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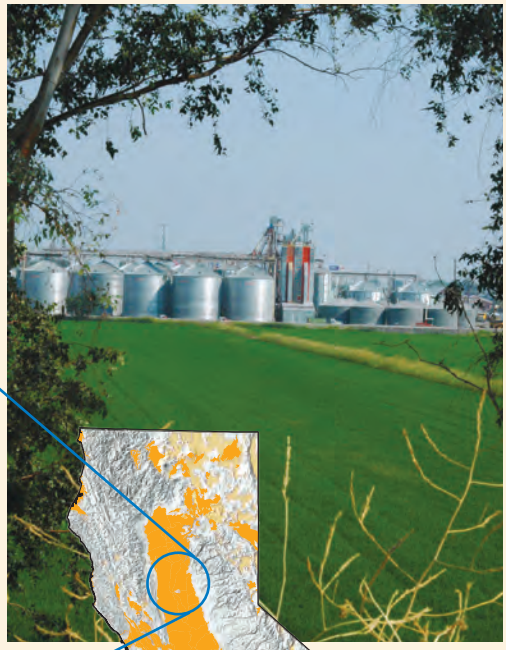
Ground-Water Quality Data in the Middle Sacramento Valley Study Unit, 2006—Results from the California GAMA Program



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Top: Rice field and grain silos in Colusa County, California, July 2008. (Photograph taken by Cathy Munday, U.S. Geological Survey.)
Bottom: Irrigation well in Butte County, California, July 2008. (Photograph taken by Michael Judd, U.S. Geological Survey.)

Ground-Water Quality Data in the Middle Sacramento Valley Study Unit, 2006—Results from the California GAMA Program

By Stephen J. Schmitt, Miranda S. Fram, Barbara J. Milby Dawson, and Kenneth Belitz

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Abbreviations and Acronyms

(Additional information or clarification given in parentheses)

AB	Assembly Bill (through the California State Assembly)
AL	action level
AL-US	action level (USEPA)
CAS	Chemical Abstracts Service (American Chemical Society)
CSU	combined standard uncertainty
D	detected
DLR	detection level for the purpose of reporting (CDPH)
E	estimated or having a higher degree of uncertainty
ESAC	East study area of the Middle Sacramento Valley study unit
FP	flow path
GAMA	Groundwater Ambient Monitoring and Assessment (program)
GPS	global positioning system
HAL-US	Lifetime Health Advisory Level (USEPA)
HPLC	high-performance liquid chromatography
IBW	inorganic blank water
LRL	laboratory reporting level
LSD	land-surface datum
LT-MDL	long-term method detection level
MCL	maximum contaminant level
MCL-CA	maximum contaminant level (CDPH)
MCL-US	maximum contaminant level (USEPA)
MDL	method detection limit
MRL	minimum reporting level
MSACV	Middle Sacramento Valley study unit
MU	method uncertainty
N	normal (1-gram-equivalent per liter of solution)
na	not available
NAWQA	National Water Quality Assessment (USGS)
nc	sample not collected
NL	notification level
NL-CA	California notification level (CDPH)
NRP	National Research Program (USGS)
NWIS	National Water Information System (USGS)
P	probability
PCFF-GAMA	Personal Computer Field Forms program designed for GAMA sampling
pK	logarithm of the reciprocal of the equilibrium constant for a specified reaction under specific conditions
QC	quality control
RICE	rice agriculture
RPD	relative percent difference
RSD	relative standard deviation
RSD5	risk-specific dose at 10^{-5}

Abbreviations and Acronyms—Continued

RSD5-US	risk-specific dose at 10^{-5} (USEPA)
SMCL	secondary maximum contaminant level
SMCL-CA	secondary maximum contaminant level (CDPH)
SMCL-US	secondary maximum contaminant level (USEPA)
SSMDC	sample-specific minimum detectable concentration
TT	treatment technique
TT-US	treatment technique (USEPA)
U.S.	United States
V	analyte detected in sample and an associated blank—thus data are not included in ground-water quality analysis results
VBW	VOC-free (nitrogen-purged) blank water
VPDB	Vienna Peedee Belemnite (the international reference standard for carbon isotopes)
VSMOW	Vienna Standard Mean Ocean Water (an isotopic water standard defined in 1968 by the International Atomic Energy Agency)
WSAC	West study area of the Middle Sacramento Valley study unit

Organizations

CDPH	California Department of Public Health (formerly the California Department of Health Services until July 1, 2007)
LLNL	Lawrence Livermore National Laboratory
MWH	Montgomery Watson Harza (laboratory)
NELAP	National Environmental Laboratory Accreditation Program
NWQL	National Water Quality Laboratory (USGS)
SWRCB	State Water Resources Control Board (California)
TML	Trace Metal Laboratory (USGS)
USEPA	U.S. Environmental Protection Agency
USGS	U. S. Geological Survey

Selected Chemical Names

$CaCO_3$	calcium carbonate
CO_3^{-2}	carbonate
DOC	dissolved organic carbon
HCl	hydrochloric acid
HCO_3^-	bicarbonate
MTBE	methyl *tert*-butyl ether
NDMA	*N*-Nitrosodimethylamine
1,2,3-TCP	1,2,3-trichloropropane
TDS	total dissolved solids
THM	trihalomethane
VOC	volatile organic compound

Abbreviations and Acronyms—Continued

Units of Measurement

ft	foot (feet)
in.	inch
L	liter
mg	milligram
mg/L	milligrams per liter (parts per million)
mi	mile
mL	milliliter
mm of Hg	millimeters of mercury
µg/L	micrograms per liter (parts per billion)
µL	microliter
µm	micrometer
NTU	nephelometric turbidity units
pCi/L	picocuries per liter
per mil	parts per thousand
$\delta^{i}E$	standard delta notation, the ratio of a heavier isotope of an element (^{i}E) to the more common lighter isotope of that element, relative to a standard reference material, expressed in per mil

Notes

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

$$°F = (1.8 \times °C) + 32$$

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

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). Milligrams per liter is equivalent to parts per million (ppm) and micrograms per liter is equivalent to parts per billion (ppb).

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Ground-Water Quality Data in the Middle Sacramento Valley Study Unit, 2006—Results from the California GAMA Program

By Stephen J. Schmitt, Miranda S. Fram, Barbara J. Milby Dawson, and Kenneth Belitz

Abstract

Ground-water quality in the approximately 3,340 mi^2 Middle Sacramento Valley study unit (MSACV) was investigated from June through September, 2006, as part of the California Groundwater Ambient Monitoring and Assessment (GAMA) program. The GAMA Priority Basin Assessment project was developed in response to the Groundwater Quality Monitoring Act of 2001 and is being conducted by the U.S. Geological Survey (USGS) in cooperation with the California State Water Resources Control Board (SWRCB).

The Middle Sacramento Valley study was designed to provide a spatially unbiased assessment of raw ground-water quality within MSACV, as well as a statistically consistent basis for comparing water quality throughout California. Samples were collected from 108 wells in Butte, Colusa, Glenn, Sutter, Tehama, Yolo, and Yuba Counties. Seventy-one wells were selected using a randomized grid-based method to provide statistical representation of the study unit (grid wells), 15 wells were selected to evaluate changes in water chemistry along ground-water flow paths (flow-path wells), and 22 were shallow monitoring wells selected to assess the effects of rice agriculture, a major land use in the study unit, on ground-water chemistry (RICE wells).

The ground-water samples were analyzed for a large number of synthetic organic constituents (volatile organic compounds [VOCs], gasoline oxygenates and degradates, pesticides and pesticide degradates, and pharmaceutical compounds), constituents of special interest (perchlorate, *N*-nitrosodimethylamine [NDMA], and 1,2,3-trichloropropane [1,2,3-TCP]), inorganic constituents (nutrients, major and minor ions, and trace elements), radioactive constituents, and microbial indicators. Naturally occurring isotopes (tritium, and carbon-14, and stable isotopes of hydrogen, oxygen, nitrogen, and carbon), and dissolved noble gases also were measured to help identify the sources and ages of the sampled ground water.

Quality-control samples (blanks, replicates, laboratory matrix spikes) were collected at approximately 10 percent of the wells, and the results for these samples were used to evaluate the quality of the data for the ground-water samples. Field blanks rarely contained detectable concentrations of any constituent, suggesting that contamination was not a noticeable source of bias in the data for the ground-water samples. Differences between replicate samples were within acceptable ranges, indicating acceptably low variability. Matrix spike recoveries were within acceptable ranges for most constituents.

This study did not attempt to evaluate the quality of water delivered to consumers; after withdrawal from the ground, water typically is treated, disinfected, or blended with other waters to maintain acceptable water quality. Regulatory thresholds apply to treated water that is served to the consumer, not to raw ground water. However, to provide some context for the results, concentrations of constituents measured in the raw ground water were compared with health-based thresholds established by the U.S. Environmental Protection Agency (USEPA) and California Department of Public Health (CDPH) and thresholds established for aesthetic concerns (secondary maximum contaminant levels, SMCL-CA) by CDPH. Comparisons between data collected for this study and drinking-water thresholds are for illustrative purposes only and are not indicative of compliance or noncompliance with regulatory thresholds.

Most constituents that were detected in ground-water samples were found at concentrations below drinking-water thresholds. VOCs were detected in less than one-third and pesticides and pesticide degradates in just over one-half of the grid wells, and all detections of these constituents in samples from all wells of the MSACV study unit were below health-based thresholds. All detections of trace elements in samples from MSACV grid wells were below health-based thresholds, with the exceptions of arsenic and boron.

Arsenic concentrations were above the USEPA maximum contaminant level (MCL-US) threshold in eight grid wells, and boron concentrations were above the CDPH notification level (NL-CA) in two grid wells. Arsenic was detected above the MCL-US in two flow-path wells. Arsenic, barium, boron, molybdenum, strontium, and vanadium were detected above health-based thresholds in a few of the RICE wells; these wells are not used to supply drinking water. All detections of radioactive constituents were below health-based thresholds, although six samples had activities of radon-222 above the lower proposed MCL-US threshold. Most of the samples from the MSACV wells had concentrations of major elements, total dissolved solids, and trace elements below the non-enforceable thresholds set for aesthetic concerns. Chloride and sulfate concentrations exceeded SMCL-CA thresholds in two and one grid well, respectively. Iron, manganese, and total dissolved solids concentrations were above the SMCL-CA thresholds in 1, 12, and 6 grid wells, respectively. Nitrate (nitrite plus nitrate, as dissolved nitrogen) concentrations from two grid wells were above the MCL-US threshold. There were no detections of microbial indicators in MSACV.

Introduction

Ground water comprises nearly half of the public water supply used in California (Hutson and others, 2004). To assess the quality of ground water from public-supply wells and establish a program for monitoring trends in ground-water quality, the California State Water Resource Control Board (SWRCB), in collaboration with the U.S. Geological Survey (USGS) and Lawrence Livermore National Laboratory (LLNL), implemented a statewide Groundwater Ambient and Monitoring and Assessment (GAMA) program (http://www.waterboards.ca.gov/gama). The GAMA program consists of three projects: Priority Basin Assessment, conducted by the USGS (http://ca.water.usgs.gov/gama/); Voluntary Domestic Well Assessment, conducted by the SWRCB; and Special Studies, conducted by LLNL.

The SWRCB initiated the GAMA Priority Basin Assessment project in response to the Ground-Water Quality Monitoring Act of 2001 (Sections 10780–10782.3 of the California Water Code, Assembly Bill 599). AB 599 is a public mandate to assess and monitor the quality of ground water used as public supply for municipalities in California. The project is a comprehensive assessment of statewide ground-water quality designed to help better understand and identify risks to ground-water resources and to increase the availability of information about ground-water quality to the public. As part of the AB 599 process, the USGS, in collaboration with the SWRCB, developed the monitoring plan for the project (Belitz and others, 2003; State Water Resources Control Board, 2003). Key aspects of the project are interagency collaboration and cooperation with local water agencies and well owners. Local participation in the project is entirely voluntary.

The GAMA Priority Basin Assessment project is unique in California because the data collected during the study include analyses for an extensive number of chemical constituents at very low concentrations—analyses that are not normally available. A broader understanding of ground-water composition will be especially useful for providing an early indication of changes in water quality and for identifying the natural and human factors affecting water quality. Additionally, the GAMA Priority Basin Assessment project will analyze a broader suite of constituents than required by the California Department of Public Health (CDPH, formerly the California Department of Health Services). An understanding of the occurrence and distribution of these constituents is important for the long-term management and protection of ground-water resources.

The range of hydrologic, geologic, and climatic conditions that exist in California must be considered in an assessment of ground-water quality. Belitz, and others (2003) partitioned the state into 10 hydrogeologic provinces, each with distinctive hydrologic, geologic, and climatic characteristics (fig. 1), and representative regions in all 10 provinces were included in the project design. Eighty percent of California's approximately 16,000 public-supply wells are located in ground-water basins within these hydrologic provinces. These ground-water basins, defined by the California Department of Water Resources, generally consist of relatively permeable, unconsolidated deposits of alluvial or volcanic origin (California Department of Water Resources, 2003). Ground-water basins were prioritized for sampling on the basis of the number of public-supply wells in the basin, with secondary consideration given to municipal ground-water use, agricultural pumping, the number of leaking underground fuel tanks, and pesticide applications within the basins (Belitz, and others, 2003). In addition, some ground-water basins or groups of adjacent similar basins with relatively few public-supply wells were assigned high priority so that all hydrogeologic provinces would be represented in the subset of basins sampled. The 116 priority basins were grouped into 35 study units. Some areas not in the defined ground-water basins were included in several of the study units to achieve representation of the 20 percent of public-supply wells not located in the ground-water basins.

Figure 1. The hydrogeologic provinces of California and the location of the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study unit (black area).

Three types of water-quality assessments are being conducted with the data collected in each study unit: (1) Status: assessment of the current quality of the ground-water resource, (2) Trends: detection of changes in ground-water quality, and (3) Understanding: identification of the natural and human factors affecting ground-water quality (Kulongoski and Belitz, 2004). This report is one of a series of status reports presenting water-quality data collected in each study unit; previous reports in this series include Wright and others (2005), Kulongoski and others (2006), Bennett and others (2006), Fram and Belitz (2007), Dawson and others (2008), and Kulongoski and Belitz (2007). Subsequent GAMA reports will address the trends and understanding aspects of the water-quality assessments.

The Middle Sacramento Valley GAMA study unit, hereinafter referred to as "MSACV," lies in the Central Valley hydrogeologic province (Belitz and others, 2003). MSACV contains eight subbasins of the Sacramento Valley ground-water basin (California Department of Water Resources, 2003) (fig. 2). MSACV was considered high priority for sampling because of the number of public-supply wells, basin area, number of sections with pesticide applications, and the amount of agricultural pumping (Belitz and others, 2003).

Purpose and Scope

The purposes of this report are: (1) to describe the study design and study methods; (2) to present the sampling, analytical, and quality assurance methods used during the study; (3) to present the results of quality-control (QC) tests; and (4) to present the analytical results for ground-water samples collected in MSACV.

Ground-water samples were analyzed for organic, inorganic, and microbial constituents, field parameters, and chemical tracers. The chemical and microbial data presented in this report were evaluated by comparison with state and federal drinking-water regulatory thresholds and other health-based standards that are applied to treated drinking water. Regulatory thresholds considered for this report are those established by the U.S. Environmental Protection Agency (USEPA) and the California Department of Public Health (CDPH) (U.S. Environmental Protection Agency, 2008a, 2008b, 2008c; California Department of Public Health, 2008a, 2008b).

The data presented in this report are intended to characterize the quality of untreated ground-water resources within the study unit, not the treated drinking water delivered to consumers by water purveyors. Discussions of the factors that influence the distribution and occurrence of the constituents detected in ground-water samples will be the subject of subsequent publications.

Acknowledgments

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Hydrogeologic Setting

Knowledge of the hydrogeologic setting is important in the design of a ground-water-quality investigation. MSACV lies within the Central Valley hydrogeologic province of California and covers approximately 3,340 mi^2 in Butte, Colusa, Glenn, Sutter, Tehama, Yolo, and Yuba Counties (fig. 2). The long axis of the study unit trends north-south for a distance of approximately 90 mi along the Sacramento River, and the short axis is approximately 40 mi long and corresponds to the width of the Central Valley between the Coast Ranges to the west and the Sierra Nevada to the east (fig. 2). MSACV contains eight subbasins of the Sacramento Valley ground-water basin (California Department of Water Resources, 2003) (fig. 2). For the purposes of this study, these eight subbasins were grouped into the East and West study areas, separated by the Sacramento River (fig. 3). The East study area includes the subbasins of Vina, West Butte, East Butte, North Yuba, South Yuba, and Sutter, whereas the West study area includes the Colusa and Corning subbasins.

The main water-bearing deposits of MSACV are primarily composed of continental and marine sediments overlying the consolidated Sierra Nevada block (California Department of Water Resources, 2003). These recent Quaternary (Holocene) to Late Tertiary (Miocene) deposits have a cumulative thickness of several hundred feet near the foothills of the Coast Ranges and Sierra Nevada and deepen to approximately 2,000 ft near the valley center. Sources of ground-water recharge include deep infiltration of precipitation, river and stream flow, and agricultural irrigation return flow.

The primary surface-water features of MSACV include the Sacramento River and smaller rivers and their principal tributaries. The rivers and tributaries include Stony Creek and Cache Creek in the West study area, and Butte Creek, the Feather, Yuba, and Bear Rivers in the East study area (fig. 2).

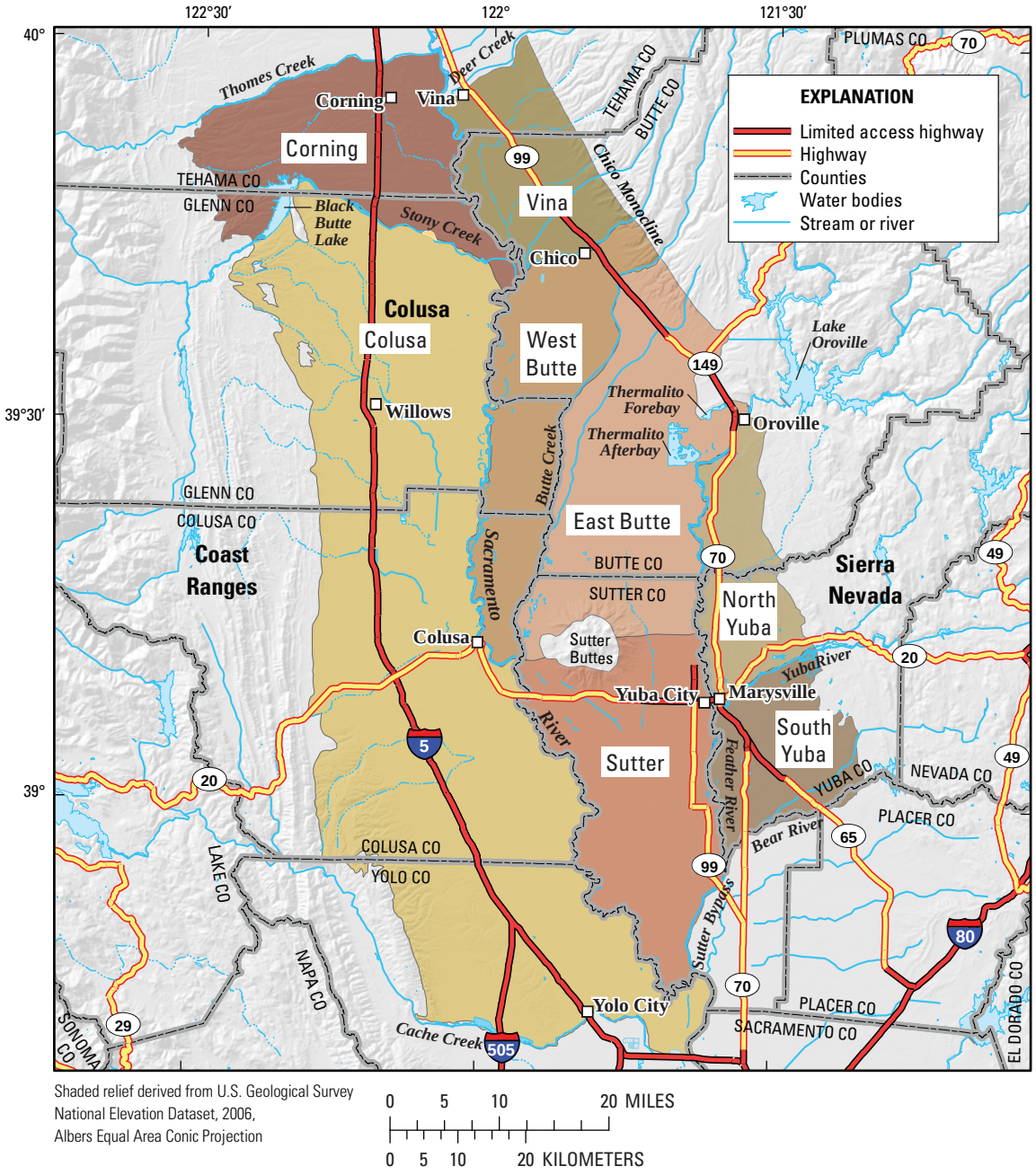

Figure 2. The Middle Sacramento Groundwater Ambient Monitoring and Assessment (GAMA) study unit showing the California Department of Water Resources defined ground-water basins and major hydrologic features within the study unit.

West Study Area—Corning and Colusa Subbasins

The West study area is bounded to the north by Thomes Creek, to the south by Cache Creek, to the west by the Coastal Ranges, and to the east by the Sacramento River (fig. 3). It covers an area of approximately 1,756 mi^2 and includes parts of Colusa, Glenn, Tehama, and Yolo Counties (California Department of Water Resources, 2003). The average annual precipitation ranges from 17 to 27 in., increasing to the north and west. The main water-bearing aquifer within this study area is the Tehama formation (Pliocene). The formation consists of unconsolidated to moderately consolidated coarse- and fine-grained sediments, indicative of floodplain deposits. The Tehama formation is up to 2,000 ft thick and varies in depth from a few feet to several hundred feet below the land surface with depth generally increasing to the east. The Tehama formation is confined by the Tertiary-age Tuscan formation, which contains low permeability lahar layers (California Department of Water Resources, 2003).

East Study Area—Vina, W. Butte, E. Butte, N. Yuba, S. Yuba, and Sutter Subbasins

The East study area is bounded to the north by Deer Creek, to the south by Sutter Bypass and Bear River, to the west by the Sacramento River, and to the east by the Chico Monocline and the Sierra Nevada (fig. 3). It covers an area of approximately 1,584 mi^2 and includes parts of Butte, Colusa, Glenn, Sutter, Tehama and Yuba Counties (California Department of Water Resources, 2003). The average annual precipitation is 17 to 32 in., with increasing rainfall to the north and east. Aquifers within this study area are composed of Tertiary to late Quaternary age deposits, with the younger Quaternary deposits typically representing the unconfined portion of the aquifer system. The Quaternary portion of the aquifer system is largely composed of unconsolidated gravel, sand, silt, and clay stream channel and alluvial fan deposits. South and east of the Sutter Buttes, the deposits contain Pleistocene alluvium, which is composed of loosely compacted silts, sands, and gravels that are moderately permeable; however, nearly impermeable hardpans and claypans do exist in this deposit, which restrict the vertical movement of ground water. The confined portion of the aquifer system includes the Tertiary-age Tuscan and Laguna formations. The Tuscan formation consists of volcanic mudflows, tuff breccia, tuffaceous sandstone, and volcanic ash deposits up to 1,250 ft thick. The Laguna formation consists of moderately consolidated and poorly to well cemented interbedded alluvial sand, gravel, and silt with a low permeability, overall (California Department of Water Resources, 2003).

Methods

The methods used for the GAMA program were selected to achieve the following objectives: (1) design a sampling plan suitable for statistical analysis, (2) collect samples in a consistent manner, (3) analyze samples using proven and reliable laboratory methods, (4) assure the quality of the ground-water data, and (5) maintain data securely and with relevant documentation.

Study Design

The wells selected for sampling in this study reflect the combination of two well selection strategies. Seventy-one wells were selected to provide a statistically unbiased, spatially distributed assessment of the quality of ground-water resources used for public drinking-water supply (fig. 3), and 37 additional wells were selected to provide greater sampling density in several areas to address specific ground-water quality issues in the study unit (fig. 4).

The spatially distributed wells were selected using a randomized grid-based method (Scott, 1990). Each of the study areas was subdivided into grid cells that were 38.6 mi^2 (100 km^2) in area. This grid-cell size met GAMA objectives for the Central Valley hydrogeologic province of a sampling density of at least one well per 38.6 mi^2 and having at least 10 grid cells per study area. For this assessment, the East study area was divided into 41 grid cells and the West study area into 46 grid cells.

Seventy-one of the 87 grid cells in MSACV contained wells that could be sampled; the other 16 grid cells did not contain accessible wells. If a grid cell contained more than one public-supply well, each well was randomly assigned a rank. The highest ranking well that met basic sampling criteria (for example, sampling point prior to treatment, capability to pump for several hours, and available well-construction information), and for which permission to sample could be obtained was then sampled. If a grid cell contained no accessible public-supply wells, domestic and irrigation wells were considered for sampling. An attempt was made to select domestic and irrigation wells with depths and screened intervals similar to those in public-supply wells in the area. Wells sampled as part of the randomized grid-cell network are hereinafter referred to as “grid wells.” Grid wells sampled in MSACV were numbered in the order of sample collection, with the following prefixes that are based on study area: “ESAC” for the East study area of the Middle Sacramento Valley study unit, and “WSAC” for the West study area of the Middle Sacramento Valley study unit.

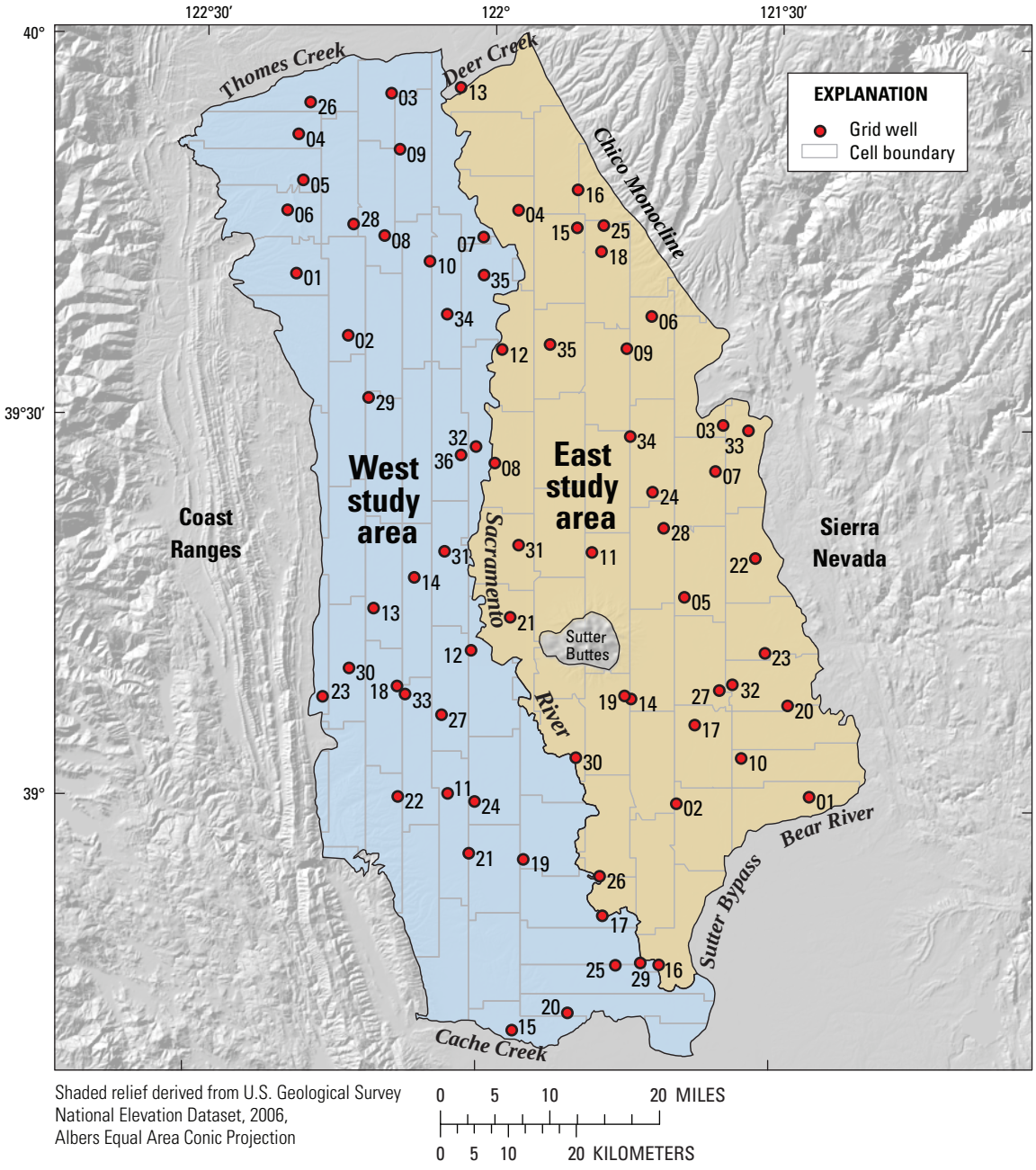

Figure 3. The East and West study areas of the Middle Sacramento Groundwater Ambient Monitoring and Assessment (GAMA) study unit showing the distribution of study area grids cells, the locations of sampled grid cell wells, and the study area boundaries.

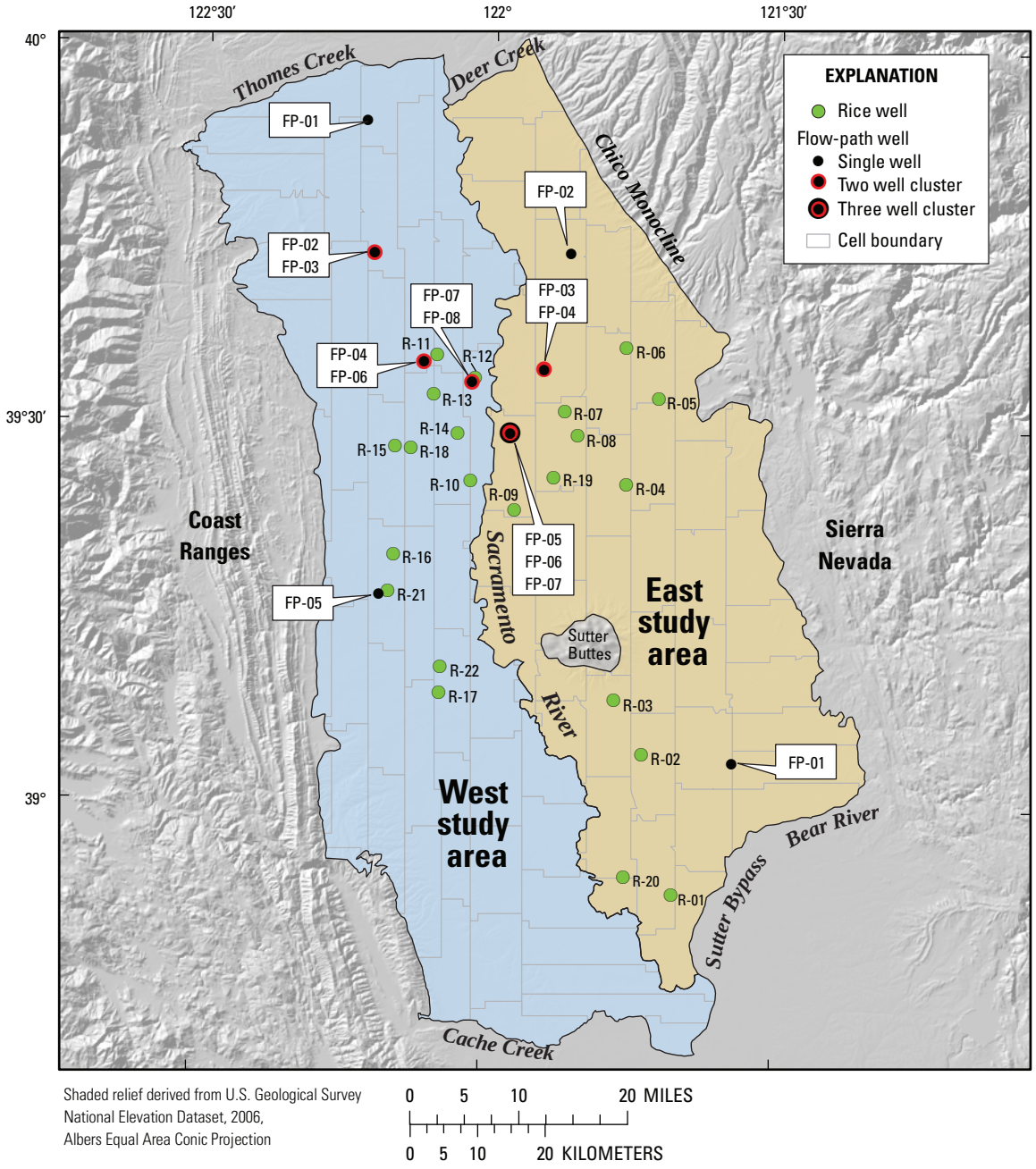

Figure 4. The East and West study areas of the Middle Sacramento Groundwater Ambient Monitoring and Assessment (GAMA) study unit showing the distribution of study area grid cells, the locations of sampled flow-path (FP) and RICE (R) wells (RICE wells are part of a well network monitoring the shallow ground-water quality associated with rice agriculture), and the study area boundaries.

In addition to the 71 grid wells, two types of nonrandomized wells were sampled in the East and West study areas. The first type of nonrandomized wells included 15 wells to evaluate changes in water chemistry along ground-water flow paths; these wells are referred to as "flow-path wells." Flow-path wells were numbered in the order of sample collection, with the prefixes ESAC-FP for wells in the East Sacramento Valley study area and WSAC-FP for wells in the West Sacramento Valley study area. The second type of nonrandomized wells consisted of 22 shallow monitoring wells selected to assess the effects of rice agriculture, a major land-use in the study unit, on shallow ground-water chemistry. In 1997, the USGS installed and sampled a set of monitoring wells in rice-growing areas of the Sacramento Valley as part of the National Water-Quality Assessment Program (Milby Dawson, 2001). Many of those monitoring wells are in the MSACV area and were resampled as part of this study. The monitoring wells are numbered in the order of sample collection with the prefix "RICE." Flow-path wells and RICE wells sampled as part of this study for better understanding were not included in the statistical characterization of water quality in MSACV, as the inclusion of these wells would have caused overrepresentation of certain grid wells and of shallow ground water.

Table 1 provides the GAMA alphanumeric identification number for each well, along with the date sampled, sampling schedule, well elevation, and well-construction information.

