	32	295	507	–	–	–53.20	–	–	–	–7.36
001N007E20N001M	08/04/2004	10:00	26	282	390	–	–	–54.40	–	–	–	–7.32
	08/04/2004	12:00	26	312	390	–	–	–53.90	–	–	–	–7.19
	08/04/2004	13:15	26	360	390	0.15	8.92	–53.40	–	–	–14.20	–7.24
	08/04/2004	13:30	26	158	390	0.34	62.70	–51.20	2.2	0.58	–17.20	–6.84
	07/15/2005	09:30	26	158	390	–	–	–50.30	–	–	–	–6.72
	07/15/2005	17:30	26	160	390	–	–	–49.30	–	–	–	–6.48
001N007E28F001M	07/19/2005	13:00	33	255	611	0.34	66.60	–51.70	3.0	0.10	–16.50	–6.85
	07/19/2005	13:15	33	580	611	0.14	8.86	–57.81	–	–	–13.20	–7.62
	07/19/2005	16:00	33	515	611	–	–	–54.08	–	–	–	–7.09
	07/20/2005	09:30	33	460	611	–	–	–57.33	–	–	–	–7.59
	07/20/2005	11:15	33	400	611	–	–	–57.03	–	–	–	–7.61
	07/20/2005	14:00	33	250	611	–	–	–54.97	–	–	–	–7.25
001N007E31C001M	07/29/2004	13:10	21	199	415	–	–	–58.60	16.9	1.09	–	–7.89
	03/26/2008	11:00	21	199	415	0.42	83.14	–58.70	13.3	0.90	–17.15	–7.89
	03/26/2008	11:15	21	210	415	–	–	–57.90	–	–	–	–7.87
	03/26/2008	13:30	21	250	415	–	–	–59.20	–	–	–	–7.86
	03/26/2008	15:00	21	310	415	–	–	–58.50	–	–	–	–7.89
	03/26/2008	17:30	21	360	415	–	–	–59.90	–	–	–	–7.95
	03/26/2008	18:30	21	390	415	0.40	85.53	–58.90	15.7	1.02	–17.20	–7.92
002N006E01Q001M	08/09/2006	09:30	34	157	362	0.67	96.59	–65.72	18.6	1.22	–16.77	–8.97
	08/09/2006	11:00	34	305	362	–	–	–61.52	–	–	–	–8.65
	08/09/2006	12:30	34	335	362	–	–	–62.67	–	–	–	–8.80
	08/09/2006	13:45	34	360	362	0.50	92.71	–64.96	14.4	0.96	–16.45	–9.00

Table 20. Isotopic data for water from selected depth-dependent wells, Eastern San Joaquin Groundwater Subbasin, California, 2004–8.–Continued

[Site locations are shown in figure 20. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Deuterium/protium and oxygen-18/16 analyzed at USGS National Research Program, Stable Isotope Laboratory, Reston, Virginia. Carbon age data analyzed by University of Waterloo, Isotope Laboratory, Waterloo, Ontario, Canada. Tritium analyzed at University of Miami, Tritium Laboratory, Miami, Florida. Sample depth in feet below land surface. **Abbreviations**: ft, feet; hh:mm, hour:minute; LSD, land surface datum; mm/dd/yyyy, month/day/year; NAVD 88, North American Vertical Datum of 1988; pCi/L, picocuries per liter; –, no data]