Well locations and identifications were verified using a global positioning system (GPS) receiver, 1:24,000 scale USGS topographic maps, comparison with existing well information in USGS and CDPH databases, and information provided by well owners. Drillers' logs for wells were obtained when available. Well information was recorded by hand on field sheets and electronically using specialized software on field laptop computers. All information was verified and then uploaded into the USGS's National Water Information System (NWIS). Well owner information is confidential. Well location information and all chemical data are currently inaccessible from NWIS's public website.

The wells in MSACV were sampled using a tiered analytical approach. All wells were sampled for a standard set of constituents, including field water-quality indicators, volatile organic compounds (VOCs), pesticides and pesticide degradates, perchlorate, stable isotopes of water, and dissolved noble gases and tritium and helium age dates. The standard set of constituents was termed the fast schedule (table 2). Wells on the intermediate schedule were sampled for all the constituents on the fast schedule, plus pharmaceuticals, *N*-nitrosodimethylamine (NDMA), 1,2,3-trichloropropane (1,2,3-TCP), nutrients, stable isotopes of oxygen and nitrogen in nitrate, major and minor ions, trace elements, species of arsenic, iron, and chromium, and carbon isotopes. Wells on the slow schedule were sampled for all the constituents on the intermediate schedule, plus dissolved organic carbon, radium 226/228, radon-222, gross alpha and beta radiation, coliform, coliphage, alkalinity, and turbidity (table 2). Fast, intermediate, and slow refer to the time required to sample the well for all the analytes on the schedule. Generally, one slow, two intermediate, or three fast wells could be sampled in one day. RICE wells were sampled on a modified intermediate schedule. In MSACV, 26 wells were sampled on the fast schedule, 52 were sampled on the intermediate schedule, 8 on the slow schedule, and 22 on the RICE monitoring-well schedule (table 2).

Sample Collection and Analysis

Samples were collected in accordance with the protocols established by the USGS's National Water Quality Assessment (NAWQA) program (Koterba and others, 1995) and the National Field Manual (U.S. Geological Survey, variously dated). These sampling protocols ensure that a representative sample of ground water is collected at each site, and that the samples are collected and handled in a way that minimizes the potential for contamination. The methods used for sample collection are described in the Appendix section "Sample Collection and Analysis."

Tables 3A–L list the compounds analyzed in each constituent class. Raw (untreated) ground-water samples were analyzed for 85 VOCs (table 3A) and 8 gasoline additives (table 3B), 135 pesticide and pesticide degradates (tables 3C, 3D), 14 pharmaceutical compounds (table 3E), 3 constituents of special interest (table 3F), 5 nutrients and dissolved organic carbon (table 3G), 10 major and minor ions and total dissolved solids (table 3H), 25 trace elements (table 3H), 6 species of arsenic, iron, and chromium (table 3I), 5 stable isotope ratios and 7 radioactive constituents, tritium, and carbon-14 (table 3J), 5 dissolved noble gases, helium stable isotope ratios, and tritium (table 3K), and 4 microbial constituents (table 3L). The methods used for sample analysis are described in the Appendix section "Sample Collection and Analysis."

Data Reporting

The methods and conventions used for reporting the data are described in the Appendix. Thirteen constituents analyzed in this study were measured by more than one method at the USGS's National Water Quality Laboratory (NWQL), but only the results from the preferred method for each of the constituents are reported. Arsenic, iron, and chromium concentrations, and tritium activities were analyzed by more than one laboratory, and both sets of results are reported.

Quality Assurance

The protocols used for this study are those used by the NAWQA program (U.S. Geological Survey, variously dated; Koterba and others, 1995), and the quality assurance protocols are described in the NWQL quality assurance plan (Maloney, 2005; Pirkey and Glodt, 1998). QC samples collected in the MSACV study include source-solution blanks, field blanks, replicates, and matrix and surrogate spikes. QC samples were collected to evaluate contamination, bias, and variability of the water-quality data that may have resulted from sample collection, processing, storage, transportation, and laboratory analysis. Quality-assurance methods and results are described in the Appendix section "Quality Assurance."

Water-Quality Results

Quality-Control Sample Results

Results of QC analyses (blanks, replicates, matrix spikes, and surrogates) were used to evaluate the quality of the data for the ground-water samples (see Appendix). Assessment of the QC data from blanks resulted in some ground-water samples being censored, as indicated with "V" codes in tables 5–14. Of the 300 constituents analyzed, 35 were detected in at least one field blank. For 15 of these constituents, concentrations detected in the field blanks were below the lowest concentration detected in ground-water samples, or the constituent was not detected in ground-water samples; thus, no data were affected. Some reported detections for five organic constituents in ground-water samples were flagged as potentially contaminated, and, therefore, were not considered as detections for ground-water quality assessment. Some low concentration detections of 12 inorganic constituents were flagged because contamination may have raised the concentrations sufficiently to have changed a nondetection into a low-level detection relative to the stated reporting limit.

Data from replicates indicate that variability between measurements generally was low, with relative standard deviations (RSD) below 5 percent for most replicate pairs for most constituents. Of the 30 pairs with RSDs above the acceptable limit of 20 percent, 29 had data that were estimated concentrations at or below the laboratory reporting level (LRL) for the constituent analyzed. At these low concentrations, small differences in the measured values in the replicate pairs account for the large RSDs. These results from the replicates confirm that the procedures used to collect and analyze the samples were consistent.

Median matrix-spike recoveries for 35 of the 232 constituents analyzed were lower than the acceptable limits, which may indicate that these constituents might not have been detected in some samples if they were present at very low concentrations.

More than 90 percent of the samples analyzed with surrogates had surrogate recoveries within acceptable limits. The QC results are described in the Appendix section "Quality-Control Sample Results."

Comparison Thresholds

Concentrations in ground-water samples were compared with CDPH and USEPA drinking-water health-based thresholds. Concentrations were also compared with thresholds established for aesthetics—secondary maximum contaminant levels (SMCLs) (California Department of Health Services, 2007a; California Department of Public Health, 2008a, 2008b; U.S. Environmental Protection Agency, 2006, 2008a, 2008b, 2008c). CDPH became the California Department of Health Services (CDHS) on July 1, 2007. The chemical and microbial data presented in this report are meant to characterize the quality of the untreated ground-water resources within MSACV, and are not intended to represent the treated drinking water delivered to consumers by water purveyors. The chemical and microbial composition of treated drinking water may differ from untreated ground water because treated drinking water may be subjected to disinfection, filtration, mixing with other waters, and exposure to the atmosphere prior to its delivery to consumers.

The following thresholds were used for comparisons:

MCL—Maximum Contaminant Level. Legally enforceable standards that apply to public-water systems and are designed to protect public health by limiting the levels of contaminants in drinking water. National MCLs established by the USEPA are the minimum standards with which states are required to comply, and individual states may choose to set more stringent standards. CDPH has established MCLs for additional constituents not regulated by the USEPA, as well as lowered the threshold concentration for a number of constituents with MCLs established by the USEPA. In this report, a threshold set by the USEPA is labeled "MCL-US," and one set by CDPH that is different from the MCL-US is labeled "MCL-CA." CDPH is notified when constituents are detected at concentrations exceeding MCL-US or MCL-CA thresholds in samples collected for the GAMA Priority Basin Assessment, but these detections do not constitute violations of CDPH regulations

AL—Action Level. Legally enforceable standards that apply to public-water systems and are designed to protect public health by limiting the levels of copper and lead in drinking water. Detections of copper or lead above the action-level thresholds trigger requirements for mandatory water treatment to reduce the corrosiveness of water to water pipes. The action levels established by the USEPA and CDPH are the same, thus these thresholds are labeled "AL-US" in this report.

TT—Treatment Technique. Legally enforceable standards that apply to public-water systems and are designed to protect public health by limiting the levels of microbial constituents in drinking water. Detections of microbial

constituents above the treatment-technique thresholds trigger requirements for mandatory additional disinfection during water treatment. The action levels established by the USEPA and CDPH are the same, thus these thresholds are labeled "TT-US" in this report.

SMCL—Secondary Maximum Contaminant Level. Non-enforceable standards applied to constituents that affect the aesthetic qualities of drinking water, such as taste, odor, and color, or technical qualities of drinking water, such as scaling and staining. Both the USEPA and CDPH define SMCLs, but unlike MCLs, SMCLs established by CDPH are not required to be at least as stringent as those established by USEPA. SMCLs established by CDPH are used in this report (SMCL-CA) for all constituents that have SMCL-CA values. The SMCL-US is used for pH because no SMCL-CA has been defined.

NL—Notification Level. Health-based notification levels established by CDPH for some of the constituents in drinking water that lack MCLs (NL-CA). If a constituent is detected above its NL-CA, California state law requires timely notification of local governing bodies and recommends consumer notification.

HAL—Lifetime Health Advisory Level. The maximum concentration of a constituent at which its presence in drinking water is not expected to cause any adverse carcinogenic effects for a lifetime of exposure. HALs are established by the USEPA (HAL-US) and are calculated assuming consumption of two liters of water per day over a 70-year lifetime by a 70-kilogram adult and that 20 percent of a person's exposure comes from drinking water.

RSD5—Risk-Specific Dose. The concentration of a constituent in drinking water corresponding to an excess estimated lifetime cancer risk of 1 in 100,000. RSD5 is an acronym for risk-specific dose at 10^{-5}. RSD5s are calculated by dividing the 10^{-4} cancer risk concentrations established by the USEPA by ten (RSD5-US).

For constituents with MCLs, detections in ground-water samples were compared with the MCL-US or MCL-CA. Constituents with SMCLs were compared with the SMCL-CA. For chloride, sulfate, specific conductance, and total dissolved solids, CDPH defines a "recommended" and an "upper" SMCL-CA; detections of these constituents in ground-water samples were compared with both levels. The SMCL-US for these constituents corresponds to the recommended SMCL-CA. Detected concentrations of constituents that lack MCLs and SMCLs were compared with NL-CAs. For constituents that lack an MCL, SMCL, or NL-CA, detected concentrations were compared with the HAL-US. For constituents that lack an MCL, SMCL, NL-CA, or HAL-CA, detected concentrations were compared with the RSD5-US. Note this hierarchy of selection of comparison thresholds means that for constituents with multiple types of established thresholds, the threshold used for comparison purposes may not be the one with the lowest concentration. The comparison thresholds used in this report are listed in tables 3A–L for all constituents and in tables 4–14 for constituents detected in ground-water samples from the MSACV. Not all constituents analyzed for this study have established thresholds. Concentrations greater than the selected comparison threshold are marked with asterisks in tables 4–14.

Ground-Water-Quality Data

Results from analyses of raw (untreated) ground-water samples from MSACV are presented in tables 4–14. Ground-water samples collected in MSACV were analyzed for up to 280 constituents, and 195 of those constituents were not detected in any of the samples (tables 3A–L). The results tables present only the constituents that were detected and list only samples that had at least one constituent detected. For constituent classes that were analyzed at all of the grid wells, the tables include the number of wells at which each analyte was detected, the frequency at which it was detected (in relation to the number of grid wells), and the total number of constituents detected at each well. Results from the flow-path and RICE wells are presented in the tables, but these results were excluded from the detection frequency calculations to avoid statistically over-representing the areas in the vicinity of these wells.

Table 4 includes water-quality indicators measured in the field and at NWQL. Tables 5–14 present the results of ground-water laboratory analyses organized by compound classes:

- Organic constituents
  - VOCs and gasoline oxygenates and degradates (table 5)
  - Pesticides and pesticide degradates (table 6)
- Constituents of special interest (table 7)
- Inorganic constituents
  - Nutrients and dissolved organic carbon (table 8)
  - Major and minor ions (table 9)
  - Trace elements (table 10)
  - Species of inorganic arsenic, iron, and chromium (table 11)
- Inorganic tracer constituents
  - Hydrogen and oxygen isotopes and tritium (table 12)
  - Stable isotopes of nitrogen and carbon and carbon-14 (table 13)
- Radioactive constituents (table 14)

Results for pharmaceutical compounds, dissolved noble gases, and tritium/helium age dates are not presented in this report; they will be included in subsequent GAMA

publications. No summary table is presented for microbial constituents because none were detected in any of the samples analyzed.

Water-Quality Indicators

Field and laboratory measurements of water-quality indicators, including dissolved oxygen, pH, specific conductance, alkalinity, and associated parameters (turbidity and water temperature) are presented in table 4. Dissolved oxygen and alkalinity are used as indicators of natural processes that control water chemistry. Specific conductance is the unit electrical conductivity of the water and is proportional to the amount of total dissolved solids (TDS) in the water. The pH value indicates the acidity or basicity of the water. Six wells (3 grid wells, 2 flow-path wells, and 1 RICE well) had pH values outside of the SMCL-CA range for pH. Laboratory pH values may be higher than field pH values because the pH of ground water often increases upon exposure to the atmosphere (see Appendix). Twenty-two wells (11 grid, 1 flow-path well, and 10 RICE wells) had specific conductance values above the recommended SMCL-CA, with 9 of those wells (4 grid wells and 5 RICE wells) above the upper threshold.

Organic Constituents

VOCs are widely used and can be found in paints, solvents, fuels, fuel additives, refrigerants, fumigants, and disinfected water and are characterized by their tendency to evaporate. VOCs generally persist longer in ground water than in surface water because ground water is isolated from the atmosphere.

Of the 85 VOCs analyzed, 24 were detected in ground-water samples; all detections were below health-based thresholds and most were less than one-hundredth of the threshold values (table 5). The only VOC detected in more than 10 percent of the grid wells was chloroform, a byproduct of drinking-water disinfection. Chloroform was the most frequently detected VOC in ground water nationally (Zogorski and others, 2006).

Pesticides include herbicides, insecticides, and fungicides, and are used to control weeds, insects, fungi, and other pests in agricultural, urban, and suburban settings. Of the 135 pesticides and pesticide degradates analyzed, 30 were detected in ground-water samples; all detections were below health-based thresholds and all were less than one-hundredth of the threshold values (table 6). The only pesticides detected in more than 10 percent of the grid wells were the herbicides bentazon, simazine, atrazine, and deethylatrazine, a degradate of atrazine. Simazine, atrazine, and deethlyatrazine are among the most commonly detected pesticide compounds in ground water nationally (Gilliom and others, 2006). Bentazon is primarily used in rice agriculture.

Constituents of Special Interest

Perchlorate, 1,2,3-TCP, and NDMA are constituents of special interest in California because they may adversely affect water quality and recently have been found in water supplies (California Department of Health Services, 2007b). Perchlorate is used as an oxidizer in rocket fuel and explosives, 1,2,3-TCP is used as a chemical synthesis product, and NDMA is an industrial by-product. Perchlorate was detected in approximately 6 percent of the grid wells, and all concentrations measured in the MSACV wells were less than one-third of the NL-CA (table 7). 1,2,3-TCP and NDMA were not detected in any samples.

Inorganic Constituents

Unlike the organic constituents and the constituents of special interest, most of the inorganic constituents are naturally present in ground water, although their concentrations may be influenced by human activities.

The nutrients, nitrogen and phosphorus, and dissolved organic carbon present in ground water can affect biological activity in aquifers and in surface water bodies that receive ground-water discharge. Nitrogen may be present in the form of ammonia, nitrite, or nitrate depending on the oxidation–reduction state of the ground water. High concentrations of nitrate can adversely affect human health, particularly the health of infants. Ground-water samples from two grid wells in MSACV had concentrations of nitrate (nitrite plus nitrate, dissolved as nitrogen) above the health-based threshold (table 8). All concentrations of nitrite and ammonia measured in ground-water samples were below health-based thresholds. Concentrations of orthophosphate (as phosphorus) and dissolved organic carbon were also low.

The major-ion composition, total dissolved solids (TDS) content, and levels of certain trace elements in ground water may produce undesirable effects on the aesthetic and technical properties of the water. Undesirable aesthetic properties include poor taste, color, or odor, and staining. Undesirable technical properties include scaling, and reduced effectiveness of treatment for other contaminants. CDPH has established non-enforceable thresholds (SMCL-CAs) that are based on aesthetic or technical properties rather than on health-based concerns for the major ions chloride and sulfate, TDS, and several trace elements. Chloride was detected in two grid wells above the recommended SMCL-CA, with one of those detections above the upper SMCL-CA. Sulfate was detected in one grid well above the lower SMCL-CA. Samples from six grid wells contained TDS above the recommended SMCL-CA, although only two of these samples were also above the upper SMCL-CA for TDS (table 9).

Iron and manganese are trace elements whose concentrations are affected by the oxidation–reduction state of the ground water. Precipitation of minerals containing iron or manganese may cause orange or black staining of surfaces. Samples from 12 grid wells had manganese concentrations above the SMCL-CA, and one of these samples also had an iron concentration above the MCL-CA (table 10).

Eighteen of the 25 trace elements analyzed in this study have health-based thresholds. Of the 18 trace elements with health-based thresholds, 2 were not detected in any samples, and all detections of 16 trace elements were below health-based thresholds (table 10). Samples from eight grid wells had arsenic concentrations above the MCL-US and samples from two grid wells had concentrations of boron above the NL-CA.

Arsenic, iron, and chromium occur in different species depending on the oxidation–reduction state of the ground water. The oxidized and reduced species have different solubilities in ground water and may have different effects on human health. The relative proportions of the oxidized and reduced species of each element can be used to aid in interpretation of the oxidation–reduction state of the aquifer. Table 11 reports measured concentrations of total arsenic, iron, and chromium, and the concentrations of the oxidized or the reduced species of each element. The concentration of the other species can be calculated by difference. For example, chromium(III) is equal to chromium(total) minus chromium(VI). The concentrations of arsenic, iron, and chromium reported in table 11 may be different than those reported in table 10 because different analytical methods were used (see Appendix). The concentrations reported in table 10 are considered more accurate.

Inorganic Tracer Constituents

Stable isotope ratios, tritium and carbon-14 activities, and noble gas concentrations are used as tracers of natural processes affecting ground-water composition. The stable isotope ratios of oxygen and hydrogen in water (table 12) may aid in interpretation of ground-water recharge sources. These stable isotope ratios reflect the altitude, latitude, and temperature of precipitation and the extent of evaporation of surface water or soil water. The nitrogen and oxygen stable isotope ratios in nitrate (table 13) may aid in interpretation of sources and processes affecting nitrate concentrations in ground water. Concentrations of dissolved noble gases are used to estimate the conditions of ground-water recharge, particularly the temperature of the recharge water. Noble gases from air dissolve in water that is in contact with the atmosphere, and the solubilities of the different noble gases vary with temperature. Results of noble gas analyses were not available in time for inclusion in this report; they will be presented in a subsequent GAMA report.

Tritium activities (table 12), carbon-14 activities (table 13), and helium isotope ratios provide information about the age of the ground water. Tritium is a short-lived radioactive isotope of hydrogen that is incorporated into the water molecule. Low levels of tritium are continuously produced by interaction of cosmic radiation with the earth's atmosphere, and a large amount of tritium was produced by atmospheric testing of nuclear weapons between 1952 and 1963. Thus, concentrations of tritium above background levels generally indicate the presence of water recharged since the early 1950s (Thatcher and others, 1977). Helium isotope ratios are used in conjunction with tritium concentrations to estimate ages for young ground water. Helium isotope analyses were not completed in time for inclusion in this report; they will be presented in a subsequent GAMA report.

Carbon-14 (table 13) is a radioactive isotope of carbon. Low levels of carbon-14 are continuously produced by interaction of cosmic radiation with the earth's atmosphere and incorporated into atmospheric carbon dioxide. The carbon dioxide dissolves in precipitation and water that is in contact with the atmosphere. Because carbon-14 decays with a half-life of approximately 5,700 years, low activities of carbon-14 relative to modern values generally indicate presence of ground water that is several thousand years old.

Of the inorganic tracer constituents analyzed for this study, the only one with a health-based threshold is tritium. All measured tritium activities in samples from MSACV wells were less than one-thousandth of the MCL-CA (table 12).

Radioactive Constituents

Radioactivity is the release of energy or energetic particles during changes in the structure of the nucleus of an atom. Most of the radioactivity in ground water comes from decay of naturally occurring isotopes of uranium and thorium that are present in minerals in the sediments or fractured rocks of an aquifer. Both uranium and thorium decay in a series of steps, eventually forming stable isotopes of lead. Radium-226, radium-228, and radon-222 are radioactive isotopes formed during the uranium and thorium decay series. In each step of the decay series, one radioactive element turns into a different radioactive element by emitting an alpha or a beta particle from its nucleus. For example, radium-226 emits an alpha particle and, therefore, turns into radon-222. Radium-228 decays to form actinium-228 by emission of a beta particle. The alpha and beta particles emitted during radioactive decay are hazardous to human health because these energetic particles may damage cells. Radiation damage to cell DNA may increase the cancer risk in humans.

Activity is often used instead of concentration for reporting the presence of radioactive constituents. Activity of radioactive constituents in ground water is measured in units of picocuries per liter (pCi/L), and one picocurie is approximately equal to two atoms decaying per minute. The number of atoms decaying is equal to the number of alpha or beta particles emitted.

The eight MSACV samples analyzed for radioactive constituents had activities of radium and of gross alpha and beta emitters less than established health-based thresholds (table 14). Activities of radon-222 in samples from six grid wells were above the proposed MCL-US of 300 pCi/L, but all were below the proposed alternative MCL-US of 4,000 pCi/L. The alternative MCL-US will apply if the state or local water agency has an approved multimedia mitigation program to address radon levels in indoor air (U.S. Environmental Protection Agency, 1999a).

Microbial Indicators

Water is disinfected during drinking-water treatment to prevent diseases that may be spread by water-borne microbial constituents derived from human or animal wastes. The specific viruses and bacteria responsible for diseases generally are not measured because routine analytical methods are not available. Measurements are made of more easily analyzed microbial constituents that serve as indicators of the presence of human or animal waste in water. Drinking-water purveyors respond to detections of microbial indicators by applying additional disinfection techniques to the water.

Samples from eight MSACV wells were analyzed for microbial indicators. None of the samples contained viral indicators F-specific and somatic coliphage, and none contained the bacterial indicator *Escherichia* coliform (*E. coli*) or total coliforms.

Future Work

Subsequent reports will focus on assessment of the data presented in this report using a variety of statistical, qualitative, and quantitative approaches to evaluate the natural and human factors affecting ground-water quality. Water-quality data contained in the CDPH and NWIS databases, and water-quality data available from other state and local water agencies, will be compiled, evaluated, and used in combination with the data presented in this report.

Summary

Ground-water quality in the approximately 3,340 mi^2 Middle Sacramento Valley study unit (MSACV) was investigated from June to September, 2006, as part of the Priority Basin Assessment project of Ground-Water Ambient Monitoring and Assessment (GAMA) program. The California State Water Resources Control Board (SWRCB), in collaboration with the U.S. Geological Survey and the Lawrence Livermore National Laboratory, is implementing the GAMA program (http://www.waterboards.ca.gov/gama/). The Priority Basin Assessment project was designed by the SWRCB and the USGS in response to the Ground-Water Quality Monitoring Act of 2001 (Belitz and others, 2003; State Water Resources Control Board, 2003). The project is a comprehensive assessment of statewide ground-water quality designed to identify and characterize risks to ground-water resources and to increase the availability of information about ground-water quality to the public. MSACV was the twelfth study unit sampled as part of the project.

MSACV is in the Central Valley hydrogeologic province, and includes within it eight ground-water basins, as defined by the California Department of Water Resources (California Department of Water Resources, 2003). The MSACV study included assessment of ground-water quality from 108 wells in Butte, Colusa, Glenn, Sutter, Tehama, Yolo, and Yuba Counties. Seventy-one of the wells (grid wells) were selected using a spatially distributed, randomized grid-based method to achieve statistically unbiased representation of the portion of the ground-water resource used for public drinking-water supplies. Fifteen of the wells (flow-path wells) were selected to provide additional sampling density to aid in understanding processes affecting ground-water quality. Twenty-two of the wells (RICE wells) were sampled for better understanding of the contribution of rice agriculture land use to ground-water conditions.

Ground-water samples were analyzed for volatile organic compounds (VOCs), pesticides and pesticide degradates, constituents of special interest, pharmaceutical compounds, nutrients, major and minor ions, trace elements, radioactivity, and microbial indicators. Naturally occurring isotopes (stable isotopes of hydrogen, oxygen, nitrogen, and carbon, and activities of tritium and carbon-14) and dissolved noble gases also were measured to provide a dataset that will be used to help interpret the source and age of the sampled ground water. This report describes the hydrogeologic setting of the MSACV region, details the sampling, analytical, and quality-assurance methods used in the study, and presents the results of the chemical and microbial analyses made of the ground-water samples collected during June to September, 2006.

QC samples (blanks, replicates, samples for matrix spikes) were collected at approximately 10 percent of the wells, and the results for these samples were used to evaluate the quality of the data for the ground-water samples. Field blanks rarely contained detectable concentrations of any constituent, suggesting that contamination was not a noticeable source of bias in the data for the ground-water samples. Most of the differences between replicate samples were within acceptable ranges, indicating acceptably low variability. Matrix spike recoveries were within acceptable ranges for most compounds.

This study did not attempt to evaluate the quality of water delivered to consumers; after withdrawal from the ground, water typically is treated, disinfected, and blended with other waters to maintain acceptable water quality. Regulatory

thresholds apply to treated water that is served to the consumer, not to raw ground water. However, to provide some context for the results, concentrations of constituents measured in the raw ground water were compared with health-based thresholds established by the U.S. Environmental Protection Agency (USEPA) and the California Department of Public Health (CDPH).

All detections of VOCs, pesticides, and pesticide degradates were below health-based thresholds, and most were less than one-hundredth of the threshold values. All detections of perchlorate, and radioactive constituents were below established thresholds. Arsenic, nitrate, and boron were the only constituents detected at concentrations above health-based thresholds in samples from the grid wells. Total dissolved solids, specific conductance, pH, iron, chloride, sulfate, and manganese were detected at concentrations above the SMCL-CA, a non-enforceable threshold set for aesthetic concerns, in samples from several of the grid wells.

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Table 1. Identification, sampling, and construction information for wells sampled for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.

[ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; ft, foot (feet); LSD, land surface datum; mm/dd/yy, month/day/year; na, not available; no., number; RICE, rice agriculture; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path]

GAMA identification no.	Sampling information		Well type	Construction information			
	Date (mm/dd/yy)	Sampling schedule[1]		Elevation of LSD (ft above NAVD88)[2]	Well depth (ft below LSD)	Top perforation (ft below LSD)	Bottom perforation (ft below LSD)
Grid wells							
ESAC-01	6/29/06	Fast	Production	76	278	150	252
ESAC-02	6/29/06	Fast	Production	38	160	140	160
ESAC-03	7/10/06	Intermediate	Production	176	272	110	150
ESAC-04	7/10/06	Fast	Production	154	200	140	200
ESAC-05	7/10/06	Intermediate	Production	77	410	207	395
ESAC-06	7/12/06	Intermediate	Production	182	260	148	260
ESAC-07	7/12/06	Fast	Production	153	220	80	220
ESAC-08	7/12/06	Fast	Production	89	108	68	108
ESAC-09	7/13/06	Fast	Production	129	554	140	554
ESAC-10	7/13/06	Intermediate	Production	60	316	96	303
ESAC-11	7/13/06	Intermediate	Production	68	520	220	510
ESAC-12	7/17/06	Intermediate	Production	107	375	0	370
ESAC-13	7/17/06	Fast	Production	207	355	na	na
ESAC-14	7/17/06	Fast	Production	47	280	140	280
ESAC-15	7/20/06	Intermediate	Production	197	500	200	480
ESAC-16	7/20/06	Intermediate	Production	297	560	240	540
ESAC-17	7/20/06	Intermediate	Production	52	200	150	na
ESAC-18	7/20/06	Intermediate	Production	220	560	240	540
ESAC-19	7/20/06	Intermediate	Production	48	265	185	265
ESAC-20	7/25/06	Fast	Production	84	354	212	354
ESAC-21	7/25/06	Intermediate	Production	53	na	na	na
ESAC-22	7/26/06	Intermediate	Production	105	90	na	na
ESAC-23	7/26/06	Fast	Production	93	72	na	na
ESAC-24	7/26/06	Fast	Production	94	327	84	318
ESAC-25	7/27/06	Slow	Production	264	570	290	550
ESAC-26	7/31/06	Slow	Production	37	200	160	200
ESAC-27	8/2/06	Slow	Production	54	135	65	125
ESAC-28	8/3/06	Slow	Production	92	360	102	360
ESAC-29	8/3/06	Intermediate	Production	31	223	199	215
ESAC-30	8/7/06	Intermediate	Production	43	na	na	na
ESAC-31	8/7/06	Intermediate	Production	62	235	48	235
ESAC-32	8/17/06	Intermediate	Production	66	140	64	124
ESAC-33	8/17/06	Fast	Production	212	335	na	na
ESAC-34	8/17/06	Intermediate	Production	102	60	na	na
ESAC-35	8/24/06	Intermediate	Production	114	558	74	558
WSAC-01	7/10/06	Fast	Production	446	na	na	na
WSAC-02	7/11/06	Fast	Production	179	na	na	na
WSAC-03	7/11/06	Slow	Production	274	na	115.5	253
WSAC-04	7/11/06	Intermediate	Production	452	880	320	880
WSAC-05	7/12/06	Fast	Production	367	236	136	236
WSAC-06	7/12/06	Intermediate	Production	485	na	na	na
WSAC-07[3]	7/18/06, 8/10/06	Fast	Production	152	220	71	200
WSAC-08	7/18/06	Slow	Production	248	180	56	170
WSAC-09[3]	7/18/06, 8/10/06	Fast	Production	222	na	na	na
WSAC-10[3]	7/18/06, 8/10/06	Intermediate	Production	187	225	145	225
WSAC-11[3]	7/19/06, 8/9/06	Intermediate	Production	142	570	240	561
WSAC-12	7/19/06	Slow	Production	52	490	na	na
WSAC-13	7/24/06	Fast	Production	87	na	na	na

Table 1. Identification, sampling, and construction information for wells sampled for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.—Continued

[ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; ft, foot (feet); LSD, land surface datum; mm/dd/yy, month/day/year; na, not available; no., number; RICE, rice agriculture; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path]

GAMA identification no.	Sampling information		Well type	Construction information			
	Date (mm/dd/yy)	Sampling schedule[1]		Elevation of LSD (ft above NAVD88)[2]	Well depth (ft below LSD)	Top perforation (ft below LSD)	Bottom perforation (ft below LSD)
WSAC-14	7/24/06	Intermediate	Production	62	159	157	159
WSAC-15	7/31/06	Intermediate	Production	147	610	280	610
WSAC-16	7/31/06	Fast	Production	30	332	313	na
WSAC-17	8/1/06	Intermediate	Production	32	260	230	260
WSAC-18	8/1/06	Slow	Production	85	402	160	380
WSAC-19	8/1/06	Fast	Production	37	364	348	356
WSAC-20	8/2/06	Fast	Production	81	340	253	340
WSAC-21	8/2/06	Intermediate	Production	168	369	237	256
WSAC-22	8/8/06	Intermediate	Production	358	870	408	870
WSAC-23	8/8/06	Fast	Production	43	56	31	56
WSAC-24	8/9/06	Fast	Production	75	185	165	185
WSAC-25	8/9/06	Intermediate	Production	45	na	na	na
WSAC-26	8/14/06	Intermediate	Production	413	330	110	330
WSAC-27	8/15/06	Fast	Production	65	300	140	300
WSAC-28	8/15/06	Intermediate	Production	292	165	145	165
WSAC-29	8/16/06	Intermediate	Production	142	759	173	651
WSAC-30	8/16/06	Intermediate	Production	121	na	na	na
WSAC-31	8/21/06	Intermediate	Production	60	260	145	245
WSAC-32	8/21/06	Fast	Production	93	180	110	180
WSAC-33	8/22/06	Fast	Production	88	205	na	na
WSAC-34	8/22/06	Intermediate	Production	144	197	60	180
WSAC-35	8/23/06	Intermediate	Production	143	410	100	410
WSAC-36	8/23/06	Intermediate	Production	82	260	160	260
Flow-path wells							
ESAC-FP-01	7/13/06	Intermediate	Production	51	750	580	720
ESAC-FP-02	8/21/06	Intermediate	Monitoring	181	na	na	na
ESAC-FP-03	8/23/06	Intermediate	Monitoring	105	130	98.8	109
ESAC-FP-04	8/23/06	Intermediate	Monitoring	107	583	509	562
ESAC-FP-05	8/24/06	Intermediate	Monitoring	105	100	80	90
ESAC-FP-06	8/24/06	Intermediate	Monitoring	105	380	340	350
ESAC-FP-07	8/25/06	Intermediate	Monitoring	105	555	520	530
WSAC-FP-01	8/14/06	Intermediate	Monitoring	312	na	na	na
WSAC-FP-02	8/15/06	Intermediate	Monitoring	257	421	390	400
WSAC-FP-03	8/15/06	Intermediate	Monitoring	257	310	270	290
WSAC-FP-04	8/16/06	Intermediate	Monitoring	131	200	138	180
WSAC-FP-05	8/16/06	Intermediate	Production	94	625	540	625
WSAC-FP-06	8/16/06	Intermediate	Monitoring	131	540	445	525
WSAC-FP-07	8/17/06	Intermediate	Monitoring	99	490	415	470
WSAC-FP-08	8/17/06	Intermediate	Monitoring	99	280	190	260
RICE wells							
RICE-01	7/17/06	RICE	Monitoring	24	50	40	45
RICE-02	7/18/06	RICE	Monitoring	38	44	34	39
RICE-03	7/18/06	RICE	Monitoring	43	35	25	30
RICE-04	7/18/06	RICE	Monitoring	88	35	25	30
RICE-05	7/19/06	RICE	Monitoring	126	35	25	30
RICE-06	7/19/06	RICE	Monitoring	138	35	25	30
RICE-07	7/20/06	RICE	Monitoring	91	45	35	40
RICE-08	7/20/06	RICE	Monitoring	88	35	25	30
RICE-09	7/24/06	RICE	Monitoring	70	34	24	28

Table 1. Identification, sampling, and construction information for wells sampled for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.—Continued

[ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; ft, foot (feet); LSD, land surface datum; mm/dd/yy, month/day/year; na, not available; no., number; RICE, rice agriculture; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path]

GAMA identification no.	Sampling information		Well type	Construction information			
	Date (mm/dd/yy)	Sampling schedule[1]		Elevation of LSD (ft above NAVD88)[2]	Well depth (ft below LSD)	Top perforation (ft below LSD)	Bottom perforation (ft below LSD)
RICE-10	7/24/06	RICE	Monitoring	80	35	25	30
RICE-11	7/25/06	RICE	Monitoring	127	35	25	30
RICE-12	7/25/06	RICE	Monitoring	98	35	25	30
RICE-13	7/26/06	RICE	Monitoring	110	35	25	30
RICE-14	7/26/06	RICE	Monitoring	82	36	26	30
RICE-15	7/27/06	RICE	Monitoring	100	35	25	30
RICE-16	7/27/06	RICE	Monitoring	82	35	25	30
RICE-17	8/15/06	RICE	Monitoring	57	35	25	30
RICE-18	8/16/06	RICE	Monitoring	99	38	28	34
RICE-19	8/16/06	RICE	Monitoring	74	38	28	34
RICE-20	8/17/06	RICE	Monitoring	24	29	19	24
RICE-21	9/12/06	RICE	Monitoring	76	35	25	30
RICE-22	9/13/06	RICE	Monitoring	51	35	25	30

[1] Sampling schedules are described in table 2.

[2] Land-surface datum (LSD) is a datum plane that is approximately at land surface at each well. The elevation of the LSD is described in feet above the North American Vertical Datum 1988.

[3] Well sampled twice (well was partially resampled to replace some sample containers lost in shipping prior to analysis).

Table 2. Classes of water-quality indicators, chemical constituents, and microbial constituents collected for the slow, intermediate, fast, and RICE well sampling schedules in the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.

[DO, dissolved oxygen; NDMA, *N*-nitrosodimethylamine; SC, specific conductance]

Analyte classes	Analyte list table	Slow schedule	Intermediate schedule	Fast schedule	RICE schedule
Water-quality indicators					
DO, SC, pH, temperature		X	X	X	X
Alkalinity, turbidity		X			X
Organic constituents					
Volatile organic compounds	3A	X	X	X	X
Gasoline additives and oxygenates	3B	X			
Pesticides and pesticide degradates	3C, 3D	X	X	X	X
Pharmaceutical compounds	3E	X	X		X
Constituents of special interest					
Perchlorate	3F	X	X	X	X
N-Nitrosodimethylamine (NDMA)	3F	X	X		
1,2,3-Trichloropropane (1,2,3-TCP)	3F	X	X		
Inorganic constituents					
Nutrients	3G	X	X		X
Dissolved organic carbon (DOC)	3G	X			X
Major and minor ions and trace elements	3H	X	X		X
Arsenic, iron, and chromium speciation	3I	X	X		X
Stable isotopes					
Stable isotopes of hydrogen and oxygen in water	3J	X	X	X	X
Stable isotopes of nitrogen and oxygen in nitrate	3J	X	X		
Stable isotopes of carbon and carbon-14 abundance	3J	X	X		
Radioactivity and gases					
Tritium	3J	X	X	X	
Tritium and noble gases	3K	X	X	X	X
Radium isotopes	3J	X			
Radon-222	3J	X			
Gross alpha and beta radiation	3J	X			
Microbial constituents					
Escherichia coliform and total coliform	3L	X			
F-specific and somatic coliphage	3L	X			

Table 3A. Volatile organic compounds, primary uses or sources, comparative thresholds, and reporting information for the U.S. Geological Survey's (USGS) National Water Quality Laboratory Schedule 2020.

[The five-digit USGS parameter code is used to uniquely identify a specific constituent or property. CAS, Chemical Abstracts Service; CDPH, California Department of Public Health; D, detected; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-CA, maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); na, not available; NL-CA, notification level (CDPH); RSD5-US, U.S. Environmental Protection Agency risk specific dose at a risk factor of 10^{-5} µg/L (RSD5s are calculated by dividing the 10^{-4} cancer risk concentration established by the USEPA by 10); THM, trihalomethane; USEPA, U.S. Environmental Protection Agency; µg/L, micrograms per liter; —, analyzed but not detected]

Constituent	Primary use or source	USGS parameter code	CAS number	LRL (µg/L)	Threshold type	Threshold value (µg/L)	Detection
Acetone	Solvent	81552	67-64-1	6	na	na	D
Acrylonitrile	Organic synthesis	34215	107-13-1	0.8	RSD5-US	0.6	—
Benzene	Gasoline hydrocarbon	34030	71-43-2	0.021	MCL-CA	1	D
Bromobenzene	Solvent	81555	108-86-1	0.028	na	na	—
Bromochloromethane	Fire retardant	77297	74-97-5	0.12	HAL-US	90	—
Bromodichloromethane	Disinfection by-product (THM)	32101	75-27-4	0.028	MCL-US[1]	80	D
Bromoform (Tribromomethane)	Disinfection by-product (THM)	32104	75-25-2	0.10	MCL-US[1]	80	D
2-Butanone (MEK, Methyl ethyl ketone)	Solvent	81595	78-93-3	2	HAL-US	4,000	D
n-Butylbenzene	Gasoline hydrocarbon	77342	104-51-8	0.12	NL-CA	260	—
sec-Butylbenzene	Gasoline hydrocarbon	77350	135-98-8	0.06	NL-CA	260	—
tert-Butylbenzene	Gasoline hydrocarbon	77353	98-06-6	0.06	NL-CA	260	—
Carbon disulfide	Organic synthesis	77041	75-15-0	0.038	NL-CA	160	D
Carbon tetrachloride (Tetrachloromethane)	Solvent	32102	56-23-5	0.06	MCL-CA	0.5	D
Chlorobenzene	Solvent	34301	108-90-7	0.028	MCL-CA	70	—
Chloroethane	Solvent	34311	75-00-3	0.12	na	na	—
Chloroform (Trichloromethane)	Disinfection by-product (THM)	32106	67-66-3	0.024	MCL-US[1]	80	D
Chloromethane	Refrigerant/organic synthesis	34418	74-87-3	0.17	HAL-US	30	D
3-Chloro-1-propene	Organic synthesis	78109	107-05-1	0.5	na	na	—
2-Chlorotoluene	Solvent	77275	95-49-8	0.04	NL-CA	140	—
4-Chlorotoluene	Solvent	77277	106-43-4	0.05	NL-CA	140	—
Dibromochloromethane	Disinfection by-product (THM)	32105	124-48-1	0.10	MCL-US[1]	80	D
1,2-Dibromo-3-chloropropane (DBCP)	Fumigant	82625	96-12-8	0.51	MCL-US	0.2	—
1,2-Dibromoethane (EDB)	Fumigant	77651	106-93-4	0.036	MCL-US	0.05	—
Dibromomethane	Solvent	30217	74-95-3	0.050	na	na	—
1,2-Dichlorobenzene	Solvent	34536	95-50-1	0.048	MCL-CA	600	—
1,3-Dichlorobenzene	Solvent	34566	541-73-1	0.03	HAL-US	600	—
1,4-Dichlorobenzene	Fumigant	34571	106-46-7	0.034	MCL-CA	5	—
trans-1,4-Dichloro-2-butene	Organic synthesis	73547	110-57-6	0.70	na	na	—
Dichlorodifluoromethane (CFC-12)	Refrigerant	34668	75-71-8	0.18	NL-CA	1,000	—
1,1-Dichloroethane	Solvent	34496	75-34-3	0.035	MCL-CA	5	D
1,2-Dichloroethane	Solvent	32103	107-06-2	0.13	MCL-CA	0.5	—
1,1-Dichloroethene (DCE)	Organic synthesis	34501	75-35-4	0.024	MCL-CA	6	—
cis-1,2-Dichloroethene	Solvent	77093	156-59-2	0.024	MCL-CA	6	D
trans-1,2-Dichloroethene	Solvent	34546	156-60-5	0.032	MCL-CA	10	D
Dichloromethane (Methylene chloride)	Solvent	34423	75-09-2	0.06	MCL-US	5	—
1,2-Dichloropropane	Fumigant	34541	78-87-5	0.029	MCL-US	5	—
1,3-Dichloropropane	Fumigant	77173	142-28-9	0.06	na	na	—
2,2-Dichloropropane	Fumigant	77170	594-20-7	0.05	na	na	—
1,1-Dichloropropene	Organic synthesis	77168	563-58-6	0.026	na	na	—
cis-1,3-Dichloropropene	Fumigant	34704	10061-01-5	0.05	RSD5-US[2]	4	—
trans-1,3-Dichloropropene	Fumigant	34699	10061-02-6	0.09	RSD5-US[2]	4	—
Diethyl ether	Solvent	81576	60-29-7	0.08	na	na	—
Diisopropyl ether (DIPE)	Gasoline oxygenate	81577	108-20-3	0.10	na	na	—
Ethylbenzene	Gasoline hydrocarbon	34371	100-41-4	0.030	MCL-CA	300	—
Ethyl *tert*-butyl ether (ETBE)	Gasoline oxygenate	50004	637-92-3	0.030	na	na	—

Table 3A. Volatile organic compounds, primary uses or sources, comparative thresholds, and reporting information for the U.S. Geological Survey's (USGS) National Water Quality Laboratory Schedule 2020.—Continued

[The five-digit USGS parameter code is used to uniquely identify a specific constituent or property. CAS, Chemical Abstracts Service; CDPH, California Department of Public Health; D, detected; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-CA, maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); na, not available; NL-CA, notification level (CDPH); RSD5-US, U.S. Environmental Protection Agency risk specific dose at a risk factor of 10^{-5} µg/L (RSD5s are calculated by dividing the 10^{-4} cancer risk concentration established by the USEPA by 10); THM, trihalomethane; USEPA, U.S. Environmental Protection Agency; µg/L, micrograms per liter; —, analyzed but not detected]

Constituent	Primary use or source	USGS parameter code	CAS number	LRL (µg/L)	Threshold type	Threshold value (µg/L)	Detection
Ethyl methacrylate	Organic synthesis	73570	97-63-2	0.18	na	na	—
1-Ethyl-2-methylbenzene (*o*-Ethyl toluene)	Gasoline hydrocarbon	77220	611-14-3	0.06	na	na	D
Hexachlorobutadiene	Organic synthesis	39702	87-68-3	0.14	RSD5-US	90	—
Hexachloroethane	Solvent	34396	67-72-1	0.14	HAL-US	1	—
2-Hexanone (*n*-Butyl methyl ketone)	Solvent	77103	591-78-6	0.4	na	na	—
Isopropylbenzene (Cumene)	Gasoline hydrocarbon	77223	98-82-8	0.038	NL-CA	770	—
4-Isopropyl-1-methylbenzene	Gasoline hydrocarbon	77356	99-87-6	0.08	na	na	D
Methyl acrylate	Organic synthesis	49991	96-33-3	1.0	na	na	—
Methyl acrylonitrile	Organic synthesis	81593	126-98-7	0.40	na	na	—
Methyl bromide (Bromomethane)	Fumigant	34413	74-83-9	0.33	HAL-US	10	—
Methyl *tert*-butyl ether (MTBE)	Gasoline oxygenate	78032	1634-04-4	0.10	MCL-CA	13	D
Methyl iodide (Iodomethane)	Organic synthesis	77424	74-88-4	0.50	na	na	—
Methyl isobutyl ketone (MIBK)	Solvent	78133	108-10-1	0.37	NL-CA	120	—
Methyl methacrylate	Organic synthesis	81597	80-62-6	0.20	na	na	—
Methyl *tert*-pentyl ether (*tert*-Amyl methyl ether, TAME)	Gasoline oxygenate	50005	994-05-8	0.04	na	na	—
Naphthalene	Gasoline hydrocarbon	34696	91-20-3	0.52	NL-CA	17	—
n-Propylbenzene	Solvent	77224	103-65-1	0.042	NL-CA	260	—
Styrene	Gasoline hydrocarbon	77128	100-42-5	0.042	MCL-US	100	—
1,1,1,2-Tetrachloroethane	Solvent	77562	630-20-6	0.03	HAL-US	70	—
1,1,2,2-Tetrachloroethane	Solvent	34516	79-34-5	0.08	MCL-CA	1	—
Tetrachloroethene (PCE)	Solvent	34475	127-18-4	0.030	MCL-US	5	D
Tetrahydrofuran	Solvent	81607	109-99-9	1.2	na	na	—
1,2,3,4-Tetramethylbenzene	Gasoline hydrocarbon	49999	488-23-3	0.14	na	na	D
1,2,3,5-Tetramethylbenzene	Gasoline hydrocarbon	50000	527-53-7	0.18	na	na	D
Toluene	Gasoline hydrocarbon	34010	108-88-3	0.02	MCL-CA	150	D
1,2,3-Trichlorobenzene	Organic synthesis	77613	87-61-6	0.18	na	na	—
1,2,4-Trichlorobenzene	Solvent	34551	120-82-1	0.12	MCL-CA	5	—
1,1,1-Trichloroethane (TCA)	Solvent	34506	71-55-6	0.032	MCL-US	200	—
1,1,2-Trichloroethane	Solvent	34511	79-00-5	0.04	MCL-US	5	—
Trichloroethene (TCE)	Solvent	39180	79-01-6	0.038	MCL-US	5	D
Trichlorofluoromethane (CFC-11)	Refrigerant	34488	75-69-4	0.08	MCL-CA	150	D
1,2,3-Trichloropropane (1,2,3-TCP)	Solvent/organic synthesis	77443	96-18-4	0.18	NL-CA	0.005	—
1,1,2-Trichloro-1,2,2-trifluoroethane (CFC-113)	Refrigerant	77652	76-13-1	0.038	MCL-CA	1,200	—
1,2,3-Trimethylbenzene	Gasoline hydrocarbon	77221	526-73-8	0.09	na	na	—
1,2,4-Trimethylbenzene	Gasoline hydrocarbon	77222	95-63-6	0.056	NL-CA	330	D
1,3,5-Trimethylbenzene	Organic synthesis	77226	108-67-8	0.044	NL-CA	330	D
Vinyl bromide (Bromoethene)	Fire retardant	50002	593-60-2	0.10	na	na	—
Vinyl chloride (Chloroethene)	Organic synthesis	39175	75-01-4	0.08	MCL-CA	0.5	—
m- and *p*-Xylene	Gasoline hydrocarbon	85795	108-38-3 / 106-42-3	0.06	MCL-CA	1,750	D
o-Xylene	Gasoline hydrocarbon	77135	95-47-6	0.038	MCL-CA	1,750	—

[1] The MCL-US and MCL-CA thresholds for trihalomethanes are the sum of chloroform, bromoform, bromodichloromethane, and dibromochloromethane.

[2] The RSD5 threshold for 1,3-dichloropropene is the sum of its isomers (*cis* and *trans*).

Table 3B. Gasoline oxygenates and their degradates, primary uses or sources, comparative thresholds, and reporting information for the U.S. Geological Survey's (USGS) National Water Quality Laboratory Schedule 4024.

[The five-digit USGS parameter code is used to uniquely identify a specific constituent or property. CAS, Chemical Abstracts Service; CDPH, California Department of Public Health; D, detected; DLR-CA, detection level for the purpose of reporting (CDPH); LRL, laboratory reporting level; MCL-US, maximum contaminant level (USEPA); na, not available; NL-CA, notification level (CDPH); USEPA, U.S. Environmental Protection Agency; µg/L, micrograms per liter; —, analyzed but not detected]

Constituent	Primary use or source	USGS parameter code	CAS number	LRL (µg/L)	Threshold type	Threshold value (µg/L)	Detection
Acetone	Degradate	81552	67-64-1	1.8	na	na	D
tert-Amyl alcohol	Gasoline oxygenate	77073	75-85-4	1	na	na	—
tert-Butyl alcohol (TBA)	Oxygenate/degradate	77035	75-65-0	1	NL-CA	12	—
Diisopropyl ether	Gasoline oxygenate	81577	108-20-3	0.04	na	na	—
Ethyl *tert*-butyl ether (ETBE)	Gasoline oxygenate	50004	637-92-3	0.06	DLR-CA	3	—
Methyl acetate	Degradate	77032	79-20-9	0.43	na	na	—
Methyl *tert*-butyl ether (MTBE)	Gasoline oxygenate	78032	1634-04-4	0.05	MCL-US	13	D
Methyl *tert*-pentyl ether	Gasoline oxygenate	50005	994-05-8	0.05	DLR-CA	3	—

Table 3C. Pesticides and pesticide degradates, primary uses or sources, comparative thresholds, and reporting information for the U.S. Geological Survey's (USGS) National Water Quality Laboratory Schedules 2032 and 2033.

[The five-digit USGS parameter code is used to uniquely identify a specific constituent or property. Rice wells were sampled for Schedule 2033, whereas all other wells were sampled for Schedule 2032. CAS, Chemical Abstracts Service; CDPH, California Department of Public Health; D, detected; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-CA, maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); na, not available; RSD5-US, U.S. Environmental Protection Agency risk specific dose at a risk factor of 10^{-5} µg/L (RSD5s are calculated by dividing the 10^{-4} cancer risk concentration established by the USEPA by 10); USEPA, U.S. Environmental Protection Agency; µg/L, micrograms per liter; —, analyzed but not detected]

Constituent[1]	Primary use or source	USGS parameter code	CAS number	LRL (µg/L)	Type of comparison threshold	Threshold (µg/L)	Detection
Acetochlor	Herbicide	49260	34256-82-1	0.006	na	na	D
Alachlor	Herbicide	46342	15972-60-8	0.005	MCL-US	2	—
Atrazine	Herbicide	39632	1912-24-9	0.007	MCL-CA	1	D
Azinphos-methyl	Insecticide	82686	86-50-0	0.05	na	na	—
Azinphos-methyl-oxon	Degradate	61635	961-22-8	0.042	na	na	—
Benfluralin	Herbicide	82673	1861-40-1	0.01	na	na	—
Carbaryl	Insecticide	82680	63-25-2	0.041	RSD5	400	D
Carbofuran	Herbicide	82674	1563-66-2	0.02	MCL-CA	18	—
2-Chloro-2,6-diethylacetanilide	Degradate	61618	6967-29-9	0.0065	na	na	—
2-Chloro-4-isopropylamino-6-amino-s-triazine (deethylatrazine)	Degradate	04040	6190-65-4	0.014	na	na	D
4-Chloro-2-methylphenol	Degradate	61633	1570-64-5	0.005	na	na	—
Chlorpyrifos	Insecticide	38933	2921-88-2	0.005	HAL-US	2	D
Chlorpyrofos, oxygen analog	Degradate	61636	5598-15-2	0.0562	na	na	—
Cyanazine[2]	Herbicide	04041	21725-46-2	0.018	HAL-US	1	—
Cyfluthrin	Insecticide	61585	68359-37-5	0.053	na	na	—
λ-Cyhalothrin	Insecticide	61595	91465-08-6	0.014	na	na	—
Cypermethrin	Insecticide	61586	52315-07-8	0.046	na	na	—
DCPA (Dacthal) monoacid	Herbicide	82682	1861-32-1	0.003	HAL-US	70	—
Desulfinylfipronil	Degradate	62170	na	0.012	na	na	D
Desulfinylfipronil amide	Degradate	62169	na	0.029	na	na	—
Diazinon	Insecticide	39572	333-41-5	0.005	HAL-US	1	—
3,4-Dichloroaniline	Degradate	61625	95-76-1	0.0045	na	na	D
3,5-Dichloroaniline[2]	Degradate	61627	626-43-7	0.012	na	na	—
Dichlorvos	Fumigant	38775	62-73-7	0.013	na	na	—
Dicrotophos	Insecticide	38454	141-66-2	0.0843	na	na	—
Dieldrin	Insecticide	39381	60-57-1	0.009	RSD5	0.2	—
2,6-Diethylaniline	Degradate	82660	579-66-8	0.006	na	na	—
Dimethoate	Insecticide	82662	60-51-5	0.0061	na	na	—
Disulfoton[2]	Insecticide	82677	298-04-4	0.021	HAL-US	0.7	—
Disulfoton sulfone[2]	Degradate	61640	218208	0.014	na	na	—
α-Endosulfan[2]	Insecticide	34362	959-98-8	0.011	na	na	—
Endosulfan sulfate[2]	Degradate	61590	1031-07-8	0.022	na	na	—
EPTC[2]	Herbicide	82668	759-94-4	0.004	na	na	—
Ethion	Insecticide	82346	563-12-2	0.016	na	na	—
Ethion monoxon	Degradate	61644	17356-42-2	0.021	na	na	—
Ethoprophos[2]	Insecticide	82672	13194-48-4	0.012	na	na	—
2-Ethyl-6-methylaniline	Degradate	61620	24549-06-2	0.01	na	na	—
Fenamiphos	Insecticide	61591	22224-92-6	0.029	HAL-US	0.7	—
Fenamiphos sulfone	Degradate	61645	31972-44-8	0.053	na	na	—
Fenamiphos sulfoxide	Degradate	61646	31972-43-7	0.04	na	na	—
Fipronil	Insecticide	62166	120068-37-3	0.016	na	na	D
Fipronil sulfide	Degradate	62167	120067-83-6	0.013	na	na	D
Fipronil sulfone	Degradate	62168	120068-36-2	0.024	na	na	D
Fonofos	Insecticide	04095	944-22-9	0.0053	HAL-US	10	—
Hexazinone	Herbicide	04025	51235-04-2	0.026	HAL-US	400	D
Isofenphos	Insecticide	61594	25311-71-1	0.011	na	na	—
Malaoxon	Degradate	61652	1634-78-2	0.039	na	na	—

Table 3C. Pesticides and pesticide degradates, primary uses or sources, comparative thresholds, and reporting information for the U.S. Geological Survey's (USGS) National Water Quality Laboratory Schedules 2032 and 2033.—Continued

[The five-digit USGS parameter code is used to uniquely identify a specific constituent or property. Rice wells were sampled for Schedule 2033, whereas all other wells were sampled for Schedule 2032. CAS, Chemical Abstracts Service; CDPH, California Department of Public Health; D, detected; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-CA, maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); na, not available; RSD5-US, U.S. Environmental Protection Agency risk specific dose at a risk factor of 10^{-5} µg/L (RSD5s are calculated by dividing the 10^{-4} cancer risk concentration established by the USEPA by 10); USEPA, U.S. Environmental Protection Agency; µg/L, micrograms per liter; —, analyzed but not detected]

Constituent[1]	Primary use or source	USGS parameter code	CAS number	LRL (µg/L)	Type of comparison threshold	Threshold (µg/L)	Detection
Malathion	Insecticide	39532	121-75-5	0.027	HAL-US	100	—
Metalaxyl	Fungicide	61596	57837-19-1	0.0069	na	na	—
Methidathion	Insecticide	61598	950-37-8	0.0087	na	na	—
Methyl paraoxon[2]	Degradate	61664	950-35-6	0.019	na	na	—
Methyl parathion	Insecticide	82667	298-00-0	0.015	HAL-US	1	—
Metolachlor	Herbicide	39415	51218-45-2	0.006	HAL-US	700	D
Metribuzin	Herbicide	82630	21087-64-9	0.028	HAL-US	70	—
Molinate	Herbicide	82671	2212-67-1	0.003	MCL-CA	20	D
Myclobutanil	Fungicide	61599	88671-89-0	0.033	na	na	—
1-Naphthol	Degradate	49295	90-15-3	0.0882	na	na	—
Oxyfluorfen[2]	Herbicide	61600	42874-03-3	0.017	na	na	—
Pendimethalin	Herbicide	82683	40487-42-1	0.022	na	na	—
cis-Permethrin	Insecticide	82687	54774-45-7	0.006	na	na	—
Phorate	Insecticide	82664	298-02-2	0.055	na	na	—
Phorate oxygen analog	Degradate	61666	2600-69-3	0.027	na	na	—
Phosmet	Insecticide	61601	732-11-6	0.0079	na	na	D
Phosmet oxon	Degradate	61668	3735-33-9	0.0511	na	na	D
Prometon	Herbicide	04037	1610-18-0	0.01	HAL-US	100	—
Prometryn	Herbicide	04036	7287-19-6	0.0059	na	na	—
Pronamide	Herbicide	82676	23950-58-5	0.004	RSD5	200	—
Propargite[2]	Insecticide	82685	2312-35-8	0.023	na	na	—
Propanil	Herbicide	82679	709-98-8	0.011	na	na	D
cis-Propiconazole	Fungicide	79846	60207-90-1	0.013	na	na	D
trans-Propiconazole	Fungicide	79847	60207-90-1	0.034	na	na	D
Simazine	Herbicide	04035	122-34-9	0.005	MCL-US	4	D
Tebuconazole[2]	Fungicide	62852	107534-96-3	0.0136	na	na	—
Tebuthiuron	Herbicide	82670	34014-18-1	0.016	HAL-US	500	D
Tefluthrin[2]	Insecticide	61606	79538-32-2	0.0033	na	na	—
Terbufos	Insecticide	82675	13071-79-9	0.017	HAL-US	0.4	—
Terbufos oxygen analog sulfone	Degradate	61674	56070-15-6	0.045	na	na	—
Terbuthylazine	Herbicide	04022	5915-41-3	0.0083	na	na	—
Thiobencarb	Herbicide	82681	28249-77-6	0.01	MCL-CA	70	—
Tribufos	Herbicide	61610	78-48-8	0.035	na	na	—
Trifluralin	Herbicide	82661	1582-09-8	0.009	HAL-US	10	—

[1] Constituents on both Schedules 2032 and 2033 unless noted otherwise.

[2] Constituent on Schedule 2033 only.

Table 3D. Pesticides and pesticide degradates, primary uses or sources, comparative thresholds, and reporting information for the U.S. Geological Survey's (USGS) National Water Quality Laboratory Schedule 2060.

[The five-digit USGS parameter code is used to uniquely identify a specific constituent or property. CAS, Chemical Abstracts Service; CDPH, California Department of Public Health; D, detected; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-CA, maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); RSD5-US, U.S. Environmental Protection Agency risk specific dose at a risk factor of 10^{-5} µg/L (RSD5s are calculated by dividing the 10^{-4} cancer risk concentration established by the USEPA by 10); USEPA, U.S. Environmental Protection Agency; µg/L, micrograms per liter; —, analyzed but not detected]

Constituent	Primary use or source	USGS parameter code	CAS number	LRL (µg/L)	Type of comparison threshold	Threshold (µg/L)	Detection
Acifluorfen	Herbicide	49315	50594-66-6	0.028	na	na	—
Aldicarb	Insecticide	49312	116-06-3	0.15	MCL-US	3	—
Aldicarb sulfone	Insecticide/degradate	49313	1646-88-4	0.018	MCL-US	2	—
Aldicarb sulfoxide	Degradate	49314	1646-87-3	0.1	MCL-US	4	—
Atrazine	Herbicide	39632	1912-24-9	0.008	MCL-CA	1	D
Bendiocarb	Insecticide	50299	22781-23-3	0.08	na	na	—
Benomyl	Fungicide	50300	17804-35-2	0.022	na	na	—
Bensulfuron-methyl	Herbicide	61693	83055-99-6	0.018	na	na	D
Bentazon	Herbicide	38711	25057-89-0	0.024	MCL-CA	18	D
Bromacil	Herbicide	04029	314-40-9	0.018	HAL-US	70	—
Bromoxynil	Herbicide	49311	1689-84-5	0.044	na	na	—
Caffeine	Beverages	50305	58-08-2	0.018	na	na	—
Carbaryl	Insecticide	49310	63-25-2	0.018	RSD5	400	D
Carbofuran	Herbicide	49309	1563-66-2	0.016	MCL-CA	18	—
Chloramben, methyl ester	Herbicide	61188	7286-84-2	0.024	na	na	—
Chlorimuron-ethyl	Herbicide	50306	90982-32-4	0.032	na	na	D
2-Chloro-6-ethylamino-4-amino-*s*-triazine (deisopropylatrazine)	Degradate	04038	1007-28-9	0.08	na	na	D
2-Chloro-4-isopropylamino-6-amino-*s*-triazine (deethylatrazine)	Degradate	04040	6190-65-4	0.028	na	na	D
3-(4-Chlorophenyl)-1-methyl urea	Degradate	61692	5352-88-5	0.036	na	na	—
Clopyralid	Herbicide	49305	1702-17-6	0.067	na	na	—
Cycloate	Herbicide	04031	1134-23-2	0.014	na	na	—
DCPA (Dactal) monoacid	Degradate	49304	887-54-7	0.028	na	na	—
Dicamba	Herbicide	38442	1918-00-9	0.036	HAL-US	400	—
2,4-D and 2,4-D methyl ester, summed on molar basis, reported as 2,4-D	Herbicide	66496	94-75-7	0.009	MCL-US	70	D
4-(2,4-Dichlorophenoxy)butyric acid (2,4-DB)	Herbicide	38746	94-82-6	0.020	na	na	—
Dichlorprop	Herbicide	49302	120-36-5	0.028	na	na	—
Dinoseb	Herbicide	49301	88-85-7	0.038	MCL-US	7	D
Diphenamid	Herbicide	04033	957-51-7	0.010	HAL-US	200	—
Diuron	Herbicide	49300	330-54-1	0.016	RSD5	200	D
Fenuron	Herbicide	49297	101-42-8	0.01	na	na	—
Flumetsulam	Herbicide	61694	98967-40-9	0.04	na	na	—
Fluometuron	Herbicide	38811	2164-17-2	0.016	HAL-US	90	—
3-Hydroxycarbofuran	Degradate	49308	16655-82-6	0.008	na	na	—
2-Hydroxy-4-isopropylamino-6-ethylamino-*s*-triazine (hydroxyatrazine)	Degradate	50355	2163-68-0	0.032	na	na	D
Imazaquin	Herbicide	50356	81335-37-7	0.036	na	na	—
Imazethapyr	Herbicide	50407	81335-77-5	0.038	na	na	—
Imidacloprid	Insecticide	61695	138261-41-3	0.02	na	na	—
Linuron	Herbicide	38478	330-55-2	0.014	na	na	—
Metalaxyl	Fungicide	50359	57837-19-1	0.03	na	na	—
Methiocarb	Insecticide	38501	2032-65-7	0.034	na	na	—
Methomyl	Insecticide	49296	16752-77-5	0.07	HAL-US	200	—
2-Methyl-4-chlorophenoxyacetic acid (MCPA)	Herbicide	38482	94-74-6	0.07	HAL-US	4	D

Table 3D. Pesticides and pesticide degradates, primary uses or sources, comparative thresholds, and reporting information for the U.S. Geological Survey's (USGS) National Water Quality Laboratory Schedule 2060.—Continued

[The five-digit USGS parameter code is used to uniquely identify a specific constituent or property. CAS, Chemical Abstracts Service; CDPH, California Department of Public Health; D, detected; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-CA, maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); RSD5-US, U.S. Environmental Protection Agency risk specific dose at a risk factor of 10^{-5} µg/L (RSD5s are calculated by dividing the 10^{-4} cancer risk concentration established by the USEPA by 10); USEPA, U.S. Environmental Protection Agency; µg/L, micrograms per liter; —, analyzed but not detected]

Constituent	Primary use or source	USGS parameter code	CAS number	LRL (µg/L)	Type of comparison threshold	Threshold (µg/L)	Detection
4-(2-Methyl-4-chlorophenoxy) butyric acid (MCPB)	Herbicide	38487	94-81-5	0.1	na	na	—
Metsulfuron methyl[1]	Herbicide	61697	74223-64-6	0.067	na	na	—
Neburon	Herbicide	49294	555-37-3	0.012	na	na	—
Nicosulfuron	Herbicide	50364	111991-09-4	0.04	na	na	—
Norflurazon	Herbicide	49293	27314-13-2	0.02	na	na	—
Oryzalin	Herbicide	49292	19044-88-3	0.023	na	na	—
Oxamyl	Insecticide	38866	23135-22-0	0.05	MCL-CA	50	—
Picloram	Herbicide	49291	1918-02-01	0.032	MCL-US	500	—
Propham	Herbicide	49236	122-42-9	0.03	HAL-US	100	—
Propiconazole	Fungicide	50471	60207-90-1	0.01	na	na	D
Propoxur	Insecticide	38538	114-26-1	0.008	na	na	—
Siduron	Herbicide	38548	1982-49-6	0.02	na	na	—
Sulfometuron-methyl	Herbicide	50337	74222-97-2	0.09	na	na	—
Tebuthiuron	Herbicide	82670	34014-18-1	0.026	HAL-US	500	D
Terbacil	Herbicide	04032	5902-51-2	0.026	HAL-US	90	—
Triclopyr	Herbicide	49235	55335-06-3	0.026	na	na	D

[1] These constituents were reported using method reporting levels (MRLs) during the period of this study.

Table 3E. Pharmaceutical compounds, primary uses or sources, comparative thresholds, and reporting information for the U.S. Geological Survey's (USGS) National Water Quality Laboratory Schedule 2080.

[The five-digit USGS parameter code is used to uniquely identify a specific constituent or property. Thresholds and threshold values as of February 10, 2007. CAS, Chemical Abstracts Service; MDL, method detection limit; na, not available; µg/L, micrograms per liter]

Constituent	Primary use or source	USGS parameter code	CAS number	MDL[1] (µg/L)	Threshold type	Threshold value (µg/L)
Acetaminophen	Analgesic	62000	103-90-2	0.60	na	na
Albuterol	Anti-inflammatory; bronchodilator	62020	18559-94-9	0.03	na	na
Caffeine	Stimulant	50305	58-08-2	0.40	na	na
Carbamazapine	Anticonvulsant; mood stabilizer	62793	298-46-4	0.02	na	na
Codeine	Opiod narcotic	62003	76-57-3	0.02	na	na
Cotinine	Nicotine metabolite	62005	486-56-6	0.03	na	na
Dehydronifedipine	Antianginal metabolite	62004	67035-22-7	0.03	na	na
Diltiazem	Antianginal; antihypertensive	62008	42399-41-7	0.02	na	na
Diphenhydramine	Antihistamine	62796	58-73-1	0.03	na	na
Paraxanthine	Caffeine metabolite	62030	611-59-6	0.10	na	na
Sulfamethoxazole	Antibacterial, antiprotozoal	62021	723-46-6	0.05	na	na
Thiabendazole	Anthelmintic	62801	148-79-8	0.02	na	na
Trimethoprim	Antibacterial	62023	738-70-5	0.01	na	na
Warfarin	Anticoagulant	62024	81-81-2	0.03	na	na

[1]The California Groundwater Ambient Monitoring and Assessment (GAMA) program uses more conservative reporting limits for the pharmaceutical compounds than recommended by the USGS's National Water Quality Laboratory. For albuterol, carbamazepine, codeine, dehydronifedipine, diltiazem, sulfamethoxazole, thiabendazole, trimethoprim, and warfarin, the MDL corresponds to the long-term method detection limit determined by the USGS's Branch of Quality Systems in October 2007 (BQS LT-MDL). For acetaminophen, caffeine, cotinine, diphenhydramine, and paraxanthine, the MDL corresponds to the effective method detection limit determined from assessment of quality-control data associated with GAMA samples collected from May 2004 to September 2007 (GAMA E-MDL). The GAMA E-MDL is higher than the BQS LT-MDL for those compounds. Detections reported by the USGS's National Water Quality Laboratory with concentrations lower than the BQS LT-MDL or GAMA E-MDL are reported as nondetections by the GAMA program.

Table 3F. Constituents of special interest, primary uses or sources, comparative thresholds, and reporting information for the Montgomery Watson Harza laboratory.