State well number	Date (mm/dd/yyyy)	Time (hh:mm)	Altitude of land surface (ft above NAVD 88)	Depth to top of sample interval (ft below LSD) (72015)	Depth to bottom of sample interval (ft below LSD) (72016)	Carbon-14 counting error, filtered, percent modern (49934)	Carbon-14, filtered, percent modern (49933)	Deuterium/ protium unfiltered, per mil (82082)	Tritium, unfiltered (pCi/L) (07000)	Tritium 2-sigma combined uncertainty, unfiltered (pCi/L) (75985)	Carbon-13/ carbon-12 unfiltered, per mil (82081)	Oxygen-18/ oxygen-16 unfiltered, per mil (82085)
002N006E04Q001M	07/13/2005	10:45	18	192	398	0.35	68.33	–62.10	4.0	0.12	–16.30	–8.55
	07/13/2005	11:30	18	375	398	0.29	47.78	–60.80	–	0.08	–16.40	–8.47
	07/13/2005	16:30	18	350	398	–	–	–59.50	–	0.08	–	–8.50
	07/14/2005	09:00	18	250	398	–	–	–60.90	–	–	–	–8.48
	07/14/2005	12:00	18	220	398	–	–	–60.00	–	0.08	–	–8.38
	07/21/2005	15:00	18	220	398	0.29	60.27	–	–	–	–16.34	–
	07/22/2005	10:00	18	–	398	0.31	51.86	–	–	–	–16.30	–
	07/22/2005	14:00	18	350	398	0.25	46.35	–	–	–	–16.47	–
002N006E05F001M	08/03/2004	13:30	12	156	350	–	–	–63.60	11.8	0.77	–	–8.77
	08/03/2004	14:15	12	255	350	–	–	–59.60	–	–	–	–8.39
	08/03/2004	15:15	12	275	350	–	–	–60.20	–	–	–	–8.44
	08/03/2004	16:00	12	320	350	–	–	–60.00	–	–	–	–8.43
	08/03/2004	17:15	12	340	350	–	–	–60.30	–	–	–	–8.42
	01/12/2005	13:50	12	–	350	–	–	–59.90	3.2	0.60	–	–8.46
002N006E11H003M	06/19/2007	12:00	27	260	495	0.37	89.51	–65.47	21.3	1.41	–17.11	–8.71
	06/19/2007	14:40	27	315	495	–	–	–64.30	–	–	–	–8.69
	06/19/2007	17:50	27	350	495	–	–	–63.49	–	–	–	–8.62
	06/20/2007	09:30	27	420	495	–	–	–65.43	–	–	–	–8.76
	06/20/2007	11:30	27	450	495	–	–	–64.32	–	–	–	–8.72
	06/20/2007	14:20	27	481	495	0.37	88.86	–64.60	20.9	1.41	–16.96	–8.75
002N006E12J001M	08/08/2006	11:00	35	240	445	0.44	79.68	–63.17	14.5	0.96	–16.62	–8.96
	08/08/2006	13:20	35	300	445	–	–	–63.29	–	–	–	–8.79
	08/08/2006	15:00	35	330	445	–	–	–61.24	–	–	–	–8.70
	08/08/2006	16:00	35	375	445	–	–	–60.77	–	–	–	–8.70
	08/08/2006	17:20	35	425	445	0.36	61.78	–62.03	2.9	0.58	–15.71	–8.67

Table 20. Isotopic data for water from selected depth-dependent wells, Eastern San Joaquin Groundwater Subbasin, California, 2004–8.–Continued

[Site locations are shown in figure 20. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Deuterium/protium and oxygen-18/16 analyzed at USGS National Research Program, Stable Isotope Laboratory, Reston, Virginia. Carbon age data analyzed by University of Waterloo, Isotope Laboratory, Waterloo, Ontario, Canada. Tritium analyzed at University of Miami, Tritium Laboratory, Miami, Florida. Sample depth in feet below land surface. **Abbreviations**: ft, feet; hh:mm, hour:minute; LSD, land surface datum; mm/dd/yyyy, month/day/year; NAVD 88, North American Vertical Datum of 1988; pCi/L, picocuries per liter; –, no data]

State well number	Date (mm/dd/yyyy)	Time (hh:mm)	Altitude of land surface (ft above NAVD 88)	Depth to top of sample interval (ft below LSD) (72015)	Depth to bottom of sample interval (ft below LSD) (72016)	Carbon-14 counting error, filtered, percent modern (49934)	Carbon-14, filtered, percent modern (49933)	Deuterium/ protium unfiltered, per mil (82082)	Tritium, unfiltered (pCi/L) (07000)	Tritium 2-sigma combined uncertainty, unfiltered (pCi/L) (75985)	Carbon-13/ carbon-12 unfiltered, per mil (82081)	Oxygen-18/ oxygen-16 unfiltered, per mil (82085)
002N006E24P004M	08/05/2004	09:30	25	200	520	0.41	88.36	–61.20	10.1	0.64	–16.44	–8.64
	08/05/2004	09:45	25	200	520	–	–	–60.30	–	–	–	–8.30
	08/05/2004	11:00	25	244	520	–	–	–61.90	–	–	–	–8.62
	08/05/2004	12:00	25	278	520	–	–	–62.00	–	–	–	–8.78
	08/05/2004	14:00	25	300	520	–	–	–62.80	–	–	–	–8.79
	08/05/2004	15:00	25	316	520	–	–	–61.40	–	–	–	–8.68
	08/05/2004	16:30	25	400	520	–	–	–60.50	–	–	–	–8.62
	08/05/2004	17:45	25	506	520	–	–	–60.00	6.0	0.58	–	–8.53
	01/26/2005	12:50	25	500	520	–	–	–61.10	12.2	1.00	–	–8.61
	01/27/2005	09:00	25	400	520	–	–	–61.20	1.9	0.60	–	–8.68
	01/27/2005	13:00	25	275	520	–	–	–62.20	3.2	0.60	–	–8.73
	01/28/2005	08:30	25	200	520	0.42	88.05	–61.80	8.6	1.00	–15.97	–8.61
002N006E27L001M	02/16/2005	15:00	15	–	495	–	–	–56.40	12.8	1.30	–	–7.59
	02/16/2005	17:00	15	360	495	–	–	–57.40	–	–	–	–7.66
	02/16/2005	18:00	15	325	495	–	–	–55.80	–	–	–	–7.73
	02/17/2005	11:30	15	–	495	–	–	–56.80	11.2	1.00	–	–7.81
	02/17/2005	19:00	15	–	495	–	–	–58.80	9.5	1.00	–	–8.01
	02/18/2005	10:00	15	–	495	–	–	–59.50	15.4	1.30	–	–8.10

Table 21. Identification numbers and screen depths for depth-dependent wells, Eastern San Joaquin Groundwater Subbasin, California.

[State well number, see well-numbering diagram in text. Site locations are shown in figure 20. **Abbreviations**: ft, feet; LSD, land surface datum; NAVD 88, North American Vertical Datum of 1988; USGS ID, U.S. Geological Survey identification number: the unique number for each site in USGS National Water Information System (NWIS) database]

State well number	USGS ID	Altitude of land surface (ft above NAVD 88)	Depth of well (ft below LSD)	Depth to top of screen interval (ft below LSD)	Depth to bottom of screen interval (ft below LSD)
001N007E08H002M	375701121132101	32	527	275	507
001N007E20N001M	375452121141401	26	410	158	390
001N007E28F001M	375429121124501	33	645	255	620
001N007E31C001M	375339121150301	21	425	199	415
002N006E01Q001M	380244121154901	34	380	157	362
002N006E04Q001M	380239121192401	18	408	192	398
002N006E05F001M	380302121203201	12	364	156	354
002N006E11H003M	380212121164601	27	500	260	495
002N006E12J001M	380201121153301	35	465	240	445
002N006E24P004M	380003121160701	25	540	200	520
002N006E27L001M	375919121182401	15	519	195	495

Table 22. Selected dissolved ions and isotopes in pore water extracted by pressure from core material from selected multiple-well monitoring sites, Eastern San Joaquin Groundwater Subbasin, California.