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. Thresholds and threshold values as of October 18, 2007. The laboratory entity code for the Montgomery Watson Harza laboratory in the USGS's National Water Information System (NWIS) is CA-MWHL. CAS, Chemical Abstracts Service; CDPH, California Department of Public Health; D, detected; HAL-CA, Lifetime Health Advisory Level (CDPH); MCL-CA, maximum contaminant level (CDPH); MRL, minimum reporting level; NL-CA, notification level (CDPH); µg/L, micrograms per liter; —, not detected]

Constituent	Primary use or source	USGS parameter code	CAS number	MRL (µg/L)	Threshold type	Threshold value (µg/L)	Detection
Perchlorate	Rocket fuel, fireworks, flares	61209	14797-73-0	0.5	MCL-CA	6	D
1,2,3-Trichloropropane (1,2,3-TCP)	Fumigant, solvent	77443	96-18-4	0.005	HAL-CA	40	—
N-Nitrosodimethylamine (NDMA)	Rocket fuel, plasticizer	64176	62-75-9	0.002	NL-CA	10	—

Table 3G. Nutrients and dissolved organic carbon, comparative thresholds, and reporting information for the U.S. Geological Survey's (USGS) National Water Quality Laboratory Schedule 2755 and parameter code 2613.

[The five-digit USGS parameter code is used to uniquely identify a specific constituent or property. CAS, Chemical Abstracts Service; D, detected; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-US, maximum contaminant level (USEPA); mg/L, milligrams per liter; na, not available; USEPA, U.S. Environmental Protection Agency]

Constituent	USGS parameter code	CAS number	LRL (mg/L)	Threshold type	Threshold value (mg/L)	Detection
Ammonia (as nitrogen)	00608	7664-41-7	0.01	HAL-US	30	D
Nitrate plus nitrite (as nitrogen)	00631	na	0.06	MCL-US	10	D
Nitrite (as nitrogen)	00613	14797-65-0	0.002	MCL-US	1	D
Total nitrogen (ammonia + nitrate + nitrite + organic nitrogen as nitrogen)	62854	17778-88-0	0.06	na	na	D
Orthophosphate (as phosphorus)	00671	14265-44-2	0.006	na	na	D
Dissolved organic carbon (DOC)	00681	na	0.33	na	na	D

Table 3H. Major and minor ions and trace elements, comparative thresholds, and reporting information for the U.S. Geological Survey's (USGS) National Water Quality Laboratory Schedule 1948.

[The five-digit USGS parameter code is used to uniquely identify a specific constituent or property. AL-US, action level (USEPA); CAS, Chemical Abstracts Service; CDPH, California Department of Public Health; D, detected; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-CA, maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); mg/L, milligrams per liter; na, not available; NL-CA, notification level (CDPH); SMCL-CA, secondary maximum contaminant level (CDPH); USEPA, U.S. Environmental Protection Agency; µg/L, micrograms per liter; —, not detected]

Constituent	USGS parameter code	CAS number	LRL	Threshold type	Threshold value	Detection
Major and minor ions (mg/L)						
Bromide	71870	24959-67-9	0.02	na	na	D
Calcium	00915	7440-70-2	0.02	na	na	D
Chloride	00940	16887-00-6	0.2	SMCL-CA	250 (500)[1]	D
Fluoride	00950	16984-48-8	0.1	MCL-CA	2	D
Iodide	78165	7553-56-2	0.002	na	na	D
Magnesium	00925	7439-95-4	0.008	na	na	D
Potassium	00935	7440-09-7	0.16	na	na	D
Silica	00955	7631-86-9	0.04	na	na	D
Sodium	00930	7440-23-5	0.2	na	na	D
Sulfate	00945	14808-79-8	0.18	SMCL-CA	250 (500)[1]	D
Total dissolved solids (TDS)	70300	na	10	SMCL-US	500 (1,000)[1]	D
Trace elements (µg/L)						
Aluminum	01106	7429-90-5	1.6	MCL-CA	1,000	D
Antimony	01095	7440-36-0	0.2	MCL-US	6	D
Arsenic	01000	7440-38-2	0.12	MCL-US	10	D
Barium	01005	7440-39-3	0.2	MCL-CA	1,000	D
Beryllium	01010	7440-41-7	0.06	MCL-US	4	—
Boron	01020	7440-42-8	8	NL-CA	1,000	D
Cadmium	01025	7440-43-9	0.04	MCL-US	5	D
Chromium	01030	7440-47-3	0.4	MCL-CA	50	D
Cobalt	01035	7440-48-4	0.04	na	na	D
Copper	01040	7440-50-8	0.4	AL-US	1,300	D
Iron	01046	7439-89-6	6	SMCL-CA	300	D
Lead	01049	7439-92-1	0.08	AL-US	15	D
Lithium	01130	7439-93-2	0.6	na	na	D
Manganese	01056	7439-96-5	0.2	SMCL-CA	50	D
Mercury	71890	7439-97-6	0.01	MCL-US	2	—
Molybdenum	01060	7439-98-7	0.4	HAL-US	40	D
Nickel	01065	7440-02-0	0.06	MCL-CA	100	D
Selenium	01145	7782-49-2	0.8	MCL-US	50	D
Silver	01075	7440-22-4	0.2	SMCL-CA	100	—
Strontium	01080	7440-24-6	0.4	HAL-US	4,000	D
Thallium	01057	7440-28-0	0.04	MCL-US	2	D
Tungsten	01155	7440-33-7	0.06	na	na	D
Uranium	22703	7440-61-1	0.04	MCL-US	30	D
Vanadium	01085	7440-62-2	0.1	NL-CA	50	D
Zinc	01090	7440-66-6	0.6	SMCL-US	5,000	D

[1] The recommended SMCL-CA thresholds for chloride, sulfate, and TDS are listed with the upper SMCL-CA thresholds in parentheses.

Table 3I. Arsenic, chromium, and iron species, comparative thresholds, and reporting information for the U.S. Geological Survey's (USGS) Trace Metal Laboratory, Boulder, Colorado.

[The five-digit USGS parameter code is used to uniquely identify a specific constituent or property. The laboratory entity code for the USGS Trace Metal Laboratory in the USGS's National Water Information System (NWIS) is USGSTMCO. CAS, Chemical Abstracts Service; CDPH, California Department of Public Health; D, detected; MCL-CA, maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); MDL, method detection limit; na, not available; SMCL-CA, secondary maximum contaminant level (CDPH); USEPA, U.S. Environmental Protection Agency; µg/L, micrograms per liter]

Constituent (valence state)	USGS parameter code	CAS number	MDL (µg/L)	Threshold type	Threshold level (µg/L)	Detection
Inorganic Arsenic(III)	99034	22569-72-8	1	na	na	D
Inorganic Arsenic(Total)	99033	7440-38-2	0.5	MCL-US	10	D
Chromium(VI)	01032	18540-29-9	1	na	na	D
Chromium(Total)	01030	7440-47-3	1	MCL-CA	50	D
Iron(II)	01047	7439-89-6	2	na	na	D
Iron(Total)	01046	7439-89-6	2	SMCL-CA	300	D

Table 3J. Isotopic and radioactive constituents, comparative thresholds, and reporting information for laboratories.

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. The laboratory entity codes for the laboratories in the USGS's National Water Information System (NWIS) listed in the footnotes are shown in parentheses following the laboratory name. Stable isotope ratios are reported in the standard delta notation (δ), the ratio of a heavier isotope to more common lighter isotope of that element, relative to a standard reference material. CAS, Chemical Abstracts Service; CDPH, California Department of Public Health; D, detected; hr, hour; MCL-CA, maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); MRL, minimum reporting level; MU, method uncertainty; na, not available; pCi/L, picocuries per liter; SSMDC, sample-specific minimum detectable concentration; USEPA, U.S. Environmental Protection Agency; —, not detected]

Constituent	USGS parameter code	CAS number	Reporting level type	Reporting level or uncertainty	Threshold type[1]	Threshold value	Detection
Stable isotope ratios (per mil)							
$\delta^{2}H$ of water[2]	82082	na	MU	2	na	na	D
$\delta^{18}O$ of water[2]	82085	na	MU	0.20	na	na	D
$\delta^{15}N$ of nitrate[2]	82690	na	MU	0.50	na	na	D
$\delta^{18}O$ of nitrate[2]	63041	na	MU	1.00	na	na	D
$\delta^{13}O$ of dissolved carbonates[3]	82081	na	1 sigma	0.05	na	na	D
Radioactive constituents (percent modern)							
Carbon-14[4]	49933	14762-75-5	1 sigma	0.0015	na	na	D
Radioactive constituents (pCi/L)							
Radon-222[5]	82303	14859-67-7	SSMDC	see table 14	Proposed MCL-US[2]	[6]300 (4,000)	D
Tritium[7]	07000	10028-17-8	MRL	1	MCL-CA	20,000	D
Gross-alpha radioactivity, 72-hr count and 30-day counts[8]	62636, 62639	12587-46-1	SSMDC	see table 14	MCL-US	15	D
Gross-beta radioactivity, 72-hr count and 30-day counts[8]	62642, 62645	12587-47-2	SSMDC	see table 14	MCL-CA	50	D
Radium-226[8]	09511	13982-63-3	SSMDC	see table 14	MCL-US[9]	5	D
Radium-228[8]	81366	15262-20-1	SSMDC	see table 14	MCL-US[9]	5	D

[1] Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists.

[2] USGS Stable Isotope Laboratory, Reston, Virginia (USGSSIVA).

[3] University of Waterloo (contract laboratory) (CAN-UWIL).

[4] University of Arizona, Accelerator Mass Spectrometry Laboratory (contract laboratory) (AZ-UAMSL).

[5] USGS National Water Quality Laboratory (USGSNWQL).

[6] Two MCLs have been proposed for radon-222. The proposed alternaltive MCL is given in parentheses.

[7] USGS Stable Isotope and Tritium Laboratory, Menlo Park, California (USGSH3CA).

[8] Eberline Analytical Services (contract laboratory) (CA-EBERL).

[9] The MCL-US threshold for radium is the sum of radium-226 and radium-228.

Table 3K. Noble gases and tritium, comparison thresholds and reporting information for the Lawrence Livermore National Laboratory.

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. The laboratory entity code for the Lawrence Livermore National Laboratory in the USGS's National Water Information System (NWIS) is CA-LLNL. CAS, Chemical Abstracts Service; CDPH, California Department of Public Health; cm^3 STP/g H_2O, cubic centimeters of gas at standard temperature and pressure per gram of water; MCL-CA, maximum contaminant level (CDPH); na, not available; pCi/L, picocuries per liter]

Constituent	USGS parameter code	CAS number	MU (percent)	Reporting units	Threshold type	Threshold value (pCi/L)	Detection
Helium-3/Helium-4	61040	na/7440-59-7	0.75	atom ratio	na	na	na
Argon	85563	7440-37-1	2	cm^3STP/g H_2O	na	na	na
Helium-4	85561	7440-59-7	2	cm^3STP/g H_2O	na	na	na
Krypton	85565	7439-90-9	2	cm^3STP/g H_2O	na	na	na
Neon	61046	7440-01-09	2	cm^3STP/g H_2O	na	na	na
Xenon	85567	7440-63-3	2	cm^3STP/g H_2O	na	na	na
Tritium	07000	10028-17-8	1	pCi/L	MCL-CA	20,000	na

Table 3L. Microbial constituents, comparison thresholds, and reporting information for the U.S. Geological Survey's (USGS) Ohio Microbiology Laboratory parameter codes 90901, 90900, 99335, and 99332.

[The five-digit USGS parameter code is used to uniquely identify a specific constituent or property. The laboratory entity code for the USGS's Ohio Microbiology Laboratory in the USGS's National Water Information System (NWIS) is given in footnote 3. MCL-US, maximum contaminant level (USEPA); MDL, method detection limit; mL, milliliters; na, not available; TT-US, U.S. Environmental Protection Agency treatment technique—a required process intended to reduce the level of contamination in drinking water; USEPA, U.S. Environmental Protection Agency; —, analyzed but not detected]

Constituent	USGS parameter code	Primary source	MDL	Threshold type[1]	Threshold value	Detection
Escherichia coliform[2]	90901	Sewage and animal waste indicator/intestinal tracts of humans and animals	1 colony/100 mL	TT-US	No fecal coliforms are allowed.	—
Total coliform (including fecal coliform and *E. coli*)[2]	90900	Water-quality indicator/ soil, water and intestinal tracts of animals	1 colony/100 mL	MCL-US	No more then 5 percent samples total coliform-positives in a month. Every sample that has total coloforms must be analyzed for fecal coliforms; no fecal coliforms are allowed.	—
F-specific coliphage[3]	99335	Viral indicator/intestinal tracts of warm-blooded animals	na	TT-US	99.99 percent killed/ inactivated	—
Somatic coliphage[3]	99332	Viral indicator/fecal contaminated waters	na	TT-US	99.99 percent killed/ inactivated	—

[1] Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists.

[2] Analyzed in the field.

[3] Analyzed by the USGS's Ohio Microbiology Laboratory (laboratory entity code USGSOHML).

Table 4. Water-quality indicators in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.

[The five-digit number below the constituent name in the headings is the U.S. Geological Survey (USGS) parameter code used to uniquely identify a specific constituent or property. °C, degrees Celsius; CDPH, California Department of Public Health; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; mg/L, milligrams per liter; mm, millimeter; na, not available; nc, sample not collected; no., number; NTU, nephelometric turbidity unit; RICE, RICE well; SMCL-CA, secondary maximum contaminant level (CDPH); SMCL-U.S., secondary maximum contaminant level (USEPA); WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; µS/cm, microsiemens per centimeter; *, value above recommended threshold level; **, value above upper threshold level; <, less than]

GAMA identification no.	Turbidity (NTU) (63676)	Dissolved oxygen (mg/L) (00300)	Water temperature (°C) (00010)	pH, lab (standard units) (00403)	pH, field (standard units) (00400)	Specific conductance, lab (µS/cm at 25°C) (90095)	Specific conductance, field (µS/cm at 25°C) (00095)	Alkalinity, lab (mg/L as $CaCO_3$) (29801)	Alkalinity, field (mg/L as $CaCO_3$) (29802)
Reporting limit or range	**0.1**	**0.2**	**0.0-38.5**	**0-14**	**0-14**	**5**	**5**	**1**	**1**
Threshold type	**na**[1]	**na**	**na**	**SMCL-US**	**SMCL-US**	**SMCL-CA**[2]	**SMCL-CA**[2]	**na**	**na**
Threshold level	**na**[1]	**na**	**na**	**6.5–8.5**	**6.5–8.5**	**900 (1,600)**	**900 (1,600)**	**na**	**na**
				Grid wells					
ESAC-01	nc	2.4	19.0	nc	nc	nc	372	nc	nc
ESAC-02	nc	<0.2	19.0	nc	nc	nc	** 2,040	nc	nc
ESAC-03	nc	3.2	23.0	7.8	7.8	432	417	146	nc
ESAC-04	nc	6.8	19.5	nc	7.5	nc	422	nc	nc
ESAC-05	nc	1.6	19.0	7.7	7.1	511	507	195	nc
ESAC-06	nc	6.9	21.0	7.5	7.1	209	208	106	nc
ESAC-07	nc	4.7	21.5	nc	7.7	nc	255	nc	nc
ESAC-08	nc	1.9	16.5	nc	7.7	nc	459	nc	nc
ESAC-09	nc	2.6	19.0	nc	* 6.3	nc	418	nc	nc
ESAC-10	nc	0.4	19.5	7.6	7.3	511	513	210	nc
ESAC-11	nc	0.4	21.0	7.7	7.4	212	220	111	nc
ESAC-12	nc	nc	18.5	7.9	nc	338	341	179	nc
ESAC-13	nc	3.9	16.5	nc	nc	nc	322	nc	nc
ESAC-14	nc	2.5	19.5	nc	7.0	nc	373	nc	nc
ESAC-15	nc	10.1	18.0	7.8	7.6	281	280	118	nc
ESAC-16	nc	9.9	20.0	7.7	7.5	385	380	134	nc
ESAC-17	nc	<0.2	19.0	7.7	7.3	* 959	898	304	nc
ESAC-18	nc	8.7	19.0	7.9	7.7	227	227	111	nc
ESAC-19	nc	2.3	21.0	7.6	7.0	429	421	191	nc
ESAC-20	nc	<0.2	20.6	nc	7.5	nc	321	nc	nc
ESAC-21	nc	<0.2	17.5	7.9	7.6	** 2,380	** 2,370	218	nc
ESAC-22	nc	8.9	18.5	7.0	* 6.5	312	314	81	nc
ESAC-23	nc	3.4	17.0	nc	* 6.3	nc	254	nc	nc
ESAC-24	nc	nc	19.5	nc	7.5	nc	281	nc	nc
ESAC-25	0.2	6.9	21.5	7.8	7.2	205	207	106	98
ESAC-26	0.1	<0.2	16.0	7.9	7.9	306	292	162	148
ESAC-27	0.1	0.8	19.0	7.3	7.1	497	486	221	212

Table 4. Water-quality indicators in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.—Continued

[The five-digit number below the constituent name in the headings is the U.S. Geological Survey (USGS) parameter code used to uniquely identify a specific constituent or property. °C, degrees Celsius; CDPH, California Department of Public Health; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; mg/L, milligrams per liter; mm, millimeter; na, not available; nc, sample not collected; no., number; NTU, nephelometric turbidity unit; RICE, RICE well; SMCL-CA, secondary maximum contaminant level (CDPH); SMCL-U.S., secondary maximum contaminant level (USEPA); WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; µS/cm, microsiemens per centimeter; *, value above recommended threshold level; **, value above upper threshold level; <, less than]

GAMA identification no.	Turbidity (NTU) (63676)	Dissolved oxygen (mg/L) (00300)	Water temperature (°C) (00010)	pH, lab (standard units) (00403)	pH, field (standard units) (00400)	Specific conductance, lab (µS/cm at 25°C) (90095)	Specific conductance, field (µS/cm at 25°C) (00095)	Alkalinity, lab (mg/L as $CaCO_3$) (29801)	Alkalinity, field (mg/L as $CaCO_3$) (29802)
Reporting limit or range	**0.1**	**0.2**	**0.0-38.5**	**0-14**	**0-14**	**5**	**5**	**1**	**1**
Threshold type	**na**[1]	**na**	**na**	**SMCL-US**	**SMCL-US**	**SMCL-CA**[2]	**SMCL-CA**[2]	**na**	**na**
Threshold level	**na**[1]	**na**	**na**	**6.5–8.5**	**6.5–8.5**	**900 (1,600)**	**900 (1,600)**	**na**	**na**
ESAC-28	0.1	2.1	20.0	7.4	7.4	371	368	186	180
ESAC-29	nc	<0.2	17.0	8.0	nc	473	465	225	nc
ESAC-30	nc	0.2	15.5	7.9	7.8	432	408	121	nc
ESAC-31	nc	<0.2	18.5	7.8	7.6	642	613	297	nc
ESAC-32	nc	1.0	18.0	7.4	7.2	356	362	174	nc
ESAC-33	nc	4.1	20.0	nc	7.0	nc	367	nc	nc
ESAC-34	nc	2.5	17.5	7.6	7.2	593	591	273	nc
ESAC-35	nc	nc	17.5	7.7	7.4	331	324	168	nc
WSAC-01	nc	2.0	22.5	nc	8.1	nc	367	nc	nc
WSAC-02	nc	6.3	19.0	nc	7.3	nc	476	nc	nc
WSAC-03	0.1	7.7	20.0	7.5	7.3	338	337	133	122
WSAC-04	nc	<0.2	24.5	8.2	7.9	318	321	173	nc
WSAC-05	nc	<0.2	19.0	nc	7.9	nc	354	nc	nc
WSAC-06	nc	2.7	19.5	7.3	7.0	572	574	275	nc
WSAC-07	nc	7.0	18.0	nc	nc	nc	500	nc	nc
WSAC-07	nc	5.4	18.0	nc	7.1	nc	481	nc	nc
WSAC-08	0.2	4.1	20.5	7.4	7.0	535	536	221	202
WSAC-09	nc	6.3	19.0	nc	nc	nc	392	nc	nc
WSAC-09	nc	5.9	18.5	nc	6.9	nc	387	nc	nc
WSAC-10	nc	6.9	19.5	7.5	7.4	597	602	231	nc
WSAC-10	nc	6.2	19.5	nc	7.2	nc	562	nc	nc
WSAC-11	nc	7.1	23.5	7.8	7.8	652	649	189	nc
WSAC-11	nc	5.6	20.5	nc	7.7	nc	625	nc	nc
WSAC-12	0.3	<0.2	20.5	8.1	7.6	719	729	213	nc
WSAC-13	nc	2.1	20.0	nc	7.1	nc	782	nc	nc
WSAC-14	nc	<0.2	17.5	7.8	7.2	** 2,040	** 2,100	324	nc
WSAC-15	nc	6.9	18.0	7.6	7.1	* 938	* 931	388	nc

Table 4. Water-quality indicators in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.—Continued

[The five-digit number below the constituent name in the headings is the U.S. Geological Survey (USGS) parameter code used to uniquely identify a specific constituent or property. °C, degrees Celsius; CDPH, California Department of Public Health; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; mg/L, milligrams per liter; mm, millimeter; na, not available; nc, sample not collected; no., number; NTU, nephelometric turbidity unit; RICE, RICE well; SMCL-CA, secondary maximum contaminant level (CDPH); SMCL-U.S., secondary maximum contaminant level (USEPA); WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; µS/cm, microsiemens per centimeter; *, value above recommended threshold level; **, value above upper threshold level; <, less than]

GAMA identification no.	Turbidity (NTU) (63676)	Dissolved oxygen (mg/L) (00300)	Water temperature (°C) (00010)	pH, lab (standard units) (00403)	pH, field (standard units) (00400)	Specific conductance, lab (µS/cm at 25°C) (90095)	Specific conductance, field (µS/cm at 25°C) (00095)	Alkalinity, lab (mg/L as $CaCO_3$) (29801)	Alkalinity, field (mg/L as $CaCO_3$) (29802)
Reporting limit or range	**0.1**	**0.2**	**0.0-38.5**	**0-14**	**0-14**	**5**	**5**	**1**	**1**
Threshold type	**na**[1]	**na**	**na**	**SMCL-US**	**SMCL-US**	**SMCL-CA**[2]	**SMCL-CA**[2]	**na**	**na**
Threshold level	**na**[1]	**na**	**na**	**6.5–8.5**	**6.5–8.5**	**900 (1,600)**	**900 (1,600)**	**na**	**na**
WSAC-16	nc	<0.2	19.0	nc	7.5	nc	* 1,240	nc	nc
WSAC-17	nc	1.3	18.0	7.5	7.2	428	429	204	nc
WSAC-18	0.1	<0.2	20.5	7.8	7.8	* 1,080	* 1,050	320	295
WSAC-19	nc	0.7	20.5	nc	7.6	nc	567	nc	nc
WSAC-20	nc	5.9	17.0	nc	7.0	nc	* 958	nc	nc
WSAC-21	nc	7.8	20.0	7.6	7.0	416	415	172	nc
WSAC-22	nc	5.1	21.0	7.8	7.7	516	523	211	nc
WSAC-23	nc	5.4	19.0	nc	7.2	nc	* 1,210	nc	nc
WSAC-24	nc	6.8	20.0	nc	7.2	nc	* 1,470	nc	nc
WSAC-25	nc	<0.2	19.5	8.0	7.8	465	449	222	nc
WSAC-26	nc	10.8	20.0	7.7	7.6	325	325	158	nc
WSAC-27	nc	0.5	18.5	nc	7.8	nc	* 914	nc	nc
WSAC-28	nc	4.8	19.5	7.4	7.2	433	425	168	nc
WSAC-29	nc	3.2	20.0	8.1	8.0	423	422	201	nc
WSAC-30	nc	2.2	19.0	7.7	7.4	** 1680	** 1,670	204	nc
WSAC-31	nc	1.8	19.0	8.2	8.0	279	280	129	nc
WSAC-32	nc	1.8	18.0	nc	7.8	nc	409	nc	nc
WSAC-33	nc	5.4	19.5	nc	7.6	nc	733	nc	nc
WSAC-34	nc	20.4	18.5	7.4	7.1	835	816	259	nc
WSAC-35	nc	13.3	18.5	7.6	7.3	475	478	206	nc
WSAC-36	nc	nc	18.5	7.9	7.6	424	461	216	nc
				Flow-path wells					
ESAC-FP-01	nc	<0.2	23.5	7.7	7.6	547	553	75	nc
ESAC-FP-02	6.6	4.0	23.5	7.5	7.2	441	449	202	nc
ESAC-FP-03	0.3	0.3	20.5	7.5	7.5	379	379	197	nc
ESAC-FP-04	1.0	0.5	20.5	8.2	8.3	206	206	108	nc
ESAC-FP-05	0.2	1.5	22.0	7.7	7.5	742	742	355	nc
ESAC-FP-06	3.1	0.2	22.0	* 8.9	* 8.8	315	316	134	nc

Table 4. Water-quality indicators in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.—Continued

[The five-digit number below the constituent name in the headings is the U.S. Geological Survey (USGS) parameter code used to uniquely identify a specific constituent or property. °C, degrees Celsius; CDPH, California Department of Public Health; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; mg/L, milligrams per liter; mm, millimeter; na, not available; nc, sample not collected; no., number; NTU, nephelometric turbidity unit; RICE, RICE well; SMCL-CA, secondary maximum contaminant level (CDPH); SMCL-U.S., secondary maximum contaminant level (USEPA); WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; µS/cm, microsiemens per centimeter; *, value above recommended threshold level; **, value above upper threshold level; <, less than]

GAMA identification no.	Turbidity (NTU) (63676)	Dissolved oxygen (mg/L) (00300)	Water temperature (°C) (00010)	pH, lab (standard units) (00403)	pH, field (standard units) (00400)	Specific conductance, lab (µS/cm at 25°C) (90095)	Specific conductance, field (µS/cm at 25°C) (00095)	Alkalinity, lab (mg/L as $CaCO_3$) (29801)	Alkalinity, field (mg/L as $CaCO_3$) (29802)
Reporting limit or range	**0.1**	**0.2**	**0.0-38.5**	**0-14**	**0-14**	**5**	**5**	**1**	**1**
Threshold type	**na**[1]	**na**	**na**	**SMCL-US**	**SMCL-US**	**SMCL-CA**[2]	**SMCL-CA**[2]	**na**	**na**
Threshold level	**na**[1]	**na**	**na**	**6.5–8.5**	**6.5–8.5**	**900 (1,600)**	**900 (1,600)**	**na**	**na**
ESAC-FP-07	2.9	0.2	21.5	8.5	8.3	405	407	158	nc
WSAC-FP-01	0.7	5.7	24.0	7.9	7.6	342	338	182	nc
WSAC-FP-02	2.6	2.7	22.5	8.2	8.2	315	323	143	nc
WSAC-FP-03	3.6	5.8	23.0	8.0	7.8	416	421	176	nc
WSAC-FP-04	1.1	<0.2	20.0	* 8.6	* 8.6	315	312	148	nc
WSAC-FP-05	nc	0.2	21.5	8.0	8.0	* 928	* 934	250	nc
WSAC-FP-06	2.1	<0.2	21.0	8.5	8.4	349	344	142	nc
WSAC-FP-07	0.6	0.2	20.5	8.4	8.2	326	330	145	nc
WSAC-FP-08	1.4	1.4	20.5	7.9	7.6	403	409	185	nc
				RICE wells					
RICE-01	4.0	<0.2	19.0	7.0	6.8	** 13,600	** 13,800	nc	nc
RICE-02	0.3	<0.2	18.5	7.8	7.3	591	593	nc	335
RICE-03	0.2	<0.2	19.5	7.5	7.0	853	875	nc	432
RICE-04	0.7	0.4	17.5	7.4	6.8	630	644	nc	328
RICE-05	0.3	0.2	18.0	7.0	* 6.4	890	* 930	nc	426
RICE-06	0.2	<0.2	18.0	7.1	6.6	720	756	nc	384
RICE-07	1.1	0.2	20.0	7.8	7.3	784	803	nc	421
RICE-08	0.1	0.4	18.0	7.7	7.3	780	796	nc	378
RICE-09	1.8	<0.2	19.5	7.9	7.2	239	267	nc	128
RICE-10	0.4	<0.2	21.0	8.0	7.4	330	363	nc	169
RICE-11	0.9	0.2	20.0	7.3	7.0	*937	* 968	nc	414
RICE-12	0.9	<0.2	21.5	7.7	7.3	798	818	nc	397
RICE-13	1.0	<0.2	19.0	7.5	7.1	*915	* 944	nc	416
RICE-14	0.5	<0.2	18.5	7.3	7.0	823	844	nc	401
RICE-15	0.5	<0.2	17.0	7.8	7.3	* 947	* 944	nc	436
RICE-16	0.6	1.5	20.0	7.8	7.3	** 1,870	** 1840	nc	596

Table 4. Water-quality indicators in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.—Continued

[The five-digit number below the constituent name in the headings is the U.S. Geological Survey (USGS) parameter code used to uniquely identify a specific constituent or property. °C, degrees Celsius; CDPH, California Department of Public Health; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; mg/L, milligrams per liter; mm, millimeter; na, not available; nc, sample not collected; no., number; NTU, nephelometric turbidity unit; RICE, RICE well; SMCL-CA, secondary maximum contaminant level (CDPH); SMCL-U.S., secondary maximum contaminant level (USEPA); WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; µS/cm, microsiemens per centimeter; *, value above recommended threshold level; **, value above upper threshold level; <, less than]

GAMA identification no.	Turbidity (NTU) (63676)	Dissolved oxygen (mg/L) (00300)	Water temperature (°C) (00010)	pH, lab (standard units) (00403)	pH, field (standard units) (00400)	Specific conductance, lab (µS/cm at 25°C) (90095)	Specific conductance, field (µS/cm at 25°C) (00095)	Alkalinity, lab (mg/L as $CaCO_3$) (29801)	Alkalinity, field (mg/L as $CaCO_3$) (29802)
Reporting limit or range	**0.1**	**0.2**	**0.0-38.5**	**0-14**	**0-14**	**5**	**5**	**1**	**1**
Threshold type	**na**[1]	**na**	**na**	**SMCL-US**	**SMCL-US**	**SMCL-CA**[2]	**SMCL-CA**[2]	**na**	**na**
Threshold level	**na**[1]	**na**	**na**	**6.5–8.5**	**6.5–8.5**	**900 (1,600)**	**900 (1,600)**	**na**	**na**
RICE-17	0.5	<0.2	18.5	7.7	7.4	** 4,770	** 4750	nc	350
RICE-18	0.4	<0.2	19.0	7.7	7.3	855	863	nc	343
RICE-19	0.2	<0.2	18.5	7.8	7.4	481	489	nc	245
RICE-20	0.2	<0.2	18.0	7.7	7.3	* 1,000	* 1,010	nc	407
RICE-21	0.1	0.2	18.5	7.6	7.3	** 1,650	** 1,680	nc	347
RICE-22	0.6	0.2	18.0	7.5	7.3	** 3,290	** 3,310	nc	415

[1]A TT-US threshold of 5 NTU does exist, but it applies to surface water and, therefore, is not included with this table.

[2] Specific conductance has a recommended and an upper threshold value. The upper value is shown in parentheses.

Table 5. Volatile organic compounds (VOCs), and gasoline oxygenates and degradates detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.

[Samples from all 108 wells were analyzed, but only wells with detections are listed. Constituents are grouped by primary use or source, and within each group are listed in order of decreasing detection frequency in the 71 grid wells. The five-digit number in parentheses below the constituent name in the headings is used by the U.S. Geological Survey to uniquely identify a specific constituent or property. CDPH, California Department of Public Health; E, estimated value; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-CA; maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); na, not available; NL-CA, notification level (CDPH); no., number; RICE, RICE well; USEPA, U.S. Environmental Protection Agency; V, analyte detected in sample and an associated blank—thus data are not included in ground-water quality analysis results; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; µg/L, micrograms per liter; —, analyzed but not detected]

GAMA identification no.	Trihalomethanes			Gasoline Hydrocarbons and Oxygenates										
	Chloroform (Trichloromethane) (µg/L) (32106)	Bromodichloromethane (µg/L) (32101)	Bromoform (µg/L) (32104)	Methyl *tert*-butyl ether (MTBE) (µg/L) (78032)	1,2,4-Trimethylbenzene (µg/L) (77222)	1,3,5-Trimethylbenzene (µg/L) (77226)	1,2,3-Trimethylbenzene (µg/L) (77221)	1,2,3,4-Tetramethylbenzene (µg/L) (49999)	1,2,3,5-Tetramethylbenzene (µg/L) (50000)	2-Ethyltoluene (µg/L) (77220)	4-Isopropyltoluene (µg/L) (77356)	Benzene (µg/L) (34030)	*m*- and *p*-Xylene (µg/L) (85795)	Toluene (µg/L) (34010)
[LRL]	**[0.024]**	**[0.028]**	**[0.1]**	**[0.1]**	**[0.056]**	**[0.044]**	**[0.09]**	**[0.14]**	**[0.18]**	**[0.06]**	**[0.08]**	**[0.021]**	**[0.06]**	**[0.02]**
Threshold type[1]	**MCL-US**	**MCL-US**	**MCL-US**	**MCL-CA**	**NL-CA**	**NL-CA**	**na**	**na**	**na**	**na**	**na**	**MCL-CA**	**MCL-CA**	**MCL-CA**
Threshold (µg/L)	[2]**80**	[2]**80**	[2]**80**	**13**	**330**	**330**	**na**	**na**	**na**	**na**	**na**	**1**	**1750**	**150**
Grid wells														
ESAC-01	V0.01	—	—	—	—	—	—	—	—	—	—	—	—	—
ESAC-02	V0.01	—	—	—	—	—	—	—	—	—	—	—	—	—
ESAC-03	0.14	—	—	E0.1	—	—	—	—	—	—	—	—	—	—
ESAC-07	E0.06	—	—	—	—	—	—	—	—	—	—	—	—	—
ESAC-15	E0.06	—	—	—	—	—	—	—	—	—	—	—	—	—
ESAC-17	—	—	—	—	—	—	—	—	—	—	—	—	—	—
ESAC-21	—	—	—	—	—	—	—	—	—	—	—	—	—	—
ESAC-22	—	—	—	—	E0.07	E0.02	—	—	—	—	—	—	—	—
ESAC-25	—	—	—	—	0.1	—	—	—	—	—	—	—	—	—
ESAC-27	—	—	—	0.1	—	—	—	—	—	—	—	—	—	—
ESAC-28	E0.09	—	—	—	V0.05	—	—	—	—	—	—	—	—	—
ESAC-32	—	—	—	—	—	—	—	—	—	—	—	—	—	—
ESAC-33	0.86	E0.04	—	0.1	—	—	—	—	—	—	—	—	—	—
WSAC-03	0.2	E0.03	0.11	—	—	—	—	—	—	—	—	—	—	—
WSAC-05	—	—	—	E0.1	—	—	—	—	—	—	—	—	—	—
WSAC-11	E0.08	—	—	—	—	—	—	—	—	—	—	—	—	—
WSAC-12	—	—	—	—	V0.02	—	—	—	—	—	—	—	—	—
WSAC-16	0.16	E0.02	—	—	—	—	—	—	—	—	—	—	—	—
WSAC-17	E0.05	—	—	—	—	—	—	—	—	—	—	—	—	—

Table 5. Volatile organic compounds (VOCs), and gasoline oxygenates and degradates detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.—Continued

[Samples from all 108 wells were analyzed, but only wells with detections are listed. Constituents are grouped by primary use or source, and within each group are listed in order of decreasing detection frequency in the 71 grid wells. The five-digit number in parentheses below the constituent name in the headings is used by the U.S. Geological Survey to uniquely identify a specific constituent or property. CDPH, California Department of Public Health; E, estimated value; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-CA; maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); na, not available; NL-CA, notification level (CDPH); no., number; RICE, RICE well; USEPA, U.S. Environmental Protection Agency; V, analyte detected in sample and an associated blank—thus data are not included in ground-water quality analysis results; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; µg/L, micrograms per liter; —, analyzed but not detected]

GAMA identification no.	Trihalomethanes			Gasoline Hydrocarbons and Oxygenates										
	Chloroform (Trichloromethane) (µg/L) (32106)	Bromodichloromethane (µg/L) (32101)	Bromoform (µg/L) (32104)	Methyl *tert*-butyl ether (MTBE) (µg/L) (78032)	1,2,4-Trimethylbenzene (µg/L) (77222)	1,3,5-Trimethylbenzene (µg/L) (77226)	1,2,3-Trimethylbenzene (µg/L) (77221)	1,2,3,4-Tetramethylbenzene (µg/L) (49999)	1,2,3,5-Tetramethylbenzene (µg/L) (50000)	2-Ethyltoluene (µg/L) (77220)	4-Isopropyltoluene (µg/L) (77356)	Benzene (µg/L) (34030)	*m*- and *p*-Xylene (µg/L) (85795)	Toluene (µg/L) (34010)
[LRL]	**[0.024]**	**[0.028]**	**[0.1]**	**[0.1]**	**[0.056]**	**[0.044]**	**[0.09]**	**[0.14]**	**[0.18]**	**[0.06]**	**[0.08]**	**[0.021]**	**[0.06]**	**[0.02]**
Threshold type[1]	**MCL-US**	**MCL-US**	**MCL-US**	**MCL-CA**	**NL-CA**	**NL-CA**	**na**	**na**	**na**	**na**	**na**	**MCL-CA**	**MCL-CA**	**MCL-CA**
Threshold (µg/L)	[2]**80**	[2]**80**	[2]**80**	**13**	**330**	**330**	**na**	**na**	**na**	**na**	**na**	**1**	**1750**	**150**
WSAC-18	—	—	—	—	0.15	—	—	—	—	—	—	—	—	—
WSAC-24	V0.02	—	—	—	—	—	—	—	—	—	—	—	—	—
WSAC-27	—	—	—	—	V0.06	E0.04	E0.1	E0.1	E0.1	E0.02	E0.01	—	—	—
WSAC-28	—	—	—	—	V0.04	—	—	—	—	—	—	—	—	—
WSAC-33	E0.08	—	—	—	—	—	—	—	—	—	—	—	—	—
Number of wells with detections	10	3	1	4	3	2	1	1	1	1	1	0	0	0
Detection frequency (percent)	14	4	1	6	4	3	1	1	1	1	1			
Flow-path wells														
ESAC-FP-02	—	—	—	—	—	—	—	—	—	—	—	—	—	—
ESAC-FP-03	—	—	—	—	—	—	—	—	—	—	—	—	—	V0.02
ESAC-FP-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—
ESAC-FP-07	—	—	—	—	V0.02	—	—	—	—	—	—	—	—	—
WSAC-FP-04	—	—	—	—	—	—	—	—	E0.1	—	—	—	—	—
WSAC-FP-05	—	—	—	—	V0.03	—	—	—	—	—	—	—	—	—
WSAC-FP-06	—	—	—	—	—	—	—	—	E0.2	—	—	—	—	—
RICE wells														
RICE-01	—	—	—	—	—	—	—	—	—	—	—	E0.02	—	—
RICE-05	—	—	—	—	—	—	—	—	—	—	—	—	V0.01	—

Table 5. Volatile organic compounds (VOCs), and gasoline oxygenates and degradates detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.—Contined

[Samples from all 108 wells were analyzed, but only wells with detections are listed. Constituents are grouped by primary use or source, and within each group are listed in order of decreasing detection frequency in the 71 grid wells. The five-digit number in parentheses below the constituent name in the headings is used by the U.S. Geological Survey to uniquely identify a specific constituent or property. CDPH, California Department of Public Health; E, estimated value; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-CA; maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); na, not available; NL-CA, notification level (CDPH); no., number; RICE, RICE well; USEPA, U.S. Environmental Protection Agency; V, analyte detected in sample and an associated blank—thus data are not included in ground-water quality analysis results; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; µg/L, micrograms per liter; —, analyzed but not detected]

GAMA identification no.	Solvents								Organic synthesis	Refrigerant	VOC detections per well
	Perchloroethene (PCE) (µg/L) (34475)	1,1-Dichloroethane (µg/L) (34496)	*cis*-1,2-Dichloroethene (µg/L) (77093)	Carbon tetrachloride (µg/L) (32102)	*trans*-1,2-Dichloroethene (µg/L) (34546)	Trichloroethene (TCE) (µg/L) (39180)	Acetone (µg/L) (81552)	2-Butanone (MEK, Methyl ethyl ketone) (µg/L) (81595)	Carbon disulfide (µg/L) (77041)	Trichlorofluoromethane (CFC-11) (µg/L) (34488)	
[LRL]	**[0.03]**	**[0.035]**	**[0.024]**	**[0.06]**	**[0.032]**	**[0.038]**	**[6]**	**[2]**	**[0.038]**	**[0.08]**	
Threshold type[1]	**MCL-US**	**MCL-CA**	**MCL-CA**	**MCL-CA**	**MCL-CA**	**MCL-US**	**na**	**HAL-US**	**NL-CA**	**MCL-CA**	
Threshold (µg/L)	**5**	**5**	**6**	**0.5**	**10**	**5**	**na**	**4000**	**160**	**150**	
Grid wells											
ESAC-01	—	—	—	—	—	—	—	—	—	—	0
ESAC-02	—	—	—	—	—	—	—	—	—	—	0
ESAC-03	E0.02	E0.03	—	—	—	—	—	—	—	—	4
ESAC-07	—	—	—	—	—	—	—	—	—	—	1
ESAC-15	0.51	0.11	2.06	—	E0.01	0.11	—	—	—	—	6
ESAC-17	—	—	—	—	—	—	—	—	0.15	—	1
ESAC-21	—	—	—	—	—	—	—	—	E0.05	—	1
ESAC-22	—	—	—	—	—	—	—	—	—	—	2
ESAC-25	—	—	—	—	—	—	—	—	—	—	1
ESAC-27	—	—	—	—	—	—	—	—	—	—	1
ESAC-28	—	—	—	—	—	—	—	—	—	—	1
ESAC-32	E0.05	—	—	—	—	—	—	—	—	—	1
ESAC-33	0.96	—	—	—	—	—	—	—	—	0.11	5
WSAC-03	—	—	—	—	—	—	—	—	—	—	3
WSAC-05	—	—	—	—	—	—	—	—	—	—	1
WSAC-11	—	—	—	—	—	—	—	—	—	—	1
WSAC-12	—	—	—	—	—	—	—	—	—	—	0
WSAC-16	—	—	—	—	—	—	—	—	—	—	2
WSAC-17	—	—	—	—	—	—	—	—	—	—	1

Table 5. Volatile organic compounds (VOCs), and gasoline oxygenates and degradates detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006. —Contined

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	Perchloroethene (PCE) (µg/L) (34475)	1,1-Dichloroethane (µg/L) (34496)	*cis*-1,2-Dichloroethene (µg/L) (77093)	Carbon tetrachloride (µg/L) (32102)	*trans*-1,2-Dichloroethene (µg/L) (34546)	Trichloroethene (TCE) (µg/L) (39180)	Acetone (µg/L) (81552)	2-Butanone (MEK, Methyl ethyl ketone)	Carbon disulfide (µg/L) (77041)	Trichlorofluoromethane (CFC-11) (µg/L) (34488)	
[LRL]	[0.03]	[0.035]	[0.024]	[0.06]	[0.032]	[0.038]	[6]	[2]	[0.038]	[0.08]	
Threshold type[1]	MCL-US	MCL-CA	MCL-CA	MCL-CA	MCL-CA	MCL-US	na	HAL-US	NL-CA	MCL-CA	
Threshold (µg/L)	5	5	6	0.5	10	5	na	4000	160	150	
WSAC-18	—	—	—	—	—	—	—	—	—	—	1
WSAC-24	—	—	—	E0.04	—	—	—	—	—	—	1
WSAC-27	—	—	—	—	—	—	—	—	—	—	6
WSAC-28	—	—	—	—	—	—	—	—	—	—	0
WSAC-33	—	—	—	—	—	—	—	—	—	—	1
Number of wells with detections	4	2	1	1	1	1	0	0	2	1	
Detection frequency (percent)	6	3	1	1	1	1			3	1	[3]28
Flow-path wells											
ESAC-FP-02	E0.03	—	—	0.18	—	—	—	—	—	—	2
ESAC-FP-03	—	—	—	—	—	—	—	—	—	—	0
ESAC-FP-06	—	—	—	—	—	—	—	—	E0.03	—	1
ESAC-FP-07	—	—	—	—	—	—	E2	6.4	E0.03	—	3
WSAC-FP-04	—	—	—	—	—	—	—	—	—	—	1
WSAC-FP-05	—	—	—	—	—	—	—	—	—	—	0
WSAC-FP-06	—	—	—	—	—	—	—	—	—	—	1
RICE wells											
RICE-01	—	—	—	—	—	—	—	—	—	—	1
RICE-05	—	—	—	—	—	—	—	—	—	—	0

[1]Maximum contaminant level thresholds are listed as MCL-US when MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists.

[2] The MCL-US threshold for trihalomethanes is the sum of chloroform, bromodichloromethane, dibromochloromethane, and bromoform.

[3] Frequency of detection of at least one VOC in the grid wells. Detections with V remark codes are not included.

Table 6. Pesticides and pesticide degradates detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.

[Results are from the U.S. Geological Survey's (USGS) National Water Quality Laboratory Schedules 2032, 2033, and 2060. Samples from all 108 wells were analyzed, but only wells with detections are listed. Constituents are grouped by primary use of source and within each group are listed in order of decreasing detection frequency in the 71 grid wells. The five-digit number in parentheses below the constituent name is used by the USGS to uniquely identify a specific constituent or property. CDPH, California Department of Public Health; E, estimated value; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-CA; maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); na, not available; no., number; RICE, RICE well; RSD5-US, U.S. Environmental Protection Agency risk specific dose at a risk factor of 10^{-5} µg/L (RSD5s are calculated by dividing the 10^{-4} cancer risk concentration established by the USEPA by 10); USEPA, U.S. Environmental Protection Agency; V, analyte detected in sample and an associated blank—thus data are not included in ground-water quality analysis results; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; µg/L, micrograms per liter; —, analyzed but not detected]

GAMA identification no.	Herbicides											
	Bentazon (µg/L) (38711)	Atrazine (µg/L) (39632)	Simazine (µg/L) (04035)	Metolachlor (µg/L) (39415)	Hexazinone (µg/L) (04025)	Dinoseb (µg/L) (49301)	Molinate (µg/L) (82671)	Prometon (µg/L) (04037)	Acetochlor (µg/L) (49260)	Metribuzin (µg/L) (82630)	Tebuthiuron (µg/L) (82670)	Propanil (µg/L) (82679)
[LRL]	[0.024]	[0.008]	[0.005]	[0.006]	[0.026]	[0.038]	[0.003]	[0.01]	[0.006]	[0.028]	[0.026]	[0.011]
Threshold type[1]	MCL-CA	MCL-CA	MCL-US	HAL-US	HAL-US	MCL-US	MCL-CA	HAL-US	na	HAL-US	HAL-US	na
Threshold value	18	1	4	700	400	7	20	100	na	70	500	na
Grid wells												
ESAC-01	—	E0.004	E0.003	—	—	—	—	—	—	—	—	—
ESAC-05	—	—	—	—	—	—	—	—	—	—	—	—
ESAC-09	0.09	—	E0.004	—	—	—	E0.02	—	—	—	—	0.097
ESAC-10	0.47	0.008	—	—	—	—	—	—	—	—	—	—
ESAC-20	0.02	—	—	—	—	—	0.013	—	—	—	—	—
ESAC-22	—	E0.004	E0.004	—	—	—	—	—	—	—	—	—
ESAC-23	—	0.077	—	0.028	—	—	—	0.02	0.059	—	—	—
ESAC-24	—	E0.007	E0.005	—	—	—	—	—	—	—	—	—
ESAC-26	—	—	0.011	—	—	—	—	—	—	—	—	—
ESAC-27	0.03	0.011	0.024	—	—	—	—	—	—	—	—	—
ESAC-28	0.05	E0.005	—	—	—	—	—	—	—	—	—	—
ESAC-31	0.43	—	—	—	—	—	—	—	—	—	—	—
ESAC-32	0.04	—	—	—	—	—	—	—	—	—	—	—
ESAC-33	0.04	E0.004	—	—	—	E0.004	—	—	—	—	—	—
ESAC-34	0.1	—	—	—	—	E0.01	—	—	—	—	—	—
ESAC-35	0.08	—	—	—	—	—	—	—	—	—	—	—
WSAC-02	—	0.04	E0.005	—	—	—	—	—	—	—	—	—
WSAC-06	—	E0.004	E0.004	—	—	—	—	—	—	—	—	—
WSAC-07	—	E0.005	E0.005	—	—	—	—	—	—	—	—	—
WSAC-08	—	—	—	—	—	—	—	—	—	—	—	—
WSAC-09	—	E0.007	E0.004	—	—	—	—	—	—	—	—	—
WSAC-11	—	—	E0.005	—	—	—	—	—	—	—	—	—
WSAC-12	0.09	—	—	—	—	—	—	—	—	—	—	—
WSAC-13	0.08	—	—	—	—	—	—	—	—	—	—	—
WSAC-14	E0.01	—	—	—	—	—	—	—	—	—	—	—
WSAC-15	—	—	0.009	E0.005	E0.009	—	—	—	—	—	0.03	—
WSAC-16	E0.005	—	—	—	—	—	—	—	—	—	—	—

Table 6. Pesticides and pesticide degradates detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006. —Continued

[Results are from the U.S. Geological Survey's (USGS) National Water Quality Laboratory Schedules 2032, 2033, and 2060. Samples from all 108 wells were analyzed, but only wells with detections are listed. Constituents are grouped by primary use of source and within each group are listed in order of decreasing detection frequency in the 71 grid wells. The five-digit number in parentheses below the constituent name is used by the USGS to uniquely identify a specific constituent or property. CDPH, California Department of Public Health; E, estimated value; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-CA; maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); na, not available; no., number; RICE, RICE well; RSD5-US, U.S. Environmental Protection Agency risk specific dose at a risk factor of 10^{-5} µg/L (RSD5s are calculated by dividing the 10^{-4} cancer risk concentration established by the USEPA by 10); USEPA, U.S. Environmental Protection Agency; V, analyte detected in sample and an associated blank—thus data are not included in ground-water quality analysis results; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; µg/L, micrograms per liter; —, analyzed but not detected]

GAMA identification no.	Herbicides											
	Bentazon (µg/L) (38711)	Atrazine (µg/L) (39632)	Simazine (µg/L) (04035)	Metolachlor (µg/L) (39415)	Hexazinone (µg/L) (04025)	Dinoseb (µg/L) (49301)	Molinate (µg/L) (82671)	Prometon (µg/L) (04037)	Acetochlor (µg/L) (49260)	Metribuzin (µg/L) (82630)	Tebuthiuron (µg/L) (82670)	Propanil (µg/L) (82679)
[LRL]	**[0.024]**	**[0.008]**	**[0.005]**	**[0.006]**	**[0.026]**	**[0.038]**	**[0.003]**	**[0.01]**	**[0.006]**	**[0.028]**	**[0.026]**	**[0.011]**
Threshold type[1]	**MCL-CA**	**MCL-CA**	**MCL-US**	**HAL-US**	**HAL-US**	**MCL-US**	**MCL-CA**	**HAL-US**	**na**	**HAL-US**	**HAL-US**	**na**
Threshold value	**18**	**1**	**4**	**700**	**400**	**7**	**20**	**100**	**na**	**70**	**500**	**na**
WSAC-17	—	—	E0.006	—	E0.008	—	—	—	—	—	—	—
WSAC-18	E0.02	—	—	—	—	—	—	—	—	—	—	—
WSAC-20	—	E0.004	0.01	E0.005	—	—	—	—	—	0.113	—	—
WSAC-23	—	—	0.008	—	—	—	—	—	—	—	—	—
WSAC-27	0.29	—	—	—	—	—	—	—	—	—	—	—
WSAC-28	—	—	—	—	—	—	—	—	—	—	—	—
WSAC-29	E0.004	E0.006	—	—	—	—	—	—	—	—	—	—
WSAC-31	0.09	—	—	—	—	—	—	—	—	—	—	—
WSAC-32	E0.01	E0.005	E0.004	—	—	—	—	—	—	—	—	—
WSAC-34	—	E0.008	—	—	—	—	—	—	—	—	—	—
WSAC-35	E0.005	E0.005	E0.004	—	E0.016	—	—	—	—	—	—	—
WSAC-36	0.11	—	—	—	—	—	—	—	—	—	—	—
Number of wells with detections	21	17	17	3	3	2	2	1	1	1	1	1
Detection frequency (percent)	30	24	24	4	4	3	3	1	1	1	1	1
Flow-path wells												
ESAC-FP-03	0.15	—	—	—	—	—	—	—	—	—	—	—
ESAC-FP-05	E0.01	—	—	—	—	—	—	—	—	—	—	—
ESAC-FP-06	—	—	—	—	—	—	—	—	—	—	—	—
ESAC-FP-07	—	—	—	—	—	—	—	—	—	—	—	—
WSAC-FP-06	—	—	—	—	—	—	—	—	—	—	—	—
WSAC-FP-08	0.13	—	—	—	—	—	—	—	—	—	—	—

Table 6. Pesticides and pesticide degradates detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006. —Continued

[Results are from the U.S. Geological Survey's (USGS) National Water Quality Laboratory Schedules 2032, 2033, and 2060. Samples from all 108 wells were analyzed, but only wells with detections are listed. Constituents are grouped by primary use of source and within each group are listed in order of decreasing detection frequency in the 71 grid wells. The five-digit number in parentheses below the constituent name is used by the USGS to uniquely identify a specific constituent or property. CDPH, California Department of Public Health; E, estimated value; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-CA; maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); na, not available; no., number; RICE, RICE well; RSD5-US, U.S. Environmental Protection Agency risk specific dose at a risk factor of 10^{-5} µg/L (RSD5s are calculated by dividing the 10^{-4} cancer risk concentration established by the USEPA by 10); USEPA, U.S. Environmental Protection Agency; V, analyte detected in sample and an associated blank—thus data are not included in ground-water quality analysis results; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; µg/L, micrograms per liter; —, analyzed but not detected]

GAMA identification no.	Herbicides											
	Bentazon (µg/L) (38711)	Atrazine (µg/L) (39632)	Simazine (µg/L) (04035)	Metolachlor (µg/L) (39415)	Hexazinone (µg/L) (04025)	Dinoseb (µg/L) (49301)	Molinate (µg/L) (82671)	Prometon (µg/L) (04037)	Acetochlor (µg/L) (49260)	Metribuzin (µg/L) (82630)	Tebuthiuron (µg/L) (82670)	Propanil (µg/L) (82679)
[LRL]	**[0.024]**	**[0.008]**	**[0.005]**	**[0.006]**	**[0.026]**	**[0.038]**	**[0.003]**	**[0.01]**	**[0.006]**	**[0.028]**	**[0.026]**	**[0.011]**
Threshold type[1]	**MCL-CA**	**MCL-CA**	**MCL-US**	**HAL-US**	**HAL-US**	**MCL-US**	**MCL-CA**	**HAL-US**	**na**	**HAL-US**	**HAL-US**	**na**
Threshold value	**18**	**1**	**4**	**700**	**400**	**7**	**20**	**100**	**na**	**70**	**500**	**na**
RICE wells												
RICE-01	—	—	—	—	—	—	0.008	—	—	—	—	—
RICE-03	—	E0.007	E0.005	—	—	—	—	—	—	—	—	E0.006
RICE-04	0.11	—	—	—	—	—	—	—	—	—	—	—
RICE-06	0.04	—	E0.003	—	—	—	—	—	—	—	—	—
RICE-07	1.46	—	—	—	—	—	—	—	—	—	—	—
RICE-08	E0.02	—	—	—	—	—	—	—	—	—	—	—
RICE-09	—	—	E0.004	—	E0.013	—	—	—	—	—	—	—
RICE-10	—	—	0.082	—	—	—	—	—	—	—	—	—
RICE-11	0.03	E0.007	E0.005	—	—	—	—	—	—	—	—	—
RICE-12	0.42	E0.005	E0.008	—	—	—	—	—	—	—	—	—
RICE-13	0.32	—	—	—	—	—	—	—	—	—	—	—
RICE-14	0.14	—	—	—	—	—	—	—	—	—	0.02	—
RICE-15	0.32	E0.007	—	—	—	—	—	—	—	—	—	—
RICE-16	0.29	—	—	—	—	—	—	—	—	—	—	—
RICE-17	1.7	—	—	—	—	—	—	—	—	—	—	—
RICE-18	1.82	—	—	—	—	—	—	—	—	—	—	—
RICE-19	0.08	0.008	—	—	—	—	—	—	—	—	—	—
RICE-20	0.21	—	E0.004	—	—	—	—	—	—	—	—	—
RICE-21	0.45	—	—	—	—	—	—	—	—	—	—	—
RICE-22	0.23	—	—	—	E0.014	—	—	—	—	—	—	—

Table 6. Pesticides and pesticide degradates detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006. —Continued

[Results are from the U.S. Geological Survey's (USGS) National Water Quality Laboratory Schedules 2032, 2033, and 2060. Samples from all 108 wells were analyzed, but only wells with detections are listed. Constituents are grouped by primary use of source and within each group are listed in order of decreasing detection frequency in the 71 grid wells. The five-digit number in parentheses below the constituent name is used by the USGS to uniquely identify a specific constituent or property. CDPH, California Department of Public Health; E, estimated value; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-CA; maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); na, not available; no., number; RICE, RICE well; RSD5-US, U.S. Environmental Protection Agency risk specific dose at a risk factor of 10^{-5} µg/L (RSD5s are calculated by dividing the 10^{-4} cancer risk concentration established by the USEPA by 10); USEPA, U.S. Environmental Protection Agency; V, analyte detected in sample and an associated blank—thus data are not included in ground-water quality analysis results; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; µg/L, micrograms per liter; —, analyzed but not detected]

GAMA identification no.	Herbicides—continued						Insecticides		
	Bensulfuron-methyl (µg/L) (61693)	MCPA (µg/L) (38482)	Triclopyr (µg/L) (49235)	2,4-D, (µg/L) (39732)	Chlorimuron (µg/L) (50306)	Bromacil (µg/L) (04029)	Chlorpyrifos (µg/L) (38933)	Carbaryl (µg/L) (82680)	Fipronil (µg/L) (62166)
[LRL]	**[0.018]**	**[0.07]**	**[0.026]**	**[0.038]**	**[0.032]**	**0.018**	**[0.005]**	**[0.041]**	**[0.016]**
Threshold type[1]	**na**	**HAL-US**	**na**	**MCL-US**	**na**	**HAL-US**	**HAL-US**	**RSD5-US**	**na**
Threshold value	**na**	**30**	**na**	**70**	**na**	**70**	**2**	**400**	**na**
				Grid wells					
ESAC-01	—	—	—	—	—		—	—	—
ESAC-05	—	—	—	—	—	V0.01	—	—	—
ESAC-09	E0.01	E0.02	0.12	—	—	—	—	E0.007	—
ESAC-10	—	—	na	—	—	—	—	—	—
ESAC-20	—	—	na	—	—	—	—	—	—
ESAC-22	—	—	—	—	—	V0.03	—	—	—
ESAC-23	—	—	na	—	—	—	0.008	—	E0.017
ESAC-24	—	—	na	—	—	—	—	—	—
ESAC-26	—	—	na	—	—	—	—	—	—
ESAC-27	—	—	na	—	—	—	—	—	—
ESAC-28	—	—	—	—	—	—	—	—	—
ESAC-31	—	—	—	—	—	—	—	—	—
ESAC-32	—	—	—	—	—	—	—	—	—
ESAC-33	—	—	—	—	—	—	—	—	—
ESAC-34	—	—	—	—	—	—	—	—	—
ESAC-35	—	—	—	—	—	—	—	—	—
WSAC-02	—	—	—	—	—	—	—	—	—
WSAC-06	—	—	—	—	—	—	—	—	—
WSAC-07	—	—	—	—	—	V0.004	—	—	—
WSAC-08	—	—	na	—	—	—	—	—	—
WSAC-09	—	—	—	—	—	—	—	—	—
WSAC-11	—	—	—	—	—	—	—	—	—
WSAC-12	—	—	—	—	—	—	—	—	—
WSAC-13	—	—	na	—	—	—	—	—	—
WSAC-14	—	—	na	—	—	—	—	—	—
WSAC-15	—	—	—	—	—	—	—	—	—
WSAC-16	—	—	na	—	—	—	—	—	—
WSAC-17	—	—	na	—	—	—	—	—	—

Table 6. Pesticides and pesticide degradates detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006. —Continued

[Results are from the U.S. Geological Survey's (USGS) National Water Quality Laboratory Schedules 2032, 2033, and 2060. Samples from all 108 wells were analyzed, but only wells with detections are listed. Constituents are grouped by primary use of source and within each group are listed in order of decreasing detection frequency in the 71 grid wells. The five-digit number in parentheses below the constituent name is used by the USGS to uniquely identify a specific constituent or property. CDPH, California Department of Public Health; E, estimated value; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-CA; maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); na, not available; no., number; RICE, RICE well; RSD5-US, U.S. Environmental Protection Agency risk specific dose at a risk factor of 10^{-5} µg/L (RSD5s are calculated by dividing the 10^{-4} cancer risk concentration established by the USEPA by 10); USEPA, U.S. Environmental Protection Agency; V, analyte detected in sample and an associated blank—thus data are not included in ground-water quality analysis results; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; µg/L, micrograms per liter; —, analyzed but not detected]

GAMA identification no.	Herbicides—continued						Insecticides		
	Bensulfuron-methyl (µg/L) (61693)	MCPA (µg/L) (38482)	Triclopyr (µg/L) (49235)	2,4-D, (µg/L) (39732)	Chlorimuron (µg/L) (50306)	Bromacil (µg/L) (04029)	Chlorpyrifos (µg/L) (38933)	Carbaryl (µg/L) (82680)	Fipronil (µg/L) (62166)
[LRL]	**[0.018]**	**[0.07]**	**[0.026]**	**[0.038]**	**[0.032]**	**0.018**	**[0.005]**	**[0.041]**	**[0.016]**
Threshold type[1]	**na**	**HAL-US**	**na**	**MCL-US**	**na**	**HAL-US**	**HAL-US**	**RSD5-US**	**na**
Threshold value	**na**	**30**	**na**	**70**	**na**	**70**	**2**	**400**	**na**
WSAC-18	—	—	—	—	—	—	—	—	—
WSAC-20	—	—	—	—	—	—	—	—	—
WSAC-23	—	—	—	—	—	—	—	—	—
WSAC-27	—	—	—	—	—	—	—	—	—
WSAC-28	—	—	—	—	—	—	—	—	—
WSAC-29	—	—	—	—	—	—	—	—	—
WSAC-31	—	—	—	—	—	—	—	—	—
WSAC-32	—	—	—	—	—	—	—	—	—
WSAC-34	—	—	—	—	—	—	—	—	—
WSAC-35	—	—	—	—	—	—	—	—	—
WSAC-36	—	—	—	—	—	—	—	—	—
Number of wells with detections	1	1	1	0	0	0	1	1	1
Detection frequency (percent)	1	1	1				1	1	1
Flow-path wells									
ESAC-FP-03	—	—	—	—	—	—	—	—	—
ESAC-FP-05	—	—	—	E0.004	—	—	—	—	—
ESAC-FP-06	—	—	E0.02	—	—	—	—	—	—
ESAC-FP-07	—	—	E0.01	—	—	—	—	—	—
WSAC-FP-06	—	—	—	—	—	—	—	—	—
WSAC-FP-08	—	—	—	—	—	—	—	—	—

Table 6. Pesticides and pesticide degradates detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006. —Continued

[Results are from the U.S. Geological Survey's (USGS) National Water Quality Laboratory Schedules 2032, 2033, and 2060. Samples from all 108 wells were analyzed, but only wells with detections are listed. Constituents are grouped by primary use of source and within each group are listed in order of decreasing detection frequency in the 71 grid wells. The five-digit number in parentheses below the constituent name is used by the USGS to uniquely identify a specific constituent or property. CDPH, California Department of Public Health; E, estimated value; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-CA; maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); na, not available; no., number; RICE, RICE well; RSD5-US, U.S. Environmental Protection Agency risk specific dose at a risk factor of 10^{-5} µg/L (RSD5s are calculated by dividing the 10^{-4} cancer risk concentration established by the USEPA by 10); USEPA, U.S. Environmental Protection Agency; V, analyte detected in sample and an associated blank—thus data are not included in ground-water quality analysis results; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; µg/L, micrograms per liter; —, analyzed but not detected]

GAMA identification no.	Herbicides—continued						Insecticides		
	Bensulfuron-methyl (µg/L) (61693)	MCPA (µg/L) (38482)	Triclopyr (µg/L) (49235)	2,4-D, (µg/L) (39732)	Chlorimuron (µg/L) (50306)	Bromacil (µg/L) (04029)	Chlorpyrifos (µg/L) (38933)	Carbaryl (µg/L) (82680)	Fipronil (µg/L) (62166)
[LRL]	**[0.018]**	**[0.07]**	**[0.026]**	**[0.038]**	**[0.032]**	**0.018**	**[0.005]**	**[0.041]**	**[0.016]**
Threshold type[1]	**na**	**HAL-US**	**na**	**MCL-US**	**na**	**HAL-US**	**HAL-US**	**RSD5-US**	**na**
Threshold value	**na**	**30**	**na**	**70**	**na**	**70**	**2**	**400**	**na**
				RICE wells					
RICE-01	—	—	—	—	—	—	—	—	—
RICE-03	—	—	—	—	—	—	—	—	—
RICE-04	—	—	—	—	—	—	—	—	—
RICE-06	—	—	—	—	—	—	—	—	—
RICE-07	—	—	—	—	—	—	—	—	—
RICE-08	—	—	—	—	—	—	—	—	—
RICE-09	—	—	—	—	—	—	—	—	—
RICE-10	—	—	—	—	1.57	—	—	—	—
RICE-11	—	—	—	—	—	—	—	—	—
RICE-12	—	—	—	—	—	—	—	—	—
RICE-13	—	—	—	—	—	—	—	—	—
RICE-14	—	—	—	—	—	—	—	—	—
RICE-15	—	—	—	—	—	—	—	—	—
RICE-16	—	—	—	—	—	—	—	—	—
RICE-17	—	—	—	—	—	—	—	—	—
RICE-18	—	—	—	—	—	—	—	—	—
RICE-19	—	—	—	—	—	—	—	—	—
RICE-20	—	—	—	—	—	—	—	—	—
RICE-21	—	—	—	—	—	—	—	—	—
RICE-22	—	—	—	—	—	—	—	—	—

Table 6. Pesticides and pesticide degradates detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006. —Continued

[Results are from the U.S. Geological Survey's (USGS) National Water Quality Laboratory Schedules 2032, 2033, and 2060. Samples from all 108 wells were analyzed, but only wells with detections are listed. Constituents are grouped by primary use of source and within each group are listed in order of decreasing detection frequency in the 71 grid wells. The five-digit number in parentheses below the constituent name is used by the USGS to uniquely identify a specific constituent or property. CDPH, California Department of Public Health; E, estimated value; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-CA; maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); na, not available; no., number; RICE, RICE well; RSD5-US, U.S. Environmental Protection Agency risk specific dose at a risk factor of 10^{-5} µg/L (RSD5s are calculated by dividing the 10^{-4} cancer risk concentration established by the USEPA by 10); USEPA, U.S. Environmental Protection Agency; V, analyte detected in sample and an associated blank—thus data are not included in ground-water quality analysis results; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; µg/L, micrograms per liter; —, analyzed but not detected]

GAMA identification no.	Fungicides		Degradates							Pesticide detections per well
	cis-Propiconazole (µg/L) (79846)	*trans*-Propiconazole (µg/L) (79847)	Deethylatrazine (µg/L) (04040)	3,4-Dichloroaniline (µg/L) (61625)	Hydroxyatrazine (µg/L) (50355)	Desulfinylfipronil (µg/L) (62170)	Fipronil sulfide (µg/L) (62167)	Fipronil sulfone (µg/L) (62168)	Deisopropylatrazine (µg/L) (04038)	
[LRL]	[0.013]	[0.034]	[0.028]	[0.0045]	[0.032]	[0.012]	[0.013]	[0.024]	[0.08]	
Threshold type[1]	na	na	na	na	na	na	na	na	na	
Threshold value	na	na	na	na	na	na	na	na	na	
					Grid wells					
ESAC-01	—	—	E0.006	—	—	—	—	—	—	3
ESAC-05	—	—	—	—	—	—	—	—	—	0
ESAC-09	—	—	—	E0.541	—	—	—	—	—	9
ESAC-10	—	—	E0.008	—	—	—	—	—	—	3
ESAC-20	—	—	—	—	—	—	—	—	—	2
ESAC-22	—	—	—	—	—	—	—	—	—	2
ESAC-23	—	—	E0.022	—	—	E0.008	E0.006	E0.008	—	10
ESAC-24	—	—	E0.007	—	—	—	—	—	—	3
ESAC-26	—	—	—	—	—	—	—	—	—	1
ESAC-27	—	—	E0.011	—	—	—	—	—	—	4
ESAC-28	—	—	E0.009	—	—	—	—	—	—	3
ESAC-31	—	—	—	—	—	—	—	—	—	1
ESAC-32	—	—	—	—	—	—	—	—	—	1
ESAC-33	—	—	E0.01	—	—	—	—	—	—	4
ESAC-34	—	—	—	—	—	—	—	—	—	2
ESAC-35	—	—	—	—	—	—	—	—	—	1
WSAC-02	—	—	E0.057	E0.006	E0.003	—	—	—	—	5
WSAC-06	—	—	E0.007	—	na	—	—	—	—	3
WSAC-07	—	—	E0.006	—	—	—	—	—	—	3
WSAC-08	—	—	E0.007	—	—	—	—	—	—	1
WSAC-09	—	—	E0.009	—	—	—	—	—	—	3
WSAC-11	—	—	—	—	—	—	—	—	—	1
WSAC-12	—	—	—	—	—	—	—	—	—	1
WSAC-13	—	—	—	—	—	—	—	—	—	1
WSAC-14	—	—	—	—	—	—	—	—	—	1
WSAC-15	—	—	E0.005	—	—	—	—	—	—	5
WSAC-16	—	—	—	—	—	—	—	—	—	1