[Site locations are shown in figure 2. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Data analyzed by U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL) in Arvada, Colorado, Deuterium/protium and oxygen-18/16 analyzed at USGS National Research Program, Stable Isotope Laboratory, Reston, Virginia, and Specific conductance done at the U.S. Geological Survey Laboratory in San Diego, California. Sample depth in feet below land surface. **Abbreviations**: E, estimated value; ft, feet; hh:mm, hour:minute; LSD, land surface datum; mg/L, milligrams per liter; mm/dd/yyyy, month/day/year; NAVD 88, North American Vertical Datum of 1988; µS/cm, microsiemens per centimeter at 25 degrees Celsius; µg/L, micrograms per liter; –, no data; <, less than value shown]

State well number	Date (mm/dd/yyyy)	Time (hh:mm)	Altitude of land surface (ft above NAVD 88)	Depth to top of sample interval (ft) (72015)	Depth to bottom of sample interval (ft) (72016)	Specific conductance, unfiltered (µS/cm) (00095)	Bromide, filtered (mg/L as Br) (71870)
002N005E01A002M	04/28/2005	10:00	4	72	75	4,060	3.93
	04/30/2005	10:00	4	963	966	2,190	1.77
	07/25/2006	10:00	4	49.9	49.9	10,800	10
	07/25/2006	10:01	4	51.5	51.5	8,120	6.89
	07/25/2006	10:02	4	49.9	49.9	3,480	3.35
	11/08/2007	07:25	4	–	–	5,630	6.49
002N006E08N001M	07/21/2006	10:02	3	52.5	55.5	–	0.14
	07/21/2006	10:03	3	610	613	–	0.49
002N006E11H004M	05/04/2005	10:00	27	640	643	601	0.07
002N006E29H001M	07/21/2006	10:00	5	59	62	–	0.08
	07/21/2006	10:01	5	615	618	–	0.14

State well number	Date (mm/dd/yyyy)	Time (hh:mm)	Chloride, filtered (mg/L as Cl) (00940)	Iodide, filtered (mg/L as I) (71865)	Barium, filtered (µg/L as Ba) (01005)	Boron, filtered (µg/L as B) (01020)	Deuterium/ Protium unfiltered (per mil) (82082)	Oxygen-18/ Oxygen-16 unfiltered (per mil) (82085)
002N005E01A002M	04/28/2005	10:00	1,270	–	3,860	288	–61.2	–7.82
	04/30/2005	10:00	490	–	394	311	–66.2	–8.84
	07/25/2006	10:00	3,590	0.482	5,370	E62	–56.8	–7.40
	07/25/2006	10:01	2,400	0.412	2,410	87	–59.0	–7.64
	07/25/2006	10:02	1,120	0.306	612	96	–60.7	–8.07
	11/08/2007	07:25	1,940	3.51	2,290	2,580	–60.8	–7.93
002N006E08N001M	07/21/2006	10:02	51.4	0.046	95.0	<70	–54.5	–7.33
	07/21/2006	10:03	142	0.253	143	301	–59.1	–8.02
002N006E11H004M	05/04/2005	10:00	18.6	–	61.4	531	–65.4	–8.67
002N006E29H001M	07/21/2006	10:00	28.1	0.074	328	E41	–44.5	–5.00
	07/21/2006	10:01	47.2	0.068	40.9	799	–63.5	–8.42

Table 23. Selected trace-element composition of acid extracts of pore water from core material and cuttings from selected multiple-well monitoring sites, Eastern San Joaquin Groundwater Subbasin, California.

[Site locations are shown in figure 2. State well number, see well-numbering diagram in text. The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Water samples were analyzed at U.S. Geological Survey National Water Quality Laboratory (NWQL) in Denver, Colorado. Dates sites were drilled given in tables 2–5, and 7. Sample depth in feet below land surface. **Abbreviations**: ft, feet; hh:mm, hour:minute; LSD, land surface datum; mm/dd/yyyy, month/day/year; NAVD 88, North American Vertical Datum of 1988; µg/L, micrograms per liter; –, no data]