Table 6. Pesticides and pesticide degradates detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006. —Continued

[Results are from the U.S. Geological Survey's (USGS) National Water Quality Laboratory Schedules 2032, 2033, and 2060. Samples from all 108 wells were analyzed, but only wells with detections are listed. Constituents are grouped by primary use of source and within each group are listed in order of decreasing detection frequency in the 71 grid wells. The five-digit number in parentheses below the constituent name is used by the USGS to uniquely identify a specific constituent or property. CDPH, California Department of Public Health; E, estimated value; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-CA; maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); na, not available; no., number; RICE, RICE well; RSD5-US, U.S. Environmental Protection Agency risk specific dose at a risk factor of 10^{-5} µg/L (RSD5s are calculated by dividing the 10^{-4} cancer risk concentration established by the USEPA by 10); USEPA, U.S. Environmental Protection Agency; V, analyte detected in sample and an associated blank—thus data are not included in ground-water quality analysis results; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; µg/L, micrograms per liter; —, analyzed but not detected]

GAMA identification no.	Fungicides		Degradates							Pesticide detections per well
	cis-Propiconazole (µg/L) (79846)	*trans*-Propiconazole (µg/L) (79847)	Deethylatrazine (µg/L) (04040)	3,4-Dichloroaniline (µg/L) (61625)	Hydroxyatrazine (µg/L) (50355)	Desulfinylfipronil (µg/L) (62170)	Fipronil sulfide (µg/L) (62167)	Fipronil sulfone (µg/L) (62168)	Deisopropylatrazine (µg/L) (04038)	
[LRL]	[0.013]	[0.034]	[0.028]	[0.0045]	[0.032]	[0.012]	[0.013]	[0.024]	[0.08]	
Threshold type[1]	na	na	na	na	na	na	na	na	na	
Threshold value	na	na	na	na	na	na	na	na	na	
WSAC-17	—	—	—	E0.005	E0.024	—	—	—	—	4
WSAC-18	—	—	—	—	—	—	—	—	—	1
WSAC-20	—	—	E0.006	—	—	—	—	—	—	5
WSAC-23	—	—	—	—	—	—	—	—	—	1
WSAC-27	—	—	—	—	—	—	—	—	—	1
WSAC-28	—	—	E0.005	—	—	—	—	—	—	1
WSAC-29	—	—	E0.005	—	—	—	—	—	—	3
WSAC-31	—	—	—	—	—	—	—	—	—	1
WSAC-32	—	—	E0.006	—	—	—	—	—	—	4
WSAC-34	—	—	E0.007	—	—	—	—	—	—	2
WSAC-35	—	—	E0.006	E0.006	—	—	—	—	—	6
WSAC-36	—	—	—	—	—	—	—	—	—	1
Number of wells with detections	0	0	19	4	3	1	1	1	0	
Detection frequency (percent)			27	6	4	1	1	1		[2]54
Flow-path wells										
ESAC-FP-03	—	—	—	—	—	—	—	—	—	1
ESAC-FP-05	—	—	—	—	—	—	—	—	—	2
ESAC-FP-06	E0.001	E0.01	—	—	—	—	—	—	—	3
ESAC-FP-07	—	—	—	—	—	—	—	—	—	1
WSAC-FP-06	—	—	—	—	—	—	—	—	E0.04	1
WSAC-FP-08	—	—	—	—	—	—	—	—	—	1

Table 6. Pesticides and pesticide degradates detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006. —Continued

[Results are from the U.S. Geological Survey's (USGS) National Water Quality Laboratory Schedules 2032, 2033, and 2060. Samples from all 108 wells were analyzed, but only wells with detections are listed. Constituents are grouped by primary use of source and within each group are listed in order of decreasing detection frequency in the 71 grid wells. The five-digit number in parentheses below the constituent name is used by the USGS to uniquely identify a specific constituent or property. CDPH, California Department of Public Health; E, estimated value; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-CA; maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); na, not available; no., number; RICE, RICE well; RSD5-US, U.S. Environmental Protection Agency risk specific dose at a risk factor of 10^{-5} µg/L (RSD5s are calculated by dividing the 10^{-4} cancer risk concentration established by the USEPA by 10); USEPA, U.S. Environmental Protection Agency; V, analyte detected in sample and an associated blank—thus data are not included in ground-water quality analysis results; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; µg/L, micrograms per liter; —, analyzed but not detected]

GAMA identification no.	Fungicides		Degradates							Pesticide detections per well
	cis-Propiconazole (µg/L) (79846)	*trans*-Propiconazole (µg/L) (79847)	Deethylatrazine (µg/L) (04040)	3,4-Dichloroaniline (µg/L) (61625)	Hydroxyatrazine (µg/L) (50355)	Desulfinylfipronil (µg/L) (62170)	Fipronil sulfide (µg/L) (62167)	Fipronil sulfone (µg/L) (62168)	Deisopropylatrazine (µg/L) (04038)	
[LRL]	**[0.013]**	**[0.034]**	**[0.028]**	**[0.0045]**	**[0.032]**	**[0.012]**	**[0.013]**	**[0.024]**	**[0.08]**	
Threshold type[1]	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	
Threshold value	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	
RICE wells										
RICE-01	—	—	—	—	—	—	—	—	—	1
RICE-03	—	—	E0.006	—	—	—	—	—	—	4
RICE-04	—	—	—	—	—	—	—	—	—	1
RICE-06	—	—	—	E0.004	—	—	—	—	—	3
RICE-07	—	—	—	—	—	—	—	—	—	1
RICE-08	—	—	—	—	—	—	—	—	—	1
RICE-09	—	—	—	—	—	—	—	—	—	2
RICE-10	—	—	—	E0.091	—	—	—	—	0.15	4
RICE-11	—	—	E0.006	—	—	—	—	—	—	4
RICE-12	—	—	E0.006	E0.006	—	—	—	—	—	5
RICE-13	—	—	—	—	—	—	—	—	—	1
RICE-14	—	—	—	—	—	—	—	—	—	2
RICE-15	—	—	—	—	—	—	—	—	—	2
RICE-16	—	—	—	—	—	—	—	—	—	1
RICE-17	—	—	—	E0.005	—	—	—	—	—	2
RICE-18	—	—	—	—	—	—	—	—	—	1
RICE-19	—	—	E0.006	—	—	—	—	—	—	3
RICE-20	—	—	—	—	—	—	—	—	—	2
RICE-21	—	—	—	—	—	—	—	—	—	1
RICE-22	—	—	—	—	—	—	—	—	—	2

[1] Maximum contaminant level thresholds are listed as MCL-US when MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists.

[2] Frequency of detection of at least one pesticide in the grid wells. Detections with V remark codes are not included.

Table 7. Constituents of special interest (perchlorate, *N*-nitrosodimethylamine [NDMA], and 1,2,3-trichloropropane [1,2,3-TCP]) detected in samples collected in the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.

[Samples from all 108 wells were analyzed for perchlorate; samples from 45 grid wells and 15 flow-path wells were sampled for NDMA and 1,2,3-TCP; only wells with at least one detection are listed. Analyses done by the Mongomery Watson Harza laboratory. The laboratory entity code for the Montgomery Watson Harza laboratory in the U. S. Geological Survey's National Water Information System (NWIS) is CA-MWHL. CDPH, California Department of Public Health; ESAC, East study area of the middle Sacramento Valley study unit; MCL-CA, maximum contaminant level (CDPH); MRL, minimum reporting level; no., number; RICE, RICE well; WSAC, West study area of the middle Sacramento Valley study unit; µg/L, micrograms per liter]

GAMA identification no.	**Perchlorate (µg/L)**
Threshold Type	**MCL-CA**
Threshold (µg/L)	**6**
[MRL]	**[0.5]**
Grid wells	
ESAC-03	0.6
ESAC-04	1.4
WSAC-20	0.6
WSAC-24	1.4
Number of wells with detections	4
Detection frequency (percent)	6
RICE wells	
RICE-10	1.3

Table 8. Nutrients and dissolved organic carbon detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.

[Samples from the 45 slow and intermediate grid wells, 15 flow-path wells, and 22 RICE wells were analyzed for nutrients; samples from all slow grid wells and all RICE wells were analyzed for dissolved organic carbon. The five-digit number in parentheses below the constituent name in the headings is used by the U.S. Geological Survey (USGS) to uniquely identify a specific constituent or property. E, estimated value; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-US, maximum contaminant level (USEPA); mg/L, milligrams per liter; na, not available; nc, not collected; no., number; RICE, RICE well; USEPA, U.S. Environmental Protection Agency; V, analyte detected in sample and an associated blank—thus data are not included in ground-water quality analysis results; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; —, analyzed but not detected; *, value above threshold level]

GAMA identification no.	Ammonia (mg/L) as nitrogen (00608)	Nitrite plus nitrate (mg/L) as nitrogen (00631)	Nitrite (mg/L) as nitrogen (00613)	Total nitrogen (nitrate + nitrite + ammonia + organic-N) (mg/L) (62854)	Orthophosphate (mg/L) as phosphorus (00671)	Dissolved organic carbon (DOC) (mg/L) (00681)
[LRL]	**[0.01]**	**[0.06]**	**[0.002]**	**[0.06]**	**[0.006]**	**[0.33]**
Threshold type[1]	**HAL-US**	**MCL-US**	**MCL-US**	**na**	**na**	**na**
Threshold value	[2]**24.7**	**10**	**1**	**na**	**na**	**na**
			Grid wells			
ESAC-03	—	2.46	—	2.50	0.075	nc
ESAC-05	—	6.25	—	6.25	0.168	nc
ESAC-06	—	0.79	—	0.82	0.118	nc
ESAC-10	0.016	0.30	0.005	0.34	0.095	nc
ESAC-11	—	—	—	—	0.100	nc
ESAC-12	—	0.82	—	[3]0.81	0.058	nc
ESAC-15	E0.008	—	—	[4]—	V0.003	nc
ESAC-16	E0.008	0.78	—	[5]0.71	0.092	nc
ESAC-17	0.075	—	—	V0.07	0.167	nc
ESAC-18	E0.006	0.74	—	[5]0.67	0.086	nc
ESAC-19	—	0.50	—	[5]0.45	0.090	nc
ESAC-21	0.117	—	—	V0.16	0.120	nc
ESAC-22	—	*10.4	—	8.81	0.053	nc
ESAC-25	—	0.54	—	0.54	0.112	E0.2
ESAC-26	0.056	—	—	V0.04	0.499	0.5
ESAC-27	E0.008	0.86	—	0.92	0.100	0.8
ESAC-28	—	1.62	—	[3]1.58	0.194	E0.3
ESAC-29	0.095	—	—	V0.12	0.240	nc
ESAC-30	—	0.13	0.011	V0.16	0.256	nc
ESAC-31	E0.006	0.13	E0.001	V0.14	0.101	nc
ESAC-32	—	0.92	—	0.95	0.090	nc
ESAC-34	—	0.89	—	0.91	0.108	nc
ESAC-35	—	0.76	—	0.78	0.066	nc
WSAC-03	—	3.38	—	[3]3.3	0.036	E0.2
WSAC-04	E0.005	—	—	[4]—	0.040	nc
WSAC-06	—	1.03	—	1.10	0.028	nc
WSAC-08	E0.006	3.43	—	[3]3.23	0.031	E0.3
WSAC-10	—	6.49	—	[3]6.35	0.027	nc
WSAC-11	—	2.27	—	[3]2.13	0.065	nc
WSAC-12	0.124	—	—	V0.17	0.200	0.5
WSAC-14	0.011	1.29	0.003	[3]1.26	0.077	nc
WSAC-15	—	*13	—	13.50	0.047	nc

Table 8. Nutrients and dissolved organic carbon detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.—Continued

[Samples from the 45 slow and intermediate grid wells, 15 flow-path wells, and 22 RICE wells were analyzed for nutrients; samples from all slow grid wells and all RICE wells were analyzed for dissolved organic carbon. The five-digit number in parentheses below the constituent name in the headings is used by the U.S. Geological Survey (USGS) to uniquely identify a specific constituent or property. E, estimated value; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-US, maximum contaminant level (USEPA); mg/L, milligrams per liter; na, not available; nc, not collected; no., number; RICE, RICE well; USEPA, U.S. Environmental Protection Agency; V, analyte detected in sample and an associated blank—thus data are not included in ground-water quality analysis results; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; —, analyzed but not detected; *, value above threshold level]

GAMA identification no.	Ammonia (mg/L) as nitrogen (00608)	Nitrite plus nitrate (mg/L) as nitrogen (00631)	Nitrite (mg/L) as nitrogen (00613)	Total nitrogen (nitrate + nitrite + ammonia + organic-N) (mg/L) (62854)	Orthophosphate (mg/L) as phosphorus (00671)	Dissolved organic carbon (DOC) (mg/L) (00681)
[LRL]	**[0.01]**	**[0.06]**	**[0.002]**	**[0.06]**	**[0.006]**	**[0.33]**
Threshold type[1]	**HAL-US**	**MCL-US**	**MCL-US**	**na**	**na**	**na**
Threshold value	[2]**24.7**	**10**	**1**	**na**	**na**	**na**
WSAC-17	—	0.73	—	[3]0.72	0.257	nc
WSAC-18	—	0.57	0.003	0.59	0.070	E0.2
WSAC-21	—	6.04	—	[3]5.73	0.081	nc
WSAC-22	E0.008	1.24	—	[3]1.22	0.047	nc
WSAC-25	E0.006	E0.05	—	V0.06	0.101	nc
WSAC-26	E0.005	3.02	—	3.15	0.049	nc
WSAC-28	—	2.54	—	2.64	0.097	nc
WSAC-29	E0.005	1.84	—	1.89	0.043	nc
WSAC-30	E0.005	7.38	—	[3]7.36	0.037	nc
WSAC-31	—	0.77	—	[3]0.75	0.077	nc
WSAC-34	—	9.10	—	[3]8.99	0.032	nc
WSAC-35	—	0.97	—	1.04	0.036	nc
WSAC-36	—	0.45	—	0.51	0.103	nc
			Flow-path wells			
ESAC-FP-01	0.320	—	—	V0.33	0.031	nc
ESAC-FP-02	—	2.37	0.010	[3]2.20	0.033	nc
ESAC-FP-03	—	0.33	0.018	V0.35	0.084	nc
ESAC-FP-04	—	0.16	0.002	V0.14	0.056	nc
ESAC-FP-05	—	6.01	E0.002	[3]5.61	0.100	nc
ESAC-FP-06	0.027	—	—	[4]—	0.062	nc
ESAC-FP-07	0.028	—	—	[4]—	0.077	nc
WSAC-FP-01	V0.007	1.32	—	1.42	0.050	nc
WSAC-FP-02	V0.007	0.76	—	0.76	0.038	nc
WSAC-FP-03	V0.009	2.82	E0.001	2.78	0.040	nc
WSAC-FP-04	0.014	—	—	[4]—	0.063	nc
WSAC-FP-05	E0.009	E0.03	E0.002	V0.07	0.064	nc
WSAC-FP-06	—	0.27	0.008	V0.27	0.034	nc
WSAC-FP-07	V0.009	—	—	[4]—	0.055	nc
WSAC-FP-08	—	1.89	—	1.97	0.052	nc

Table 8. Nutrients and dissolved organic carbon detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.—Continued

[Samples from the 45 slow and intermediate grid wells, 15 flow-path wells, and 22 RICE wells were analyzed for nutrients; samples from all slow grid wells and all RICE wells were analyzed for dissolved organic carbon. The five-digit number in parentheses below the constituent name in the headings is used by the U.S. Geological Survey (USGS) to uniquely identify a specific constituent or property. E, estimated value; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-US, maximum contaminant level (USEPA); mg/L, milligrams per liter; na, not available; nc, not collected; no., number; RICE, RICE well; USEPA, U.S. Environmental Protection Agency; V, analyte detected in sample and an associated blank—thus data are not included in ground-water quality analysis results; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; —, analyzed but not detected; *, value above threshold level]

GAMA identification no.	Ammonia (mg/L) as nitrogen (00608)	Nitrite plus nitrate (mg/L) as nitrogen (00631)	Nitrite (mg/L) as nitrogen (00613)	Total nitrogen (nitrate + nitrite + ammonia + organic-N) (mg/L) (62854)	Orthophosphate (mg/L) as phosphorus (00671)	Dissolved organic carbon (DOC) (mg/L) (00681)
[LRL]	**[0.01]**	**[0.06]**	**[0.002]**	**[0.06]**	**[0.006]**	**[0.33]**
Threshold type[1]	**HAL-US**	**MCL-US**	**MCL-US**	**na**	**na**	**na**
Threshold value	**[2]24.7**	**10**	**1**	**na**	**na**	**na**
			RICE wells			
RICE-01	0.517	—	—	0.51	0.109	—
RICE-02	—	0.88	—	0.86	0.149	V0.8
RICE-03	—	1.72	—	1.67	0.057	V0.9
RICE-04	V0.007	0.47	—	0.55	0.093	1.1
RICE-05	V0.013	—	—	V0.13	0.099	2.4
RICE-06	V0.005	0.27	—	V0.32	0.079	1.6
RICE-07	V0.006	0.11	—	V0.11	0.098	1.0
RICE-08	—	1.83	—	1.78	0.082	V0.5
RICE-09	—	E0.04	—	V0.07	0.101	V0.7
RICE-19	V0.008	—	—	V0.06	0.106	1.1
RICE-20	V0.005	3.77	0.005	3.80	0.326	1.4
RICE-10	—	0.36	—	V0.37	0.160	1.0
RICE-11	V0.008	4.93	0.006	4.98	0.058	2.6
RICE-12	V0.01	0.40	0.006	0.47	0.115	1.4
RICE-13	—	3.82	0.026	3.75	0.104	2.3
RICE-14	—	—	—	V0.1	0.051	2.3
RICE-15	—	0.30	—	V0.31	0.097	1.3
RICE-16	V0.007	0.08	0.003	V0.1	0.086	1.2
RICE-17	V0.005	0.88	—	0.99	0.100	2.1
RICE-18	V0.006	0.71	—	0.78	0.076	V0.7
RICE-21	V0.011	0.17	—	V0.21	0.041	V0.8
RICE-22	V0.011	—	—	V0.08	0.048	1.3

[1]Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists.

[2] The HAL-US is 30 mg/L "as ammonia." To facilitate comparison to the analytical results, we have converted and reported this HAL-US as 24.7 mg/L "as nitrogen."

[3]Total nitrogen in these samples is less than the sum of the filtered nitrogen analytes, but falls within the USGS's National Water Quality Laboratory acceptance criteria of a 10 percent relative percent difference.

[4]Total nitrogen in these samples is less than the sum of the filtered nitrogen analytes and exceeds the USGS's National Water Quality Laboratory acceptance criteria of 10 percent relative difference, but the sum of the filtered nitrogen analytes is less than the LRL for total nitrogen.

[5]Total nitrogen in these samples is less than the sum of the filtered nitrogen analytes and exceeds the USGS's National Water Quality Laboratory acceptance criteria of 10 percent relative difference. Values were verified by the laboratory.

Table 9. Major and minor ions and total dissolved solids detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.

[Samples from the 45 slow and intermediate grid wells, 15 flow-path wells, and 22 RICE wells were analyzed. The five-digit number in parentheses below the constituent name in the headings is used by the U.S. Geological Survey to uniquely identify a specific constituent or property. CDPH, California Department of Public Health; E, estimated value; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; LRL, laboratory reporting level; MCL-CA, maximum contaminant level (CDPH); mg/L, milligrams per liter; na, not available; no., number; RICE, RICE well; SMCL-CA, secondary maximum contaminant level (CDPH); WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; —, analyzed but not detected; *, value above threshold level; **, value above upper threshold level]

GAMA identification no.	Bromide (mg/L) (71870)	Calcium (mg/L) (00915)	Chloride (mg/L) (00940)	Fluoride (mg/L) (00950)	Iodide (mg/L) (71865)	Magnesium (mg/L) (00925)	Potassium (mg/L) (00935)	Silica (mg/L) (00955)	Sodium (mg/L) (00930)	Sulfate (mg/L) (00945)	Total dissolved solids (TDS) (mg/L) (70301)	Bicarbonate[1] (mg/L as $CaCO_3$)	Carbonate[1] (mg/L as $CaCO_3$)
Threshold type[2]	na	na	SMCL-CA[3]	MCL-CA	na	na	na	na	na	SMCL-CA[3]	SMCL-CA[3]	na	na
Threshold (mg/L)	na	na	250 (500)	2.00	na	na	na	na	na	250 (500)	500 (1,000)	na	na
[LRL]	[0.02]	[0.02]	[0.2]	[0.1]	[0.002]	[0.008]	[0.16]	[0.04]	[0.2]	[0.18]	[10]	[1]	[1]
Grid wells													
ESAC-03	0.06	29.1	21.5	E0.09	0.002	16.4	1.39	34.2	38.1	33.5	274	177	1
ESAC-05	0.11	32.7	7.85	E0.07	0.002	36.8	3.51	63.6	19.1	44.1	353	237	1
ESAC-06	—	18.1	2.26	E0.08	—	12.1	1.75	71.7	7.33	1.5	183	129	—
ESAC-10	0.11	40.6	36.6	0.15	0.036	28.1	1.73	42.7	23.6	13.9	316	255	—
ESAC-11	0.03	13.6	4.62	E0.07	0.019	10.5	3.73	75.7	17.1	2.0	194	135	—
ESAC-12	0.05	23.9	12.9	0.12	E0.001	12.5	1.59	34.9	30	9.5	237	217	1
ESAC-15	0.03	22.4	8.13	E0.07	—	14.4	1.17	60.0	11.9	6.3	195	143	—
ESAC-16	0.08	18.9	36.3	E0.08	—	14.0	3.25	63.7	35.9	10.3	267	163	—
ESAC-17	0.23	55.4	124	0.11	0.079	48.9	5.10	50.3	61.7	22.0	* 552	369	1
ESAC-18	—	17.9	5.12	E0.09	—	11.3	2.38	59.1	10.7	2.6	179	134	—
ESAC-19	E0.01	38.1	9.65	0.24	—	17.8	3.46	69.5	24.7	25.0	306	232	—
ESAC-21	1.71	58.2	** 626	—	1.110	25.0	8.28	36.8	401	—	**1,290	264	1
ESAC-22	0.05	23.0	11.4	—	E0.001	17.4	0.31	60.6	12	21.0	240	99	—
ESAC-25	—	17.2	2.07	E0.09	—	11.3	1.35	67.4	8.43	2.5	177	129	—
ESAC-26	—	8.84	4.12	0.14	0.025	7.85	1.20	47.4	47.7	4.0	212	196	1
ESAC-27	0.14	39.6	19.6	E0.06	0.037	29.0	1.68	50.1	20.6	20.6	312	269	—
ESAC-28	0.02	24.1	5.55	0.14	E0.001	26.4	2.62	61.2	15.2	6.8	259	226	—
ESAC-29	0.07	24.5	15.0	E0.08	0.068	15.6	2.44	37.1	54.8	10.6	297	272	1
ESAC-30	0.16	18.7	58.5	0.11	0.040	21.7	1.67	48.6	36.6	7.3	268	146	1
ESAC-31	0.09	50.1	27.9	E0.08	0.105	32.2	2.49	50.3	49.5	17.4	410	360	1
ESAC-32	E0.02	32.5	4.62	—	—	21.7	1.45	52.1	9.17	12.6	243	212	—
ESAC-34	0.08	50.3	13.5	0.11	0.003	34.4	1.83	62.4	26.9	38.6	397	332	1
ESAC-35	—	28.8	2.60	—	—	19.2	1.55	57.0	10.2	8.4	232	204	—
WSAC-03	—	32.3	7.11	0.10	—	16.2	0.70	28.9	12.8	20.8	207	162	—
WSAC-04	0.03	16.5	5.11	0.18	0.021	15.9	0.56	24.9	34.2	1.2	203	208	2
WSAC-06	0.05	40.5	15.2	0.29	0.003	37.7	0.57	30.3	24.4	24.7	344	335	—
WSAC-08	0.05	67.5	21.4	E0.09	E0.001	19.7	0.84	19.5	17.9	25.8	310	269	—
WSAC-10	0.06	66.5	23.1	E0.08	E0.002	23.8	0.87	21.8	21.8	31.8	329	281	—
WSAC-11	0.28	29.4	87.4	0.21	0.006	29.9	1.05	30.0	51.9	10.5	365	229	1
WSAC-12	0.25	22.8	50.8	0.11	0.125	16.2	1.50	41.3	115	62.3	440	257	1
WSAC-14	0.81	84.5	236	0.42	0.524	70.4	2.12	42.0	259	* 429	** 1,330	393	1
WSAC-15	0.12	48.6	27.1	0.29	0.010	35.6	1.80	26.0	101	49.5	* 584	472	1

Table 9. Major and minor ions and total dissolved solids detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.—Continued

[Samples from the 45 slow and intermediate grid wells, 15 flow-path wells, and 22 RICE wells were analyzed. The five-digit number in parentheses below the constituent name in the headings is used by the U.S. Geological Survey to uniquely identify a specific constituent or property. CDPH, California Department of Public Health; E, estimated value; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; LRL, laboratory reporting level; MCL-CA, maximum contaminant level (CDPH); mg/L, milligrams per liter; na, not available; no., number; RICE, RICE well; SMCL-CA, secondary maximum contaminant level (CDPH); WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; —, analyzed but not detected; *, value above threshold level; **, value above upper threshold level]

GAMA identification no.	Bromide (mg/L) (71870)	Calcium (mg/L) (00915)	Chloride (mg/L) (00940)	Fluoride (mg/L) (00950)	Iodide (mg/L) (71865)	Magnesium (mg/L) (00925)	Potassium (mg/L) (00935)	Silica (mg/L) (00955)	Sodium (mg/L) (00930)	Sulfate (mg/L) (00945)	Total dissolved solids (TDS) (mg/L) (70301)	Bicarbonate[1] (mg/L as $CaCO_3$)	Carbonate[1] (mg/L as $CaCO_3$)
Threshold type[2]	na	na	SMCL-CA[3]	MCL-CA	na	na	na	na	na	SMCL-CA[3]	SMCL-CA[3]	na	na
Threshold (mg/L)	na	na	250 (500)	2.00	na	na	na	na	na	250 (500)	500 (1,000)	na	na
[LRL]	[0.02]	[0.02]	[0.2]	[0.1]	[0.002]	[0.008]	[0.16]	[0.04]	[0.2]	[0.18]	[10]	[1]	[1]
WSAC-17	E0.01	27.3	7.38	0.12	0.008	23.4	1.62	37.6	29.7	20.6	275	248	—
WSAC-18	0.40	50.5	96.4	0.47	0.420	37.6	1.26	28.2	117	110	* 623	388	1
WSAC-21	0.04	27.6	14.0	0.30	0.003	19.8	0.50	29.9	26.9	7.0	257	209	—
WSAC-22	0.16	29.8	34.1	0.20	0.026	24.5	1.05	22.4	39.9	12.0	297	256	1
WSAC-25	0.08	23.0	17.5	0.18	0.013	22.4	2.35	41.5	44.1	8.3	294	268	1
WSAC-26	0.03	33.3	2.80	0.43	—	16.3	0.56	30.0	11.7	3.9	208	192	—
WSAC-28	0.04	43.8	20.1	E0.08	—	22.1	0.69	26.1	10.9	21.0	258	204	—
WSAC-29	0.05	20.9	8.49	0.29	0.008	21.5	0.80	23.3	36.2	11.9	253	242	1
WSAC-30	1.29	79.5	* 358	0.64	—	68.5	0.53	21.4	136	87.0	* 910	248	1
WSAC-31	0.03	18.9	4.23	0.19	E0.002	11.3	0.74	28.2	25	11.1	181	155	1
WSAC-34	0.08	88.9	74.0	E0.09	E0.002	38.5	1.10	23.4	23.4	39.4	486	315	—
WSAC-35	0.02	45.2	16.9	E0.07	0.003	18.9	0.86	22.9	23.6	19.9	277	250	—
WSAC-36	—	24.6	4.41	0.17	0.020	22.5	1.03	30.7	31.7	8.0	256	262	1
Flow-path wells													
ESAC-FP-01	0.31	45.3	124	E0.09	0.026	9.09	1.87	65.1	39	—	331	91	—
ESAC-FP-02	0.03	40.3	13.5	E0.06	E0.002	26.0	1.54	60.2	18.5	11.3	304	246	—
ESAC-FP-03	—	33.0	2.43	E0.05	0.008	23.5	1.34	56.4	10.3	9.2	257	240	—
ESAC-FP-04	—	14.3	1.79	—	E0.002	11.2	2.29	57.7	10.9	2.1	166	130	1
ESAC-FP-05	—	66.1	9.43	E0.08	0.006	41.5	2.75	51.0	22.4	26.5	460	431	1
ESAC-FP-06	0.07	13.5	19.4	E0.09	0.054	3.99	2.88	41.8	51.7	1.4	216	152	6
ESAC-FP-07	0.13	14.6	35.9	E0.09	0.101	4.69	2.73	46.9	68.8	0.3	270	187	3
WSAC-FP-01	E0.02	24.7	2.33	0.33	—	20.5	0.76	31.1	19.9	1.7	217	220	1
WSAC-FP-02	0.04	20.6	11.1	0.15	0.002	16.7	0.75	27.3	21.8	8.9	197	172	1
WSAC-FP-03	0.05	35.4	15.7	0.13	E0.001	24.8	0.75	30.2	16.4	16.7	259	213	1
WSAC-FP-04	0.05	19.9	13.9	0.13	0.032	7.34	1.89	21.3	34.5	0.6	189	174	3
WSAC-FP-05	0.41	28.7	100	0.29	0.227	25.3	2.38	40.4	128	88.4	* 565	302	1
WSAC-FP-06	0.10	16.0	22.4	0.18	0.055	15.8	0.87	21.1	30.4	7.6	202	168	2
WSAC-FP-07	0.07	15.9	15.1	0.12	0.041	7.21	1.56	37.1	41.1	7.2	213	173	2
WSAC-FP-08	0.04	36.9	10.5	0.12	E0.002	18.6	0.73	25.5	18.5	12.6	244	224	1

Table 9. Major and minor ions and total dissolved solids detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.—Continued

[Samples from the 45 slow and intermediate grid wells, 15 flow-path wells, and 22 RICE wells were analyzed. The five-digit number in parentheses below the constituent name in the headings is used by the U.S. Geological Survey to uniquely identify a specific constituent or property. CDPH, California Department of Public Health; E, estimated value; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; LRL, laboratory reporting level; MCL-CA, maximum contaminant level (CDPH); mg/L, milligrams per liter; na, not available; no., number; RICE, RICE well; SMCL-CA, secondary maximum contaminant level (CDPH); WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; —, analyzed but not detected; *, value above threshold level; **, value above upper threshold level]

GAMA identification no.	Bromide (mg/L) (71870)	Calcium (mg/L) (00915)	Chloride (mg/L) (00940)	Fluoride (mg/L) (00950)	Iodide (mg/L) (71865)	Magnesium (mg/L) (00925)	Potassium (mg/L) (00935)	Silica (mg/L) (00955)	Sodium (mg/L) (00930)	Sulfate (mg/L) (00945)	Total dissolved solids (TDS) (mg/L) (70301)	Bicarbonate[1] (mg/L as $CaCO_3$)	Carbonate[1] (mg/L as $CaCO_3$)
Threshold type[2]	na	na	SMCL-CA[3]	MCL-CA	na	na	na	na	na	SMCL-CA[3]	SMCL-CA[3]	na	na
Threshold (mg/L)	na	na	250 (500)	2.00	na	na	na	na	na	250 (500)	500 (1,000)	na	na
[LRL]	[0.02]	[0.02]	[0.2]	[0.1]	[0.002]	[0.008]	[0.16]	[0.04]	[0.2]	[0.18]	[10]	[1]	[1]
RICE wells													
RICE-01	12.60	814	** 4730	—	nc	447	11.50	24.3	1250	[4]—	** 7,390	135	—
RICE-02	0.05	41.5	8.07	E0.08	nc	36.5	0.87	52.4	33.3	23.3	402	406	1
RICE-03	0.19	67.4	34.4	E0.08	nc	43.9	2.54	58.4	53.3	37.8	* 566	525	1
RICE-04	—	63.3	7.05	0.18	nc	40.2	2.05	57.3	16.9	17.7	404	399	—
RICE-05	0.07	85.1	16.9	0.13	nc	54.7	1.66	70.2	35.5	48.0	* 569	519	—
RICE-06	—	68.7	2.44	0.11	nc	51.9	1.36	67.9	16.1	15.2	456	468	—
RICE-07	0.04	73.0	3.88	0.15	nc	52.4	1.36	52.3	23.1	28.1	488	511	1
RICE-08	0.05	68.2	9.57	E0.1	nc	49.0	1.12	52.4	34.3	36.4	487	459	1
RICE-09	—	22.5	3.05	E0.09	nc	15.1	0.77	39.6	11	5.1	174	155	1
RICE-10	0.03	36.8	3.85	0.24	nc	18.8	0.69	28.5	11.2	7.8	212	204	1
RICE-11	0.10	91.3	26.8	0.18	nc	60.6	0.62	33.4	27.8	49.4	* 562	504	—
RICE-12	0.08	59.9	14.0	0.32	nc	45.6	0.50	30.5	55	20.4	468	482	1
RICE-13	0.10	66.5	26.7	0.12	nc	50.2	0.91	32.7	56.7	37.4	* 539	506	1
RICE-14	0.07	59.5	9.67	0.19	nc	50.9	0.49	28.8	47.7	38.4	478	488	—
RICE-15	0.04	39.2	7.10	0.89	nc	47.7	0.45	21.9	105	79.5	* 566	529	2
RICE-16	0.15	29.2	23.9	1.70	nc	31.9	0.56	17.6	356	* 375	** 1,200	723	2
RICE-17	0.60	92.8	147	1.70	nc	114	0.72	21.5	838	** 2,080	** 3,510	423	2
RICE-18	0.05	59.4	9.18	0.26	nc	38.3	0.81	27.4	72.8	104.0	* 522	416	1
RICE-19	0.04	38.0	3.56	E0.07	nc	25.4	1.23	42.3	27.4	8.5	294	297	1
RICE-20	0.21	47.9	46.9	0.41	nc	64.1	0.85	46.6	81	63.2	* 614	494	1
RICE-21	0.42	77.2	106	0.62	nc	44.3	0.54	19.9	232	* 359	** 1,050	422	1
RICE-22	0.65	73.1	156	0.90	nc	50.0	0.53	16.7	603	** 1,080	** 2,240	505	1

[1]Bicarbonate and carbonate concentrations were calculated from the laboratory alkalinity and pH values (table 4) using the advance speciation method (http://or.water.usgs.gov/alk/methods.html).