State well number	Date (mm/dd/yyyy)	Time (hh:mm)	Altitude of land surface (ft above NAVD 88)	Depth to top of sample interval (ft) (72015)	Depth to bottom of sample interval (ft) (72016)	Arsenic, filtered (µg/L as As) (01000)	Chromium, filtered (µg/L as Cr) (01030)	Iron, filtered (µg/L as Fe) (01046)	Manganese, filtered (µg/L as Mn) (01056)	Vanadium, filtered (µg/L as V) (01085)	Uranium (natural), filtered (µg/L as U) (22703)
001N006E04J003M	12/05/2005	10:13	8	120	120	12.1	–	1,000,000	44,500	3,450	26.5
	12/05/2005	10:14	8	360	360	21.7	–	1,010,000	62,400	2,910	605
	12/05/2005	10:15	8	440	440	–	–	563,000	40,300	1,020	23.7
	12/05/2005	10:16	8	600	600	11.8	69.2	521,000	69,400	1,620	59.5
002N005E01A002M	12/05/2005	10:01	4	60	80	–	–	196,000	23,100	1,970	158
	12/05/2005	10:02	4	72	75	9.3	80.2	138,000	17,200	1,160	84.3
	12/05/2005	10:03	4	72	75	0.19	1.4	160,000	27,900	1,550	173
	12/05/2005	10:04	4	240	260	23.2	–	445,000	47,800	2,160	154
	12/05/2005	10:05	4	400	420	14.8	–	541,000	120,000	1,540	30.1
	12/05/2005	10:06	4	600	620	13.8	89.1	310,000	21,700	752	20.6
	12/05/2005	10:07	4	960	960	11.9	48.7	41,800	81,000	506	59.1
	03/27/2006	08:01	4	60	80	56.1	538	374,000	26,100	3,890	483
	07/25/2006	10:00	4	49.9	49.9	332	750	614,000	17,800	2,770	77.0
	07/25/2006	10:01	4	49.9	49.9	294	678	447,000	34,500	2,090	100
	07/25/2006	10:02	4	51.5	51.5	268	784	480,000	34,900	2,310	108
002N006E08N001M	07/21/2006	10:02	3	52.5	55.5	170	755	1,560,000	24,800	3,600	31.2
	07/21/2006	10:03	3	610	613	122	1,360	2,930,000	74,700	8,710	82.6
002N006E11H004M	12/05/2005	10:08	27	240	260	9.2	99.2	262,000	13,800	572	43.6
	12/05/2005	10:09	27	120	140	9.7	–	92,900	27,900	224	43.5
	12/05/2005	10:10	27	560	580	–	–	353,000	30,500	1,120	17.4
	12/05/2005	10:11	27	620	640	10.3	53.6	584,000	34,900	785	17.6
	12/05/2005	10:12	27	640	643	10.1	97.6	480,000	94,600	1,300	65.8
	03/27/2006	08:02	27	560	580	81.6	362	696,000	31,300	2,060	110
002N006E29H001M	07/21/2006	10:00	5	–	–	51.9	377	1,680,000	114,000	4,120	11.1
	07/21/2006	10:01	5	–	–	22.8	1,990	2,720,000	58,200	19,000	20.5

References Cited

Bennett, G.L., Belitz, Kenneth, and Milby-Dawson, B.J., 2006, California GAMA program: groundwater quality data in the Northern San Joaquin Basin study unit, 2005: U.S. Geological Survey Data Series 196, 122 p., available at http://pubs.er.usgs.gov/usgspubs/ds/ds196.

Beukens, R.P., 1992, Radiocarbon accelerator mass spectrometry, *in* Taylor, R.E., Long, A., and Kra, R.S., eds., Background, precision, and accuracy, radiocarbon after four decades: an Interdisciplinary perspective: New York, Springer-Verlag, p. 230–239.

Burow, K.R., Weissmann, G.S., Miller, R.D., and Placzek, Gary, 1997, Hydrogeologic facies characterization of an alluvial fan near Fresno, California, using geophysical techniques: U.S. Geological Survey Open-File Report 97–46, 15 p., available at http://pubs.er.usgs.gov/usgspubs/ofr/ofr9746.

California Department of Water Resources, 1967, San Joaquin County investigation: Bulletin–146: Sacramento, California Department of Water Resources variously paged.

California Department of Water Resources, 2003, Hydrogeologic investigation in Stockton, California, May 2002: Sacramento, California Department of Water Resources, Central District, Division of Planning and Local Assistance, variously paged.