[2]Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists.

[3]The SMCL-CA for chloride, sulfate, and total dissolved solids have recommended and upper threshold values. The upper value is shown in parentheses.

[4]Laboratory reporting level is 4.5 mg/L.

Table 10. Trace elements detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.

[Samples from the 45 slow and intermediate grid wells, 15 flow-path wells, and 22 RICE wells were analyzed. The five-digit number in parentheses below the constituent name in the headings is used by the U.S. Geological Survey to uniquely identify a specific constituent or property. AL-US, action level (USEPA); CDPH, California Department of Public Health; E, estimated value; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-CA, maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); na, not available; nc, not collected; NL-CA, notification level (CDPH); no., number; RICE, RICE well; SMCL-CA, secondary maximum contaminant level (CDPH); USEPA, U.S. Environmental Protection Agency; V, analyte detected in sample and an associated blank—thus data are not included in groundwater quality analysis results; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; µg/L, micrograms per liter; —, analyzed but not detected; *, value above threshold level]

GAMA identification no.	Aluminum (µg/L) (01106)	Antimony (µg/L) (01095)	Arsenic (µg/L) (01000)	Barium (µg/L) (01005)	Boron (µg/L) (01020)	Cadmium (µg/L) (01025)	Chromium (µg/L) (01030)	Cobalt (µg/L) (01035)	Copper (µg/L) (01040)	Iron (µg/L) (01046)	Lead (µg/L) (01049)
[LRL]	[1.6]	[0.2]	[0.12]	[0.2]	[8]	[0.04]	[0.04]	[0.04]	[0.4]	[6]	[0.08]
Threshold type[1]	MCL-CA	MCL-US	MCL-US	MCL-CA	NL-CA	MCL-US	MCL-CA	na	AL-US	SMCL-CA	AL-US
Threshold level	1000	6	10	1000	1000	5	50	na	1300	300	15
					Grid wells						
ESAC-03	—	—	0.83	56	808	—	1.1	0.078	7.6	—	1.37
ESAC-05	—	E0.1	*19.6	104	26	—	4.9	0.084	1.2	—	0.24
ESAC-06	E1.5	—	0.97	15	—	—	1.2	—	3.3	—	2.11
ESAC-10	—	—	5	99	20	—	0.16	—	—	30	0.19
ESAC-11	—	0.87	*70	130	53	—	V0.02	E0.03	—	7	0.19
ESAC-12	4.5	—	4.4	87	107	—	6.0	—	3.2	E4	1.03
ESAC-15	E0.8	—	0.47	16	83	—	6.7	—	E0.21	—	0.14
ESAC-16	E1.1	—	0.78	25	316	—	0.58	—	—	—	0.1
ESAC-17	—	—	*15.9	385	379	—	V0.02	—	—	*355	0.2
ESAC-18	E1.4	—	0.73	21	70	—	0.94	—	—	—	0.09
ESAC-19	E1.1	0.38	9.2	147	96	—	6.9	—	0.72	8	0.43
ESAC-21	E1.5	—	*80.6	461	*1,010	E0.03	V0.04	E0.02	—	221	0.51
ESAC-22	—	—	0.39	19	13	—	1.1	0.07	1.7	—	0.86
ESAC-25	E1.3	—	0.83	13	16	—	0.73	—	0.57	—	0.15
ESAC-26	1.7	E0.11	*23.1	39	237	—	V0.02	—	—	6	0.26
ESAC-27	—	—	6.5	78	37	—	1.1	0.27	1.8	—	1.12
ESAC-28	—	—	*10.1	52	24	—	6.9	—	0.62	—	0.31
ESAC-29	E1.2	—	9.2	141	712	—	V0.03	—	—	295	0.08
ESAC-30	E1	E0.15	*17	38	111	—	V0.03	E0.02	E0.25	E4	E0.15
ESAC-31	E0.8	—	*12	124	140	—	0.12	E0.03	—	19	E0.1
ESAC-32	E1	—	2.6	29	14	—	3.0	—	1.9	E5	0.74
ESAC-34	E1.2	—	5.6	90	E6	—	4.6	—	E0.25	—	0.21
ESAC-35	1.9	—	0.8	23	27	—	4.5	—	E0.25	—	0.1

Table 10. Trace elements detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.—Continued

[Samples from the 45 slow and intermediate grid wells, 15 flow-path wells, and 22 RICE wells were analyzed. The five-digit number in parentheses below the constituent name in the headings is used by the U.S. Geological Survey to uniquely identify a specific constituent or property. AL-US, action level (USEPA); CDPH, California Department of Public Health; E, estimated value; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-CA, maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); na, not available; nc, not collected; NL-CA, notification level (CDPH); no., number; RICE, RICE well; SMCL-CA, secondary maximum contaminant level (CDPH); USEPA, U.S. Environmental Protection Agency; V, analyte detected in sample and an associated blank—thus data are not included in ground-water quality analysis results; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; µg/L, micrograms per liter; —, analyzed but not detected; *, value above threshold level]

GAMA identification no.	Aluminum (µg/L) (01106)	Antimony (µg/L) (01095)	Arsenic (µg/L) (01000)	Barium (µg/L) (01005)	Boron (µg/L) (01020)	Cadmium (µg/L) (01025)	Chromium (µg/L) (01030)	Cobalt (µg/L) (01035)	Copper (µg/L) (01040)	Iron (µg/L) (01046)	Lead (µg/L) (01049)
[LRL]	[1.6]	[0.2]	[0.12]	[0.2]	[8]	[0.04]	[0.04]	[0.04]	[0.4]	[6]	[0.08]
Threshold type[1]	MCL-CA	MCL-US	MCL-US	MCL-CA	NL-CA	MCL-US	MCL-CA	na	AL-US	SMCL-CA	AL-US
Threshold level	1000	6	10	1000	1000	5	50	na	1300	300	15
WSAC-03	—	—	0.48	66	16	—	1.2	0.081	0.8	—	0.2
WSAC-04	—	—	3.6	98	33	—	—	0.041	E0.2	43	—
WSAC-06	—	—	0.63	86	87	—	0.72	—	2.6	E3	1.67
WSAC-08	—	—	0.24	103	160	—	1.1	—	0.56	E3	3.43
WSAC-10	—	—	0.36	123	197	—	1.6	—	2	—	0.16
WSAC-11	E1	—	2.6	232	599	—	11.1	—	0.47	—	0.27
WSAC-12	1.8	—	2.2	126	212	—	V0.04	—	E0.28	53	—
WSAC-14	E1.3	—	2.6	29	364	0.04	V0.05	0.09	2	E4	0.62
WSAC-15	E1	—	1.3	295	*2330	—	7.3	0.04	0.47	—	0.08
WSAC-17	E1	E0.17	6.7	48	344	—	0.80	E0.02	1.4	—	0.69
WSAC-18	E1.2	—	1.3	74	447	—	0.07	0.04	E0.24	—	1.37
WSAC-21	E1	—	1.4	198	193	—	8.0	—	E0.26	—	0.1
WSAC-22	E0.8	—	7.9	268	105	—	2.5	—	0.93	14	0.68
WSAC-25	E1	—	4	106	762	—	0.48	—	—	—	0.32
WSAC-26	E1.4	—	1.1	106	11	—	4.3	0.06	0.46	—	0.35
WSAC-28	—	—	0.33	63	36	—	1.3	—	E0.24	—	—
WSAC-29	E1	—	3.1	145	64	—	11.5	—	E0.25	—	0.42
WSAC-30	E0.8	—	0.39	58	339	—	6.0	—	2.7	E5	0.43
WSAC-31	E1.3	—	4.7	61	71	3.54	10.8	—	E0.22	—	0.17
WSAC-34	E0.9	—	0.46	197	—	—	2.7	E0.03	0.47	—	—
WSAC-35	E1.1	—	1.2	117	128	—	2.2	—	0.66	—	0.17
WSAC-36	E1.2	—	4.5	142	117	—	4.3	—	0.47	E4	0.32

Table 10. Trace elements detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.—Continued

[Samples from the 45 slow and intermediate grid wells, 15 flow-path wells, and 22 RICE wells were analyzed. The five-digit number in parentheses below the constituent name in the headings is used by the U.S. Geological Survey to uniquely identify a specific constituent or property. AL-US, action level (USEPA); CDPH, California Department of Public Health; E, estimated value; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-CA, maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); na, not available; nc, not collected; NL-CA, notification level (CDPH); no., number; RICE, RICE well; SMCL-CA, secondary maximum contaminant level (CDPH); USEPA, U.S. Environmental Protection Agency; V, analyte detected in sample and an associated blank—thus data are not included in groundwater quality analysis results; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; µg/L, micrograms per liter; —, analyzed but not detected; *, value above threshold level]

GAMA identification no.	Aluminum (µg/L) (01106)	Antimony (µg/L) (01095)	Arsenic (µg/L) (01000)	Barium (µg/L) (01005)	Boron (µg/L) (01020)	Cadmium (µg/L) (01025)	Chromium (µg/L) (01030)	Cobalt (µg/L) (01035)	Copper (µg/L) (01040)	Iron (µg/L) (01046)	Lead (µg/L) (01049)
[LRL]	**[1.6]**	**[0.2]**	**[0.12]**	**[0.2]**	**[8]**	**[0.04]**	**[0.04]**	**[0.04]**	**[0.4]**	**[6]**	**[0.08]**
Threshold type[1]	**MCL-CA**	**MCL-US**	**MCL-US**	**MCL-CA**	**NL-CA**	**MCL-US**	**MCL-CA**	**na**	**AL-US**	**SMCL-CA**	**AL-US**
Threshold level	**1000**	**6**	**10**	**1000**	**1000**	**5**	**50**	**na**	**1300**	**300**	**15**
					Flow-path wells						
ESAC-FP-01	1.3	—	1.1	73	171	—	V0.02	—	—	106	0.08
ESAC-FP-02	2.1	—	0.71	35	108	—	1.3	0.28	V0.2	65	0.13
ESAC-FP-03	V0.8	—	2.4	47	19	—	1.2	E0.03	—	134	0.11
ESAC-FP-04	V1.7	—	3.2	16	67	—	1.3	—	—	67	—
ESAC-FP-05	2.7	0.23	6.5	116	55	—	5.3	E0.03	—	—	—
ESAC-FP-06	39.4	E0.18	*12.7	17	208	—	0.70	E0.02	—	14	E0.07
ESAC-FP-07	17.2	—	9	35	243	—	0.22	E0.03	—	10	E0.05
WSAC-FP-01	V1.4	—	2.4	128	28	—	16.1	E0.02	—	—	—
WSAC-FP-02	2.2	E0.11	3.3	132	101	—	18.4	—	—	V6	—
WSAC-FP-03	3.7	E0.13	1.6	173	81	—	4.8	E0.02	V0.55	—	—
WSAC-FP-04	11.1	—	5.5	91	80	—	0.16	0.04	—	V6	—
WSAC-FP-05	4.5	—	8.3	42	230	E0.02	—	—	0.35	9	0.8
WSAC-FP-06	3.0	E0.15	4	167	98	—	0.33	—	—	15	—
WSAC-FP-07	4.4	—	*10.6	8	99	—	V0.07	—	—	40	—
WSAC-FP-08	V1.4	—	1.1	99	114	—	4.8	—	—	10	—

Table 10. Trace elements detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.—Continued

[Samples from the 45 slow and intermediate grid wells, 15 flow-path wells, and 22 RICE wells were analyzed. The five-digit number in parentheses below the constituent name in the headings is used by the U.S. Geological Survey to uniquely identify a specific constituent or property. AL-US, action level (USEPA); CDPH, California Department of Public Health; E, estimated value; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-CA, maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); na, not available; nc, not collected; NL-CA, notification level (CDPH); no., number; RICE, RICE well; SMCL-CA, secondary maximum contaminant level (CDPH); USEPA, U.S. Environmental Protection Agency; V, analyte detected in sample and an associated blank—thus data are not included in groundwater quality analysis results; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; µg/L, micrograms per liter; —, analyzed but not detected; *, value above threshold level]

GAMA identification no.	Aluminum (µg/L) (01106)	Antimony (µg/L) (01095)	Arsenic (µg/L) (01000)	Barium (µg/L) (01005)	Boron (µg/L) (01020)	Cadmium (µg/L) (01025)	Chromium (µg/L) (01030)	Cobalt (µg/L) (01035)	Copper (µg/L) (01040)	Iron (µg/L) (01046)	Lead (µg/L) (01049)
[LRL]	[1.6]	[0.2]	[0.12]	[0.2]	[8]	[0.04]	[0.04]	[0.04]	[0.4]	[6]	[0.08]
Threshold type[1]	MCL-CA	MCL-US	MCL-US	MCL-CA	NL-CA	MCL-US	MCL-CA	na	AL-US	SMCL-CA	AL-US
Threshold level	1000	6	10	1000	1000	5	50	na	1300	300	15
					RICE wells						
RICE-01	—[2]	—[2]	4.9	*5,900	*1,260	—[2]	0.42	E0.18	—[2]	*4,610	—[2]
RICE-02	V1.3	E0.11	*10.4	39	55	—	2.4	0.09	—	V3	—
RICE-03	V0.8	E0.14	6.2	188	117	—	2.0	E0.02	V0.31	V5	—
RICE-04	—	—	4.7	154	16	—	1.7	E0.03	V0.54	57	—
RICE-05	—	—	1.4	160	9	E0.02	0.14	0.27	V0.97	28	—
RICE-06	—	—	1.8	85	16	—	0.41	0.04	V0.62	V4	—
RICE-07	V1.0	—	6.2	78	25	—	1.6	E0.02	V0.24	—	—
RICE-08	V1.0	—	6	96	35	—	4.1	—	—	—	—
RICE-09	1.8	E0.18	4.6	26	62	—	V0.07	0.15	V0.28	V6	—
RICE-10	V1.1	E0.16	3.1	87	57	—	0.37	E0.02	V0.32	—	—
RICE-11	V1.1	E0.1	1.6	552	92	E0.02	1.3	0.21	V1.1	V4	—
RICE-12	V1.0	E0.1	3.2	408	223	—	0.08	0.31	—	218	E0.04
RICE-13	V1.2	E0.11	2.3	286	199	—	3.1	0.44	V1.1	—	0.08
RICE-14	V1.2	—	1.1	357	174	—	V0.10	0.39	V0.27	110	—
RICE-15	—	—	1.1	65	551	—	0.77	0.04	V0.48	—	—
RICE-16	V1.3	—	0.57	20	945	—	V0.05	0.13	—	*304	—
RICE-17	E2.4	—	1.6	15	*1,640	0.05	13.1	0.13	V0.83	—	—
RICE-18	2.9	—	1	81	204	—	7.8	0.06	V0.53	—	—
RICE-19	V1.6	E0.11	4.1	61	68	—	V0.08	0.05	V0.69	—	—
RICE-20	V1.4	E0.14	7.5	46	195	0.04	V0.02	0.6	V0.80	—	—
RICE-21	2.2	—	0.38	46	97	—	0.13	0.13	V0.29	155	0.13
RICE-22	—	—	1.9	15	*4,630	—	0.85	1.6	—	166	—

Table 10. Trace elements detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.—Continued

[Samples from the 45 slow and intermediate grid wells, 15 flow-path wells, and 22 RICE wells were analyzed. The five-digit number in parentheses below the constituent name in the headings is used by the U.S. Geological Survey to uniquely identify a specific constituent or property. AL-US, action level (USEPA); CDPH, California Department of Public Health; E, estimated value; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-CA, maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); na, not available; nc, not collected; NL-CA, notification level (CDPH); no., number; RICE, RICE well; SMCL-CA, secondary maximum contaminant level (CDPH); USEPA, U.S. Environmental Protection Agency; V, analyte detected in sample and an associated blank—thus data are not included in ground-water quality analysis results; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; µg/L, micrograms per liter; —, analyzed but not detected; *, value above threshold level]

GAMA identification no.	Lithium (µg/L) (01130)	Manganese (µg/L) (01056)	Molybdenum (µg/L) (01060)	Nickel (µg/L) (01065)	Selenium (µg/L) (01145)	Strontium (µg/L) (01080)	Thallium (µg/L) (01057)	Tungsten (µg/L) (01155)	Vanadium (µg/L) (01085)	Zinc (µg/L) (01090)	Uranium (µg/L) (22703)
[LRL]	**[0.6]**	**[0.2]**	**[0.4]**	**[0.06]**	**[0.08]**	**[0.4]**	**[0.04]**	**[0.06]**	**[0.1]**	**[0.6]**	**[0.04]**
Threshold type[1]	**na**	**SMCL-CA**	**HAL-US**	**MCL-CA**	**MCL-US**	**HAL-US**	**MCL-US**	**na**	**NL-CA**	**SMCL-CA**	**MCL-US**
Threshold level	**na**	**50**	**40**	**100**	**50**	**4000**	**2**	**na**	**50**	**5000**	**30**
					Grid wells						
ESAC-03	14.1	E0.1	0.5	1.19	0.09	254	—	0.35	9.7	3.6	0.37
ESAC-05	E0.4	—	1.8	1.38	0.61	214	—	0.06	28.8	2.8	2.76
ESAC-06	2.1	E0.2	E0.2	0.26	E0.05	112	—	—	28.8	10.7	0.12
ESAC-10	E0.4	*95.1	0.6	0.18	1.0	319	—	E0.05	6.5	1.7	6.07
ESAC-11	20.9	*112	2.0	V0.04	—	138	—	0.27	40.4	V0.42	0.69
ESAC-12	2.8	0.2	2.3	0.13	0.40	290	—	0.11	12.2	4.4	0.45
ESAC-15	—	—	—	V0.07	0.16	145	—	—	17.7	V0.73	0.08
ESAC-16	6.5	E0.1	E0.2	0.14	E0.06	123	—	—	21.1	V0.52	0.23
ESAC-17	0.7	*568	1.8	0.22	—	488	—	0.23	E0.05	3.2	—
ESAC-18	1.6	—	E0.2	0.09	E0.04	116	—	E0.03	19.8	V0.58	0.35
ESAC-19	4.8	—	1.1	0.14	0.6	342	—	0.07	22.7	3.2	1.50
ESAC-21	3.8	*257	16.5	V0.07	—	460	—	0.1	0.11	1.3	—
ESAC-22	0.7	E0.2	—	0.58	0.09	111	—	—	6.8	6.3	0.04
ESAC-25	4.1	—	E0.3	0.12	E0.06	115	—	—	30.6	V1.2	0.07
ESAC-26	1.0	*80.2	4.2	—	—	112	—	0.53	9.6	1.3	0.21
ESAC-27	0.7	*110	0.8	0.57	0.24	258	—	—	8.4	V0.93	2.24
ESAC-28	E0.6	1.3	1.1	0.11	0.12	179	—	0.07	26.2	1.3	1.41
ESAC-29	2.4	*219	E4	0.09	—	276	—	0.23	0.42	12.2	—
ESAC-30	1.7	*99.6	1.4	0.08	0.31	195	—	0.28	35	V0.97	0.39
ESAC-31	1.9	*72.2	2.6	0.13	0.10	388	—	0.08	13.9	V0.92	1.88
ESAC-32	0.7	E0.1	—	0.17	0.16	227	—	—	9.5	4.5	1.09

Table 10. Trace elements detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.—Continued

[Samples from the 45 slow and intermediate grid wells, 15 flow-path wells, and 22 RICE wells were analyzed. The five-digit number in parentheses below the constituent name in the headings is used by the U.S. Geological Survey to uniquely identify a specific constituent or property. AL-US, action level (USEPA); CDPH, California Department of Public Health; E, estimated value; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-CA, maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); na, not available; nc, not collected; NL-CA, notification level (CDPH); no., number; RICE, RICE well; SMCL-CA, secondary maximum contaminant level (CDPH); USEPA, U.S. Environmental Protection Agency; V, analyte detected in sample and an associated blank—thus data are not included in ground-water quality analysis results; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; µg/L, micrograms per liter; —, analyzed but not detected; *, value above threshold level]

GAMA identification no.	Lithium (µg/L) (01130)	Manganese (µg/L) (01056)	Molybdenum (µg/L) (01060)	Nickel (µg/L) (01065)	Selenium (µg/L) (01145)	Strontium (µg/L) (01080)	Thallium (µg/L) (01057)	Tungsten (µg/L) (01155)	Vanadium (µg/L) (01085)	Zinc (µg/L) (01090)	Uranium (µg/L) (22703)
[LRL]	**[0.6]**	**[0.2]**	**[0.4]**	**[0.06]**	**[0.08]**	**[0.4]**	**[0.04]**	**[0.06]**	**[0.1]**	**[0.6]**	**[0.04]**
Threshold type[1]	**na**	**SMCL-CA**	**HAL-US**	**MCL-CA**	**MCL-US**	**HAL-US**	**MCL-US**	**na**	**NL-CA**	**SMCL-CA**	**MCL-US**
Threshold level	**na**	**50**	**40**	**100**	**50**	**4000**	**2**	**na**	**50**	**5000**	**30**
ESAC-34	0.8	—	0.5	0.10	0.36	360	—	E0.03	38.5	137	3.71
ESAC-35	1.3	—	—	—	E0.05	197	—	E0.05	22.4	V0.84	1.05
WSAC-03	3.7	—	1.0	1.32	0.10	368	—	—	3.9	6.6	0.14
WSAC-04	4.4	43.3	1.6	0.59	—	199	—	E0.03	—	V1.2	—
WSAC-06	11.5	—	0.5	0.21	0.08	506	—	—	5.0	62.9	0.40
WSAC-08	3.9	0.2	1.0	0.12	0.09	841	—	—	1.8	10.2	0.54
WSAC-10	6.4	—	E0.7	E0.14	0.09	849	—	—	2.8	13.3	0.78
WSAC-11	21.6	—	—	—	0.50	360	—	—	8.3	V0.51	0.28
WSAC-12	3.8	*106	7.8	V0.05	—	256	—	0.42	0.53	V0.67	0.07
WSAC-14	24.8	*89.8	4.5	0.36	10.8	1570	E0.02	0.08	10.7	8.6	2.57
WSAC-15	37	E0.1	0.5	0.66	1.4	641	—	0.18	5.7	V0.68	2.61
WSAC-17	1.3	0.2	4.0	0.17	0.57	234	—	0.07	18.5	36.4	1.16
WSAC-18	18.6	*84.6	3.7	V0.05	1.2	877	—	E0.05	8.4	V0.37	E0.14
WSAC-21	14.9	E0.1	E0.3	0.08	0.36	276	—	—	5.5	28.1	0.18
WSAC-22	15	36.6	0.6	0.11	0.16	435	—	E0.03	2.6	16.4	0.25
WSAC-25	26.9	1.8	3.5	V0.05	0.31	332	—	0.19	10.8	5.4	0.64
WSAC-26	14.9	—	0.9	V0.07	0.10	254	—	—	3.8	8.9	0.33
WSAC-28	4.1	—	E0.4	0.12	E0.04	428	—	—	2.8	V0.43	0.10
WSAC-29	9.8	3.1	1.0	0.18	0.77	395	—	—	10.8	3.4	0.43
WSAC-30	22	E0.1	1.0	0.30	0.75	1480	—	—	3.7	4.5	1.06
WSAC-31	2.7	—	2.0	V0.03	0.77	226	—	0.06	17.9	V0.53	0.19
WSAC-34	6.9	—	0.7	0.33	0.08	1130	—	—	3.0	2.0	0.79
WSAC-35	5.5	—	0.8	0.11	0.17	619	—	—	3.8	3.3	0.46
WSAC-36	4.6	0.5	3.1	V0.06	0.30	439	—	E0.05	9.4	1.5	0.72

Table 10. Trace elements detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.—Continued

[Samples from the 45 slow and intermediate grid wells, 15 flow-path wells, and 22 RICE wells were analyzed. The five-digit number in parentheses below the constituent name in the headings is used by the U.S. Geological Survey to uniquely identify a specific constituent or property. AL-US, action level (USEPA); CDPH, California Department of Public Health; E, estimated value; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-CA, maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); na, not available; nc, not collected; NL-CA, notification level (CDPH); no., number; RICE, RICE well; SMCL-CA, secondary maximum contaminant level (CDPH); USEPA, U.S. Environmental Protection Agency; V, analyte detected in sample and an associated blank—thus data are not included in ground-water quality analysis results; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; µg/L, micrograms per liter; —, analyzed but not detected; *, value above threshold level]

GAMA identification no.	Lithium (µg/L) (01130)	Manganese (µg/L) (01056)	Molybdenum (µg/L) (01060)	Nickel (µg/L) (01065)	Selenium (µg/L) (01145)	Strontium (µg/L) (01080)	Thallium (µg/L) (01057)	Tungsten (µg/L) (01155)	Vanadium (µg/L) (01085)	Zinc (µg/L) (01090)	Uranium (µg/L) (22703)
[LRL]	**[0.6]**	**[0.2]**	**[0.4]**	**[0.06]**	**[0.08]**	**[0.4]**	**[0.04]**	**[0.06]**	**[0.1]**	**[0.6]**	**[0.04]**
Threshold type[1]	**na**	**SMCL-CA**	**HAL-US**	**MCL-CA**	**MCL-US**	**HAL-US**	**MCL-US**	**na**	**NL-CA**	**SMCL-CA**	**MCL-US**
Threshold level	**na**	**50**	**40**	**100**	**50**	**4000**	**2**	**na**	**50**	**5000**	**30**
Flow-path wells											
ESAC-FP-01	0.6	*184	0.8	V0.05	—	455	—	0.22	E0.05	6.4	—
ESAC-FP-02	—	14.5	0.7	2.2	E0.07	261	—	V0.05	7.5	6.3	0.46
ESAC-FP-03	—	16.8	E0.2	0.31	—	225	—	0.09	23.4	—	0.70
ESAC-FP-04	—	3.5	0.4	0.30	0.12	100	—	0.21	10.0	V0.68	0.09
ESAC-FP-05	1.3	V0.3	0.6	0.57	0.38	534	—	0.31	26.3	—	5.44
ESAC-FP-06	0.7	8.4	4.9	0.47	—	127	—	1.1	2.9	—	0.07
ESAC-FP-07	E0.4	16.4	8.3	0.76	—	96.7	—	0.69	0.7	—	0.05
WSAC-FP-01	12.7	—	0.8	0.31	0.57	439	—	0.03	8.9	—	0.36
WSAC-FP-02	8.5	V0.5	0.8	0.33	0.39	379	—	0.07	10.3	V0.6	0.20
WSAC-FP-03	13.4	V0.8	0.6	0.72	0.11	410	—	0.09	6.4	V1.2	0.12
WSAC-FP-04	16.9	8.4	1.9	1.1	—	635	—	1.4	0.19	—	0.07
WSAC-FP-05	5.6	*60.6	3.9	0.09	E0.06	758	—	0.21	0.82	2.4	0.56
WSAC-FP-06	7.6	7.2	1.1	0.33	0.20	449	—	0.36	8	V1.2	0.07
WSAC-FP-07	4	22.6	2.1	V0.17	—	296	—	0.33	—	—	0.04
WSAC-FP-08	5.5	V0.4	1.3	0.27	0.08	475	—	V0.03	6	V1.4	0.22

Table 10. Trace elements detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.—Continued

[Samples from the 45 slow and intermediate grid wells, 15 flow-path wells, and 22 RICE wells were analyzed. The five-digit number in parentheses below the constituent name in the headings is used by the U.S. Geological Survey to uniquely identify a specific constituent or property. AL-US, action level (USEPA); CDPH, California Department of Public Health; E, estimated value; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; HAL-US, Lifetime Health Advisory Level (USEPA); LRL, laboratory reporting level; MCL-CA, maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); na, not available; nc, not collected; NL-CA, notification level (CDPH); no., number; RICE, RICE well; SMCL-CA, secondary maximum contaminant level (CDPH); USEPA, U.S. Environmental Protection Agency; V, analyte detected in sample and an associated blank—thus data are not included in ground-water quality analysis results; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; µg/L, micrograms per liter; —, analyzed but not detected; *, value above threshold level]

GAMA identification no.	Lithium (µg/L) (01130)	Manganese (µg/L) (01056)	Molybdenum (µg/L) (01060)	Nickel (µg/L) (01065)	Selenium (µg/L) (01145)	Strontium (µg/L) (01080)	Thallium (µg/L) (01057)	Tungsten (µg/L) (01155)	Vanadium (µg/L) (01085)	Zinc (µg/L) (01090)	Uranium (µg/L) (22703)
[LRL]	**[0.6]**	**[0.2]**	**[0.4]**	**[0.06]**	**[0.08]**	**[0.4]**	**[0.04]**	**[0.06]**	**[0.1]**	**[0.6]**	**[0.04]**
Threshold type[1]	**na**	**SMCL-CA**	**HAL-US**	**MCL-CA**	**MCL-US**	**HAL-US**	**MCL-US**	**na**	**NL-CA**	**SMCL-CA**	**MCL-US**
Threshold level	**na**	**50**	**40**	**100**	**50**	**4000**	**2**	**na**	**50**	**5000**	**30**
					RICE wells						
RICE-01	E3.3	*3,420	E1.6	1.3	—[2]	*7,880	—[2]	nc	1.1	4.7	—[2]
RICE-02	E0.4	14.2	1.3	0.46	E0.06	354	—	nc	*51.3	V0.48	4.29
RICE-03	1.1	2.6	—	0.38	E0.04	800	—	nc	34.4	V0.56	4.44
RICE-04	0.8	19.9	0.6	0.96	0.09	449	—	nc	25.7	V0.75	3.36
RICE-05	0.7	*75.4	—	1.9	—	618	—	nc	27.1	V1.1	3.52
RICE-06	E0.3	34.1	—	0.86	E0.04	420	—	nc	40.9	V0.75	2.67
RICE-07	—	3.4	E0.4	0.28	—	660	—	nc	*57.4	V0.34	5.19
RICE-08	0.7	V0.2	E0.3	0.22	0.20	666	—	nc	38	V0.52	3.27
RICE-09	1.0	41.9	1.3	0.29	—	179	—	nc	18.4	—	0.34
RICE-10	2.5	7.9	2.5	0.22	E0.05	359	—	nc	10.9	—	0.64
RICE-11	18.3	9.1	0.5	1.6	—	1,340	—	nc	5.8	V1.0	1.13
RICE-12	14.3	*55.2	1.7	0.56	—	1,000	—	nc	2.2	V1.1	1.57
RICE-13	19.9	26.6	0.8	1.1	—	1,010	—	nc	8.4	V0.57	1.48
RICE-14	11.5	*379	1.2	1.3	—	919	—	nc	0.55	V0.99	1.65
RICE-15	23.3	1.3	5.4	0.40	0.43	812	—	nc	5.5	V0.47	4.44
RICE-16	26.1	*434	9.8	V0.20	11	795	—	nc	0.54	V0.53	7.76
RICE-17	31.2	27.5	*46.2	0.61	7.8	1,900	—	nc	8.5	V1.6	10.20
RICE-18	18.9	7.7	0.9	0.28	0.55	772	—	nc	5.2	V0.88	2.04
RICE-19	0.8	6.1	1.2	0.32	—	370	—	nc	24.8	V1.2	1.25
RICE-20	0.9	*216	10.9	1.3	0.32	461	—	nc	29.6	V0.44	4.90
RICE-21	19.7	*156	2.4	0.31	0.45	1200	—	nc	0.42	V0.8	2.38
RICE-22	102	*602	9.6	2.3	E0.77	*4,540	—	nc	E0.74	E4	4.81

[1] Maximum contaminant level thresholds are listed as MCL-US when MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists.

[2] Laboratory reporting level is four times the LRL stated above.

Table 11. Species of inorganic arsenic, iron, and chromium detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.