California Department of Water Resources, 2006, California's groundwater, San Joaquin Valley groundwater basin, Eastern San Joaquin subbasin–Bulletin 118: Sacramento, California Department of Water Resources, 6 p., accessed April 2012 at http://www.water.ca.gov/pubs/groundwater/bulletin_118/basindescriptions/5-22.01.pdf.

CDM, Inc., 2001, San Joaquin County water management plan: phase 1—planning analysis and strategy: Sacramento, Calif., Camp, Dresser, and McKee, Inc., variously paged.

Century Geophysical Corp., 2008, User guide, slim hole induction tool model numbers 9510, 9511, and 9512: Tulsa, Okla., accessed February 15, 2008, at http://www.century-geo.info/dnn/EquipmentSales/LoggingTools/9512LoggingTool.aspx.

Chao, T.T., and Sanzolone, R.F., 1989, Fractionation of soil selenium by sequential partial dissolution: Soil Science of America Journal, v. 53, no. 2, p. 385–392.

Coplen, T.B., 1994, Reporting of the stable hydrogen, carbon, and oxygen isotopic abundances: Pure and Applied Chemistry, v. 66, no. 2, p. 273–276.

Coplen, T.B., Wildman, J.D., and Chem, J., 1991, Improvements in the gaseous hydrogen-water equilibration technique for hydrogen isotope ratio analysis: Analytical Chemistry, v. 63, no. 9, p. 910–912.

Curtis, G.H., 1954, Mode of origin of pyroclastic debris in the Mehrten formation of the Sierra Nevada: University of California Publications in Geological Science, v. 29, no. 9, p. 453–502.

Driscoll, F.G., 1986, Groundwater and wells (2nd ed.): Saint Paul, Minn., Johnson Filtration Systems, Inc., 1,089 p.

Epstein, S., and Mayeda, T., 1953, Variations of ^{18}O content of waters from natural sources: Geochimica et Cosmochimica Acta, v. 4, p. 213–224.

Faires, L.M., 1993, Methods of analysis by the U.S. Geological Survey National Water Quality Laboratory—determination of metals in water by inductively coupled plasma-mass spectrometry: U.S. Geological Survey Open-File Report 92–634, 28 p.

Fishman, M.J., 1993, Methods of analysis by the U.S. Geological Survey National Water Quality Laboratory—determination of inorganic and organic constituents in water and fluvial sediments: U.S. Geological Survey Open-File Report 93–125, 217 p., available at http://pubs.er.usgs.gov/usgspubs/ofr/ofr93125.

Fishman, M.J., and Friedman, L.C., 1989, Methods for determination of inorganic substances in water and fluvial sediments: U.S. Geological Survey Techniques of Water-Resources Investigations, book 5, chap. A1, 545 p.

Folk, R.L., 1954, The distinction between grain size and mineral composition in sedimentary rock nomenclature: Journal of Geology, v. 62, no. 4, p. 344–359.

Gleason, J.D., Friedman, I., and Hanshaw, B.B., 1969, Extraction of dissolved carbonate species from natural water for carbon isotope analysis: U.S. Geological Survey Professional Paper 650–D, p. 248–250.

Gonfiantini, R., 1978, Standards for stable isotope measurements in natural compounds: Nature, v. 271, p. 534–536.

Hammermeister, D.P., Blout, D.O., and McDaniel, J.C., 1986, Drilling and coring methods that minimize the disturbance of cuttings, core, and rock formations in the unsaturated zone, Yucca Mountain, Nevada, in Proceedings of the NWWA Conference on Characterization and Monitoring of the Vadose (Unsaturated) Zone: Worthington, Ohio, National Water Well Association, p. 507–541.

Hill, A.D., 1990, Production logging—theoretical and interpretive elements, in Society of Petroleum Engineers Monograph: Richardson, Tex., Society of Petroleum Engineers, v. 14, 145 p.

Izbicki, J.A., 2004, A small-diameter sample pump for collection of depth-dependent samples from production wells under pumping conditions: U.S. Geological Survey Fact Sheet 2004–3096, 2 p., available at http://pubs.er.usgs.gov/usgspubs/fs/fs20043096.

Izbicki, J.A., Ball, J.W., Bullen, T.D., and Sutley, S.J., 2008, Chromium, chromium isotopes and selected trace elements, western Mojave Desert, USA: Applied Geochemistry, v. 23, no. 5, p. 1325–1352.

Izbicki, J.A., Christensen, A.H., Hanson, R.T., Martin, Peter, Crawford, S.M., and Smith, G.A., 1999, U.S. Geological Survey combined well-bore flow and depth-dependent water sampler: U.S. Geological Survey Fact Sheet 196–99, 2 p., available at http://pubs.er.usgs.gov/usgspubs/fs/fs19699.

Izbicki, J.A., Christensen, A.H., Newhouse, M.W., and Aiken, G.R., 2005, Inorganic, isotopic, and organic composition of high-chloride water from wells in a coastal southern California aquifer: Applied Geochemistry, v. 20, no. 8, p. 1496–1517.

Izbicki, J.A., Metzger, L.F., McPherson, K.R., Everett, R.R., and Bennett, G.L., 2006, Sources of high-chloride water to wells, Eastern San Joaquin Groundwater Subbasin, California: U.S. Geological Survey Open-File Report 2006–1309, 8 p., available at http://pubs.er.usgs.gov/usgspubs/ofr/ofr20061309.

Izbicki, J.A., Stamos, C.L., Metzger, L.F., Halford, K.J., Kulp, T.R., and Bennett, G.L., 2008, Source, distribution, and management of arsenic in water from wells, Eastern San Joaquin Groundwater Subbasin, California: U.S. Geological Survey Open-File Report 2008–1272, 8 p., available at http://pubs.er.usgs.gov/usgspubs/ofr/ofr20081272.

Jones, S.R., and Garbarino, J.R., 1999, Methods of analysis by the U.S. Geological Survey National Water Quality Laboratory—determination of arsenic and selenium in water and sediment by graphite furnace-atomic absorption spectrometry: U.S. Geological Survey Open-File Report 98–639, 39 p.

Jurgens, B.C., Burow, K.R., Dalgish, B.A., and Shelton, J.L., 2008, Hydrogeology, water chemistry, and factors affecting the transport of contaminants in the zone of contribution of a public-supply well in Modesto, Eastern San Joaquin Valley, California: U.S. Geological Survey Scientific Investigations Report 2008–5156, 78 p., available at http://pubs.er.usgs.gov/usgspubs/sir/sir20085156.

Keys, W.S., 1990, Borehole geophysics applied to groundwater investigations: U.S. Geological Survey Techniques of Water-Resources Investigations, book 2, chap. E2, 150 p.

Keys, W.S., and MacCary, L.M., 1983, Application of borehole geophysics to water-resources investigations:. U.S. Geological Survey Techniques of Water Resources Investigations, book 2, chap. E1, 126 p.

Manheim, F.T., Brooks, E.G., and William, J.W., 1994, Description of a hydraulic sediment squeezer: U.S. Geological Survey Open-File Report 94–584, 39 p.

McNeil, J.D., Bosnar, M., and Snelgrove, F.B., 1990, Resolution of an electromagnetic borehole conductivity logger for geotechnical and ground water applications: Mississauga, Ontario, Geonics Ltd., Technical Note 25, p. 25–28.

Mendenhall, W.C., 1908, Ground waters of the San Joaquin Valley, California: U.S. Geological Survey Water-Supply Paper 222, 52 p.

Montgomery Watson, Inc., 2000, Salinity assessment and monitoring well network evaluation: Sacramento, Calif., San Joaquin County Flood Control and Water Conservation District, file no. 1510285.1, variously paged.

Munsell Color, 1975, Munsell soil color charts: Baltimore, Md., Munsell Color, Inc.

Munsell Color, 1994, Munsell soil color charts: Baltimore, Md., Munsell Color, Inc.

National Research Council, 1947, Report of the subcommittee on sediment terminology: American Geophysical Union Transactions, v. 28, no. 6, p. 936–938.

Newhouse, M.W., Izbicki, J.A., and Smith, G.A., 2005, Comparison of velocity-log data collected using impeller and electromagnetic flowmeters: Ground Water, v. 43, no. 3, p. 434–438.

Northeastern San Joaquin County Groundwater Banking Authority, 2004, Eastern San Joaquin Basin groundwater management plan: Stockton, Calif., Northeastern San Joaquin Groundwater Banking Authority, variously paged.

Ostlund, H.G., and Warner, E., 1962, Electrolytic enrichment of tritium and deuterium for natural tritium measurements, *in* Tritium in the physical and biological sciences: Vienna, International Atomic Energy Agency, v. 1, p. 96–104.

Paillet, F.L., 2000, Flow logging in difficult boreholes—making the best of a bad deal, *in* International Symposium on Borehole Geophysics for Minerals, Geotechnical, and Groundwater Applications, 7th, Denver, Colo., 2000, Proceedings: Houston, The Minerals and Geotechnical Logging Society, a Chapter at Large of the Society of Professional Well Log Analysts, p. 125–135.

Patton, C.J., and Truitt, E.P., 1992, Methods of analysis by the U.S. Geological Survey National Water Quality Laboratory—determination of total phosphorus by a Kjeldahl digestion method and an automated colorimetric finish that includes dialysis: U.S. Geological Survey Open-File Report 92–146, 39 p.

Piper, A.M., Gale, H.S., Thomas, H.E., and Robinson, T.W., 1939, Geology and groundwater hydrology of the Mokelumne area, California: U.S. Geological Survey Water-Supply Paper 780, 270 p.

Schlumberger, 1972, Log interpretation, volume I—principles: New York, Schlumberger Limited, 112 p.

Soil Conservation Service, 1992, Soil survey of San Joaquin County, California: U.S. Department of Agriculture, 480 p.

Struzeski, T.M., DeGiacomo, W.J., and Zayhowski, E.J., 1996, Methods of analysis by the U.S. Geological Survey National Water Quality Laboratory—determination of total phosphorous by a Kjeldahl digestion method and an automated colorimetric finish that includes dialysis: U.S. Geological Survey Open-File Report 96–149, 17 p.

Stuiver, M., and Polach, H.A., 1977, Discussion: reporting of ^{14}C data: Radiocarbon, v. 19, no. 3, p. 355–363.

Thatcher, L.L., Janzer, V.J., and Edwards, K.W., 1977, Methods for determination of radioactive substances in water and fluvial sediments: U.S. Geological Survey Techniques of Water-Resources, book 5, chap. A5, 95 p.

U.S. Environmental Protection Agency, 2006, Ground water and drinking water—list of drinking water contaminants and MCL's: accessed August 15, 2006, at http://www.epa.gov/safewater/mcl.html#sec.

U.S. Geological Survey, variously dated, National field manual for the collection of water-quality data: Techniques of Water-Resources Investigations, book 9, chap. A1–A9, variously paged, available at http://pubs.water.usgs.gov/twri9A.

Wigley, T.M.L., and Muller, A.B., 1981, Fractionation corrections in radiocarbon dating: Radiocarbon, v. 23, p. 173–190.

Wilde, F.D., ed., 2001, Field measurements, *in* U.S. Geological Survey, National field manual for the collection of water-quality data: Techniques of Water-Resources Investigations book 9, chap. A6, variously paged, available at http://water.usgs.gov/owq/FieldManual/Chapter6/Ch6_contents.html.

Williams, J.H., Lapham, W.W., and Barringer, T.H., 1993, Application of electromagnetic logging to contamination investigations in glacial sand-and-gravel aquifers: Ground Water Monitoring & Remediation, v. 13, no. 3, p. 129–138.

Young, S.C., and Pearson, H.S., 1995, The electromagnetic borehole flowmeter—description and applications: Ground Water Monitoring and Remediation Review, v. 15, no. 4, p.138–146.

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