[Samples from the 45 slow and intermediate grid wells, 15 flow-path wells, and 22 RICE wells were analyzed for iron, arsenic, and chromium; only wells with at least one detection are listed. The five-digit number in parentheses below the constituent name in the headings is used by the U.S. Geological Survey (USGS) to uniquely identify a specific constituent or property. Analyses made by the USGS's Trace Metals Laboratory. The laboratory entity code for the USGS's Trace Metals Laboratory in the USGS's National Water Information System (NWIS) is USGSTMCO. CDPH, California Department of Public Health; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; MCL-CA, maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); MDL, method detection limit; na, not available; no., number; NRP, National Research Program (USGS); NWQL, National Water Quality Laboratory (USGS); RICE, RICE well; RSD, relative standard deviation; SMCL-CA, secondary maximum contaminant level (CDPH); USEPA, U.S. Environmental Protection Agency; V, analyte detected in sample and an associated blank—thus data are not included in ground-water quality analysis results; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; µg/L, micrograms per liter; —, analyzed but not detected; * , value above threshold level]

GAMA identification no.	Iron(Total)[2] (µg/L) (01046)	Iron(II) (µg/L) (01047)	Inorganic Arsenic(Total)[2] (µg/L) (99033)	Inorganic Arsenic(III) (µg/L) (99034)	Chromium(Total) (µg/L) (01030)	Chromium(VI) (µg/L) (01032)
Threshold type[1]	**SMCL-CA**	**na**	**MCL-US**	**na**	**MCL-CA**	**na**
Threshold (µg/L)	**300**	**na**	**10**	**na**	**50**	**na**
[MDL]	**[2]**	**[2]**	**[0.5]**	**[1]**	**[1]**	**[1]**
			Grid wells			
ESAC-03	—	—	—	—	1	—
ESAC-05	—	—	* 17	—	4	4
ESAC-06	—	—	V3.6	—	—	—
ESAC-10	28	17	4.9	—	—	—
ESAC-11	6	4	[3]* 35	—	—	—
ESAC-12	3	—	3.6	—	6	5
ESAC-15	—	—	V0.7	—	2	—
ESAC-16	—	—	V1.2	—	—	—
ESAC-17	* 359	238	* 14	13	—	—
ESAC-18	—	—	V1.7	—	—	—
ESAC-19	6	—	8.0	—	5	5
ESAC-21	198	57	* 70	70	—	—
ESAC-22	—	—	—	—	1	1
ESAC-25	—	—	V4.3	—	—	—
ESAC-26	6	4	* 19	4	—	—
ESAC-27	—	—	6.2	—	—	—
ESAC-28	—	—	7.8	—	5	4
ESAC-29	* 304	26	8.7	7	—	—
ESAC-30	4	3	* 15	—	—	—
ESAC-31	21	18	* 11	4	—	—
ESAC-32	—	—	2.0	—	2	2
ESAC-34	—	—	5.1	—	4	3
ESAC-35	—	—	V1.7	—	3	2
WSAC-03	—	—	—	—	—	—
WSAC-04	36	23	V5.0	—	—	—
WSAC-06	—	—	V1.5	—	—	—
WSAC-08	2	—	V0.8	—	—	—
WSAC-10	4	—	—	—	1	1
WSAC-11	2	—	1.9	—	9	8
WSAC-12	54	36	1.9	1	—	—
WSAC-14	4	4	2.0	—	—	—

Table 11. Species of inorganic arsenic, iron, and chromium detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.—Continued

[Samples from the 45 slow and intermediate grid wells, 15 flow-path wells, and 22 RICE wells were analyzed for iron, arsenic, and chromium; only wells with at least one detection are listed. The five-digit number in parentheses below the constituent name in the headings is used by the U.S. Geological Survey (USGS) to uniquely identify a specific constituent or property. Analyses made by the USGS's Trace Metals Laboratory. The laboratory entity code for the USGS's Trace Metals Laboratory in the USGS's National Water Information System (NWIS) is USGSTMCO. CDPH, California Department of Public Health; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; MCL-CA, maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); MDL, method detection limit; na, not available; no., number; NRP, National Research Program (USGS); NWQL, National Water Quality Laboratory (USGS); RICE, RICE well; RSD, relative standard deviation; SMCL-CA, secondary maximum contaminant level (CDPH); USEPA, U.S. Environmental Protection Agency; V, analyte detected in sample and an associated blank—thus data are not included in ground-water quality analysis results; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; µg/L, micrograms per liter; —, analyzed but not detected; *, value above threshold level]

GAMA identification no.	Iron(Total)[2] (µg/L) (01046)	Iron(II) (µg/L) (01047)	Inorganic Arsenic(Total)[2] (µg/L) (99033)	Inorganic Arsenic(III) (µg/L) (99034)	Chromium(Total) (µg/L) (01030)	Chromium(VI) (µg/L) (01032)
Threshold type[1]	**SMCL-CA**	**na**	**MCL-US**	**na**	**MCL-CA**	**na**
Threshold (µg/L)	**300**	**na**	**10**	**na**	**50**	**na**
[MDL]	**[2]**	**[2]**	**[0.5]**	**[1]**	**[1]**	**[1]**
WSAC-15	—	—	1.6	—	6	5
WSAC-17	—	—	5.9	—	—	—
WSAC-18	—	—	1.3	—	—	—
WSAC-21	2	—	1.5	—	6	5
WSAC-22	11	—	6.5	—	2	1
WSAC-25	—	—	[3]2.6	—	—	—
WSAC-26	—	—	V1.8	—	3	2
WSAC-28	—	—	V0.9	—	—	—
WSAC-29	—	—	3.6	—	11	10
WSAC-30	4	—	—	—	7	5
WSAC-31	—	—	4.1	—	9	5
WSAC-34	—	—	V1.0	—	2	2
WSAC-35	—	—	V3.5	—	1	1
WSAC-36	4	3	5.7	—	3	2
			Flow-path wells			
ESAC-FP-01	103	82	V1.8	—	—	—
ESAC-FP-02	61	10	V1.4	—	4	2
ESAC-FP-03	130	69	1.8	—	2	—
ESAC-FP-04	62	—	3.5	—	2	1
ESAC-FP-05	—	—	6.0	—	5	4
ESAC-FP-06	12	6	* 12	—	—	—
ESAC-FP-07	8	2	8.0	—	—	—
WSAC-FP-01	—	—	1.5	—	17	17
WSAC-FP-02	5	—	2.7	—	21	19
WSAC-FP-03	3	—	1.1	—	4	3
WSAC-FP-04	6	—	5.4	4	—	—
WSAC-FP-05	10	—	6.9	—	—	—
WSAC-FP-06	13	3	4.3	—	—	—
WSAC-FP-07	39	11	9.3	9	—	—
WSAC-FP-08	6	—	0.7	—	4	4

Table 11. Species of inorganic arsenic, iron, and chromium detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.—Continued

[Samples from the 45 slow and intermediate grid wells, 15 flow-path wells, and 22 RICE wells were analyzed for iron, arsenic, and chromium; only wells with at least one detection are listed. The five-digit number in parentheses below the constituent name in the headings is used by the U.S. Geological Survey (USGS) to uniquely identify a specific constituent or property. Analyses made by the USGS's Trace Metals Laboratory. The laboratory entity code for the USGS's Trace Metals Laboratory in the USGS's National Water Information System (NWIS) is USGSTMCO. CDPH, California Department of Public Health; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; MCL-CA, maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); MDL, method detection limit; na, not available; no., number; NRP, National Research Program (USGS); NWQL, National Water Quality Laboratory (USGS); RICE, RICE well; RSD, relative standard deviation; SMCL-CA, secondary maximum contaminant level (CDPH); USEPA, U.S. Environmental Protection Agency; V, analyte detected in sample and an associated blank—thus data are not included in ground-water quality analysis results; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; µg/L, micrograms per liter; —, analyzed but not detected; *, value above threshold level]

GAMA identification no.	Iron(Total)[2] (µg/L) (01046)	Iron(II) (µg/L) (01047)	Inorganic Arsenic(Total)[2] (µg/L) (99033)	Inorganic Arsenic(III) (µg/L) (99034)	Chromium(Total) (µg/L) (01030)	Chromium(VI) (µg/L) (01032)
Threshold type[1]	**SMCL-CA**	**na**	**MCL-US**	**na**	**MCL-CA**	**na**
Threshold (µg/L)	**300**	**na**	**10**	**na**	**50**	**na**
[MDL]	**[2]**	**[2]**	**[0.5]**	**[1]**	**[1]**	**[1]**
			RICE wells			
RICE-01	* 4,790	4,720	3.7	4	1	—
RICE-02	3	—	8.8	—	—	—
RICE-03	4	2	[3]4	—	1	1
RICE-04	[3]4	4	4.0	—	1	—
RICE-05	28	28	0.9	—	—	—
RICE-06	4	3	1.5	—	—	—
RICE-07	2	2	5.5	—	1	—
RICE-08	3	3	5.3	—	4	4
RICE-09	3	2	3.8	—	—	—
RICE-10	2	2	2.8	—	—	—
RICE-11	—	—	V2.5	—	—	—
RICE-12	207	126	3.0	—	—	—
RICE-13	—	—	V3.5	—	2	2
RICE-14	112	96	0.7	—	—	—
RICE-15	—	—	V1.5	—	—	—
RICE-16	* 309	250	0.6	—	—	—
RICE-17	2	—	V3.0	—	12	9
RICE-18	—	—	1.1	—	6	5
RICE-19	—	—	3.5	—	—	—
RICE-20	—	—	6.8	—	—	—
RICE-21	140	130	—	—	—	—
RICE-22	[3]6	3	0.7	—	—	—

[1] Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists.

[2] V codes were applied to ground-water samples for which the concentration measured by the NRP laboratory was greater than the concentration measured by the NWQL preferred method (table 10), and the difference between the results was greater than 20 percent RSD.

[3] Concentration measured by the NRP laboratory was less than the concentration measured by the NWQL preferred method (table 10), and the difference between the results was greater than 20 percent RSD.

Table 12. Stable isotope ratios of water and tritium detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.

[Samples from 70 of the grid wells (WSAC-14 not analyzed), the 15 flow-path wells, and 2 of the RICE wells were analyzed for stable isotopes of water; samples from 70 of the grid wells (WSAC-13 not analyzed), and the 15 flow-path wells were analyzed for tritium. The five-digit number in parentheses below the constituent name in the headings is used by the U.S. Geological Survey (USGS) to uniquely identify a specific constituent or property. Stable isotope ratios are reported in the standard delta notation (δ), the ratio of a heavier isotope to more common lighter isotope of that element, relative to a standard reference material. The laboratory entity codes for the laboratories in the USGS's National Water Information System (NWIS) listed in the footnotes are shown in parentheses following the laboratory name. CDPH, California Department of Public Health; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; MCL-CA, maximum contaminant level (CDPH); nc, sample not collected; no., number; pCi/L, picocuries per liter; RICE, RICE well; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; <, less than]

GAMA identification no.	δ^{2}H of water[1] (per mil) (82082)	δ^{18}O of water[1] (per mil) (82085)	Tritium[2] (pCi/L) (07000)
Threshold type	**na**	**na**	**MCL-CA**
Threshold	**na**	**na**	**20,000**
		Grid wells	
ESAC-01	–63.1	–8.81	1.9
ESAC-02	–63.4	–8.68	11.5
ESAC-03	–63.4	–8.80	8
ESAC-04	–59.8	–8.19	2.8
ESAC-05	–63.8	–8.88	8
ESAC-06	–59.0	–8.25	1.3
ESAC-07	–56.6	–7.92	4.2
ESAC-08	–78.9	–11.02	9.9
ESAC-09	–56.6	–7.83	3.8
ESAC-10	–48.7	–6.65	2.9
ESAC-11	–60.0	–8.47	<1
ESAC-12	–71.1	–10.11	1
ESAC-13	–80.0	–11.35	3.5
ESAC-14	–57.0	–8.10	2.6
ESAC-15	–67.0	–9.73	1
ESAC-16	–60.0	–8.80	2.9
ESAC-17	–60.8	–8.28	3.5
ESAC-18	–66.1	–9.58	<1
ESAC-19	–56.3	–7.91	<1
ESAC-20	–54.3	–7.78	<1
ESAC-21	–75.2	–10.31	<1
ESAC-22	–53.0	–7.51	12.2
ESAC-23	–72.5	–10.43	10.2
ESAC-24	–57.9	–8.25	<1
ESAC-25	–61.2	–8.72	<1
ESAC-26	–82.2	–11.52	<1
ESAC-27	–55.2	–7.51	9.3
ESAC-28	–67.5	–9.48	7.4
ESAC-29	–59.2	–8.10	2.9
ESAC-30	–83.0	–11.74	<1
ESAC-31	–70.2	–9.41	8.6
ESAC-32	–67.6	–9.47	9.6
ESAC-33	–61.2	–8.70	12.5
ESAC-34	–55.9	–7.37	13.4
ESAC-35	–70.6	–9.88	4.2

Table 12. Stable isotope ratios of water and tritium detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.—Continued

[Samples from 70 of the grid wells (WSAC-14 not analyzed), the 15 flow-path wells, and 2 of the RICE wells were analyzed for stable isotopes of water; samples from 70 of the grid wells (WSAC-13 not analyzed), and the 15 flow-path wells were analyzed for tritium. The five-digit number in parentheses below the constituent name in the headings is used by the U.S. Geological Survey (USGS) to uniquely identify a specific constituent or property. Stable isotope ratios are reported in the standard delta notation (δ), the ratio of a heavier isotope to more common lighter isotope of that element, relative to a standard reference material. The laboratory entity codes for the laboratories in the USGS's National Water Information System (NWIS) listed in the footnotes are shown in parentheses following the laboratory name. CDPH, California Department of Public Health; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; MCL-CA, maximum contaminant level (CDPH); nc, sample not collected; no., number; pCi/L, picocuries per liter; RICE, RICE well; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; <, less than]

GAMA identification no.	δ^{2}H of water[1] (per mil) (82082)	δ^{18}O of water[1] (per mil) (82085)	Tritium[2] (pCi/L) (07000)
Threshold type	**na**	**na**	**MCL-CA**
Threshold	**na**	**na**	**20,000**
WSAC-01	–72.1	–9.98	<1
WSAC-02	–63.0	–8.41	6.4
WSAC-03	–68.1	–9.64	7.4
WSAC-04	–67.4	–9.24	<1
WSAC-05	–65.0	–8.90	7.7
WSAC-06	–66.2	–9.46	8.6
WSAC-07	–66.9	–9.24	13.4
WSAC-08	–62.6	–8.61	11.8
WSAC-09	–63.3	–8.83	6.7
WSAC-10	–63.7	–8.82	7.4
WSAC-11	–59.5	–8.60	<1
WSAC-12	–76.3	–10.35	<1
WSAC-13	–63.9	–8.91	nc
WSAC-14	nc	nc	<1
WSAC-15	–44.7	–5.81	8.3
WSAC-16	–52.1	–6.93	2.6
WSAC-17	–75.9	–10.61	8.6
WSAC-18	–62.2	–8.45	1.6
WSAC-19	–58.7	–8.37	<1
WSAC-20	–44.4	–5.90	4.5
WSAC-21	–59.0	–8.38	1.9
WSAC-22	–59.5	–8.53	5.8
WSAC-23	–60.5	–8.15	7.7
WSAC-24	–59.1	–8.54	1.3
WSAC-25	–51.7	–7.14	<1
WSAC-26	–64.2	–9.08	3.8
WSAC-27	–65.4	–8.84	9.3
WSAC-28	–63.6	–8.75	11.8
WSAC-29	–64.4	–8.87	<1
WSAC-30	–66.9	–9.21	14.7
WSAC-31	–64.8	–9.21	<1
WSAC-32	–74.3	–10.51	8.3
WSAC-33	–62.0	–8.88	<1
WSAC-34	–64.8	–9.04	9.6
WSAC-35	–68.8	–9.37	7.4
WSAC-36	–66.6	–9.26	1.6

Table 12. Stable isotope ratios of water and tritium detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.—Continued

[Samples from 70 of the grid wells (WSAC-14 not analyzed), the 15 flow-path wells, and 2 of the RICE wells were analyzed for stable isotopes of water; samples from 70 of the grid wells (WSAC-13 not analyzed), and the 15 flow-path wells were analyzed for tritium. The five-digit number in parentheses below the constituent name in the headings is used by the U.S. Geological Survey (USGS) to uniquely identify a specific constituent or property. Stable isotope ratios are reported in the standard delta notation (δ), the ratio of a heavier isotope to more common lighter isotope of that element, relative to a standard reference material. The laboratory entity codes for the laboratories in the USGS's National Water Information System (NWIS) listed in the footnotes are shown in parentheses following the laboratory name. CDPH, California Department of Public Health; ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; MCL-CA, maximum contaminant level (CDPH); nc, sample not collected; no., number; pCi/L, picocuries per liter; RICE, RICE well; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; <, less than]

GAMA identification no.	δ^{2}H of water[1] (per mil) (82082)	δ^{18}O of water[1] (per mil) (82085)	Tritium[2] (pCi/L) (07000)
Threshold type	**na**	**na**	**MCL-CA**
Threshold	**na**	**na**	**20,000**
	Flow-path wells		
ESAC-FP-01	–53.6	–7.34	<1
ESAC-FP-02	–69.4	–10.06	3.5
ESAC-FP-03	–72.9	–10.11	6.4
ESAC-FP-04	–64.0	–9.14	<1
ESAC-FP-05	–61.7	–8.01	12.8
ESAC-FP-06	–75.5	–10.58	<1
ESAC-FP-07	–80.8	–11.08	<1
WSAC-FP-01	–65.3	–9.13	<1
WSAC-FP-02	–67.7	–9.55	<1
WSAC-FP-03	–63.5	–8.96	9.0
WSAC-FP-04	–66.6	–9.43	1.3
WSAC-FP-05	–71.6	–9.63	<1
WSAC-FP-06	–69.7	–9.66	<1
WSAC-FP-07	–72.9	–10.22	<1
WSAC-FP-08	–69.2	–9.70	12.8
	RICE wells		
RICE-07	–54.1	–6.63	nc
RICE-11	–63.0	–8.47	nc

[1] USGS Stable Isotope Laboratory, Reston, Virginia (USGSSIVA).

[2] USGS Stable Isotope and Tritium Laboratory, Menlo Park, California (USGSH3CA).

Table 13. Nitrogen and oxygen isotopes in nitrate, nitrogen isotopes in nitrogen gas, and carbon-14 activities detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.

[Samples from 42 of the slow and intermediate grid wells (ESAC-35, WSAC-10, and WSAC-11 not analyzed) and the 15 flow-path wells were analyzed for isotopes of nitrate; samples from 43 of the slow and intermediate grid wells (ESAC-35 and WSAC-11 not analyzed) and the 15 flow-path wells were analyzed for carbon-14 activities. Nitrogen and oxygen isotope ratios are reported in the standard delta notation (δ), the ratio of a heavier isotope to more common lighter isotope of that element, relative to a standard reference material. The five-digit number in parentheses below the constituent name in the headings is used by the U.S. Geological Survey (USGS) to uniquely identify a specific constituent or property. The laboratoroy entity codes for the laboratories in the USGS's National Water Information System (NWIS) listed in the footnotes are shown in parentheses following the laboratory name. ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; na, not available; nc, sample not collected; no., number; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; —, nitrate not detected, therefore sample was not analyzed for nitrate isotopes]

GAMA identification no.	δ^{18}O of nitrate[1] (per mil) (63041)	δ^{15}N of nitrate[1] (per mil) (82690)	δ^{13}O of dissolved carbonates[2] (per mil) (82081)	^{3}Carbon-14 (percent modern) (49933)
Threshold type	**na**	**na**	**na**	**na**
Threshold	**na**	**na**	**na**	**na**
		Grid wells		
ESAC-03	2.76	8.43	–16.37	89
ESAC-05	4.00	6.41	–15.53	98
ESAC-06	2.58	3.92	–17.02	91
ESAC-10	5.28	11.76	–14.19	106
ESAC–11	—	—	–16.57	25
ESAC-12	0.46	4.59	–15.62	62
ESAC-15	—	—	–14.19	95
ESAC-16	1.00	4.38	–17.44	88
ESAC-17	—	—	–14.18	81
ESAC-18	1.39	4.59	–14.84	93
ESAC-19	–0.55	4.55	–15.46	82
ESAC-21	—	—	5.57	11
ESAC-22	3.99	3.52	–18.13	111
ESAC-25	0.01	2.71	–16.03	90
ESAC-26	—	—	–12.79	50
ESAC-27	3.54	9.35	–17.24	93
ESAC-28	2.86	6.38	–15.29	99
ESAC-29	—	—	–15.00	53
ESAC-30	11.21	26.65	–12.86	56
ESAC-31	16.33	24.47	–17.50	82
ESAC-32	6.60	7.46	–19.37	108
ESAC-34	5.64	9.88	–17.47	100
WSAC-03	2.28	4.23	–16.32	103
WSAC-04	—	—	–8.58	34
WSAC-06	3.57	11.54	–16.17	102
WSAC-08	1.02	5.82	–14.29	23
WSAC-10	nc	nc	–14.04	114
WSAC-11	nc	nc	–15.69	66
WSAC-12	—	—	nc	nc
WSAC-14	14.65	25.43	–12.09	40
WSAC-15	3.37	4.53	–15.09	104

Table 13. Nitrogen and oxygen isotopes in nitrate, nitrogen isotopes in nitrogen gas, and carbon-14 activities detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.—Continued

[Samples from 42 of the slow and intermediate grid wells (ESAC-35, WSAC-10, and WSAC-11 not analyzed) and the 15 flow-path wells were analyzed for isotopes of nitrate; samples from 43 of the slow and intermediate grid wells (ESAC-35 and WSAC-11 not analyzed) and the 15 flow-path wells were analyzed for carbon-14 activities. Nitrogen and oxygen isotope ratios are reported in the standard delta notation (δ), the ratio of a heavier isotope to more common lighter isotope of that element, relative to a standard reference material. The five-digit number in parentheses below the constituent name in the headings is used by the U.S. Geological Survey (USGS) to uniquely identify a specific constituent or property. The laboratoroy entity codes for the laboratories in the USGS's National Water Information System (NWIS) listed in the footnotes are shown in parentheses following the laboratory name. ESAC, East study area of the middle Sacramento Valley study unit; ESAC-FP, East study area of the middle Sacramento Valley study unit–flow path; na, not available; nc, sample not collected; no., number; WSAC, West study area of the middle Sacramento Valley study unit; WSAC-FP, West study area of the middle Sacramento Valley study unit–flow path; —, nitrate not detected, therefore sample was not analyzed for nitrate isotopes]

GAMA identification no.	δ^{18}O of nitrate[1] (per mil) (63041)	δ^{15}N of nitrate[1] (per mil) (82690)	δ^{13}O of dissolved carbonates[2] (per mil) (82081)	[3]Carbon-14 (percent modern) (49933)
Threshold type	**na**	**na**	**na**	**na**
Threshold	**na**	**na**	**na**	**na**
WSAC-17	5.58	13.78	–15.50	81
WSAC-18	12.82	27.24	–13.10	34
WSAC-21	0.29	1.58	–17.09	88
WSAC-22	0.34	7.46	–15.13	78
WSAC-25	16.81	28.19	–14.14	39
WSAC-26	1.29	2.55	–14.62	74
WSAC-28	0.40	3.67	–13.78	114
WSAC-29	0.06	4.85	–15.03	44
WSAC-30	6.20	10.21	–13.42	84
WSAC-31	–0.20	5.00	–15.56	41
WSAC-34	1.96	5.07	–15.62	114
WSAC-35	2.63	7.86	–14.93	94
WSAC-36	7.25	13.64	–15.42	65
		Flow-path wells		
ESAC-FP-01	—	—	–15.25	27
ESAC-FP-02	0.38	8.30	–14.82	100
ESAC-FP-03	11.89	19.89	–17.50	93
ESAC-FP-04	2.17	4.07	–17.45	58
ESAC-FP-05	0.98	5.65	–22.23	100
ESAC-FP-06	—	—	–14.98	9
ESAC-FP-07	—	—	–11.63	5
WSAC-FP-01	0.47	4.18	–13.49	43
WSAC-FP-02	–3.09	2.52	–13.19	23
WSAC-FP-03	0.07	4.49	–17.89	85
WSAC-FP-04	—	—	–14.00	18
WSAC-FP-05	10.56	20.26	–16.50	14
WSAC-FP-06	6.69	9.76	–14.40	15
WSAC-FP-07	—	—	–14.82	15
WSAC-FP-08	3.42	7.43	–15.22	93

[1] USGS Stable Isotope Laboratory, Reston, Virginia (USGSSIVA).

[2] University of Waterloo (contract laboratory) (CAN-UWIL).

[3] University of Arizona, Accelerator Mass Spectrometry Laboratory (contract laboratory) (AZ-UAMSL).

Table 14. Radioactive constituents detected in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) Program, California, June to September, 2006.

[Samples from the eight slow grid wells were analyzed. The five-digit number in parentheses below the constituent name in the headings is used by the U.S. Geological Survey (USGS) to uniquely identify a specific constituent or property. Analyses by Eberline Analytical Services. The laboratory entity code for Eberline Analytical Services in the USGS's National Water Information System (NWIS) is CA-EBERL. CDPH, California Department of Public Health; E, estimated value; ESAC, East study area of the middle Sacramento Valley study unit; MCL-CA, maximum contaminant level (CDPH); MCL-US, maximum contaminant level (USEPA); no., number; pCi/L, picocuries per liter; USEPA, U.S. Environmental Protection Agency; WSAC, West study area of the middle Sacramento Valley study unit; <, nondetection; L<, nondetection, however, result may be biased low on the basis of matrix-spike results with the potential for a false nondetection; *, value above lower threshold]

GAMA identification no.	Radium-226 (pCi/L) (09511)	Radium-228 (pCi/L) (81366)	Radon-222 (pCi/L) (82303)	Gross alpha radioactivity, 72-hour count (pCi/L) (62636)	Gross alpha radioactivity, 30-day count (pCi/L) (62639)	Gross beta radioactivity, 72-hour count (pCi/L) (62642)	Gross beta radioactivity, 30-day count (pCi/L) (62645)
Threshold type[1]	**MCL-US**[2]	**MCL-US**[2]	**proposed MCL-US**[3]	**MCL-US**	**MCL-US**	**MCL-CA**	**MCL-CA**
Threshold value	**5**	**5**	**300 (4,000)**	**15**	**15**	**50**	**50**
			Grid wells				
ESAC-25	E0.02	<0.46	78	<2.2	<2.1	E1.1	E1.6
ESAC-26	E0.03	<0.46	*307	<1.2	<2.5	E1.9	E2.0
ESAC-27	E0.05	<0.51	*972	E1.5	E1.2	E1.6	E1.4
ESAC-28	E0.03	<0.62	*343	E1.1	<2.2	2.7	E3.2
WSAC-03	E0.03	<0.44	*447	E0.6	<3.3	<1.9	<2.8
WSAC-08[4]	E0.03	<0.54	*463	L<2.2	L<2.1	E1.7	<1.7
WSAC-12	0.09	E0.45	*411	<1.7	<2.7	<2.0	E1.0
WSAC-18[4]	E0.05	<0.54	214	L<4.9	L<3.1	E1.2	E1.6

[1] Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists.

[2] The MCL-US threshold for radium is the sum of radium-226 and radium-228.

[3] Two MCL-US thresholds have been proposed: 300 pCi/L and 4,000 pCi/L.

[4] Potential to be biased low for gross alpha 72-hour and gross alpha 30-day radioactivity counts because of relatively high concentration of calcium.

Appendix

The appendix discusses methods used to collect and analyze ground-water samples and to report the data for the MSACV study unit. These methods were selected to obtain representative samples of the ground water used for drinking-water supplies in the study and to minimize potential bias of the data. Procedures to analyze and interpret QC data collected as part of the ground-water sampling are also discussed.

Sample Collection and Analysis

Ground-water samples were collected using standard and modified USGS protocols (Koterba and others, 1995), the National Field Manual for the collection of water quality data (U.S. Geological Survey, variously dated) and protocols described by Weiss (1968), Shelton and others (2001), Ball and McClesky (2003a,b), and Wright and others (2005).

Prior to sampling, each well was pumped continuously to purge at least three casing-volumes of water from the well (Wilde and others, 1999). Wells were sampled using Teflon tubing with brass and stainless-steel fittings attached to a sampling point on the well discharge pipe as close to the well as possible. The sampling point was always located upstream of any well-head treatment system or water storage tank. If a chlorinating system was attached to the well, the chlorinator was shut off at least 24 hours prior to purging and sampling the well to clear all chlorine out of the system.

For the *fast* and *intermediate* schedules, samples were collected at the well head using a foot-long length of Teflon tubing. For the *slow* schedule, the samples were collected inside an enclosed chamber located inside a mobile laboratory and connected to the well head by a 10- to 50-ft length of Teflon tubing (Lane and others, 2003).

For intermediate monitoring schedules (flow-path and RICE wells), samples were collected using a portable, 2-in. diameter submersible pump (Grundfos RediFlo2 pump) attached to reels of approximately 300 ft of Teflon tubing. The 10- to 50-ft Teflon tubing used to sample slow schedules was attached to the outflow section of the reels and samples were collected inside an enclosed chamber in a mobile laboratory. Two separate submersible pumps and reels were used to collect samples from monitoring wells in MSACV. All fittings and lengths of tubing were cleaned between samples (Wilde, 2004).

For the field measurements, ground water was pumped through a flow-through chamber fitted with a multiprobe meter that simultaneously measures the water-quality indicators dissolved oxygen, temperature, pH, turbidity, and specific conductance. Field measurements were made in accordance with protocols in the USGS's National Field Manuals (Lewis, 2006; Radtke and others, 2005; Wilde, 2006; Wilde and others, 2006; Wilde and Radtke, 2005). All sensors on the multiprobe meter were calibrated daily. Measurements of temperature, dissolved oxygen, pH, and specific conductance values were recorded at 5-minute intervals for at least 30 minutes, and when these values remained stable for 20 minutes, samples for laboratory analyses were then collected. Field measurements and instrument calibrations were recorded by hand on field record sheets and electronically in PCFF ("Personal Computer Field Forms")-GAMA, a software package designed by the USGS with support from the GAMA program. Analytical service requests were also managed by PCFF-GAMA. Chain of custody documentation forms were completed by hand or electronically. Information from PCFF-GAMA was uploaded directly into NWIS at the end of every week of sample collection.

For analyses requiring filtered water, ground water was diverted through a 0.45-µm pore size vented capsule filter, a disk filter, or a baked glass-fiber filter depending on the protocol for the analysis (Wilde, 2004; Wilde and others, 1999). Prior to sample collection, polyethylene sample bottles were prerinsed twice using dionized water and once with sample water before collection. Samples requiring acidification were acidified to a pH of 2 or less with the appropriate acids using ampoules of certified, traceable concentrated acids obtained from NWQL.

Temperature-sensitive samples were stored on ice prior to, and during, daily shipping to the various laboratories. The nontemperature-sensitive samples, tritium, noble gases, chromium speciation, and stable isotopes were shipped monthly, whereas VOCs, pesticides and pesticide degradates, constituents of special interest, dissolved organic carbon, radium isotopes, gross alpha and beta radioactivity, and radon-222 samples were shipped daily.

Detailed sampling protocols for individual analyses and groups of analytes are described in Koterba and others (1995) and the USGS's National Field Manuals (Wilde, 2004; Wilde and others, 1999) and in the references for analytical methods listed in table A1; only brief descriptions are given here. VOCs and gasoline oxygenates and degradates, and 1,2,3-TCP samples were collected in 40-mL baked amber glass sample vials that were purged with three vial volumes of sample water before bottom-filling to eliminate atmospheric contamination. Six normal (6 N) hydrochloric acid (HCl) was added as a preservative to the VOC samples, but not to the gasoline oxygenate and degradate samples, or the 1,2,3-TCP samples. Perchlorate samples were collected in 125-mL polyethylene bottles. Tritium samples were collected by bottom-filling two 1-L polyethylene bottles with unfiltered ground water, after first overfilling the bottle with three volumes of water. Stable isotopes of water were collected in 60-mL clear glass bottles filled with unfiltered water, sealed with a conical cap, and secured with electrical tape to prevent leakage and evaporation.

Pesticides and pesticide degradation products, pharmaceutical compounds, and NDMA samples were collected in 1-L baked amber glass bottles. Pesticide and pharmaceutical samples were filtered with a glass-fiber filter during collection, whereas the NDMA samples were filtered at the Montgomery Watson Harza laboratory prior to analysis.

Ground-water samples for major and minor ions, trace elements, alkalinity, and total dissolved solids analyses required filling one 250-mL polyethylene bottle with raw ground water, and one 500-mL and one 250-mL polyethylene bottles with filtered ground water (Wilde, 2004). A Whatman capsule filter was used for filtration. Each 250-mL filtered sample was then preserved with an ampoule of 7.5 N nitric acid. Mercury samples were collected by filtering ground water into a 250-mL glass bottle and preserving with an ampoule of 6 N HCl. Arsenic and iron speciation samples were filtered into 250-mL polyethylene bottles that were covered with tape to prevent light exposure and preserved with 6 N HCl. Nutrient samples were filtered into 125-mL brown polyethylene bottles. Nitrate isotope samples were filtered into 125-mL polyethylene bottles. Radium isotopes and gross alpha and beta radiation samples were filtered into 1-L polyethylene bottles and acidified with nitric acid. Carbon isotope samples were filtered and bottom-filled into two 500-mL glass bottles that were first overfilled with three bottle volumes of ground water. These samples had no headspace and were sealed with a conical cap to avoid atmospheric contamination. Samples for alkalinity titrations were collected by filtering ground water into 500-mL polyethylene bottles.

Dissolved organic carbon (DOC), chromium, radon-222, dissolved gases, and microbial constituents were collected from the hose bib at or near the well head, regardless of the sampling schedule (fast, intermediate, or slow). DOC was collected after rinsing the sampling equipment with universal blank water (Wilde, 2004). Using a 50-mL syringe and 0.45-µm disk filter, ground-water samples were filtered into 125-mL baked amber glass bottles and preserved with 4.5 N sulfuric acid. Chromium speciation samples were collected using a 10-mL syringe with an attached 0.45-µm disk filter. After the syringe was thoroughly rinsed and filled with ground water, 4 mL was forced through the disk filter; the next 2 mL of the ground water was then slowly filtered into a small centrifuge vial for analysis of total chromium. Hexavalent chromium, Cr(VI), was then collected by attaching a small cation-exchange column to the syringe filter, and after conditioning the column with 2 mL of sample water, 2 mL was collected in a second centrifuge vial. Both vials were preserved with 10 µL of 7.5 N nitric acid (Ball and McClesky, 2003a,b).

For the collection of radon-222, a stainless steel and Teflon valve assembly was attached to the sampling port at the well head (Wilde, 2004). The valve was partially closed to create back pressure, and a 10-mL sample was taken through a Teflon septum on the value assembly using a glass syringe affixed with a stainless-steel needle. The sample was then injected into a 25-mL vial partially filled with scintillation mixture (mineral oil) and shaken. The vial was then placed in a cardboard tube to shield it from light during shipping.

Noble gases were collected in 3/8-in. copper tubes using reinforced nylon tubing connected to the hose bib at the wellhead. Ground water was flushed through the tubing to dislodge bubbles before flow was restricted with a back pressure valve. Clamps on either side of the copper tube were then tightened, trapping a sample of ground water for analyses of noble gases (Weiss, 1968).

Samples for analysis of microbial constituents also were collected at the well head (Bushon, 2003; Myers, 2004). Prior to the collection of samples, the sampling port was sterilized using isopropyl alcohol, and ground water was run through the sampling port for at least three minutes to remove any traces of the sterilizing agent. One sterilized 3-L carboy was filled for coliphage analyses (F-specific and somatic coliphage determinations), and two sterilized 250-mL bottles were filled with ground water for coliform (total coliforms and *Escherichia* coliform) analyses. Total coliforms and *Escherichia* coliform (*E. coli*) plates were prepared using sterilized equipment and reagents (Myers, 2004). Plates were counted under an ultraviolet light, following a 22- to 24-hour incubation time.

Turbidity and alkalinity were measured in the mobile laboratory at the well site. Turbidity was measured in the field with a calibrated turbidity meter. Alkalinity concentrations were measured on filtered samples by Gran's titration method (Rounds, 2006). Titration data were entered directly into PCFF-GAMA, and the concentrations of bicarbonate (HCO_3^-) and carbonate (CO_3^{2-}) were automatically calculated from the titration data using the advanced speciation method. Concentrations of HCO_3^- and CO_3^{2-} were also calculated from the laboratory alkalinity and pH measurements. Calculations were made in a spreadsheet using the advanced speciation method (http://or.water.usgs.gov/alk/methods.html) with pK_1 = 6.35, pK_2 = 10.33, and pK_W = 14.

Ten laboratories performed chemical and microbial analyses for this study (see table A1), with most of the analyses being performed at NWQL or by laboratories contracted by NWQL. NWQL maintains a rigorous quality-assurance program (Maloney, 2005; Pirkey and Glodt, 1998). Laboratory QC samples, including method blanks, continuing calibration verification standards, standard reference samples, reagent spikes, external certified reference materials, and external blind proficiency samples, are analyzed regularly. Method detection limits are continuously tested and laboratory reporting levels updated accordingly. NWQL maintains National Environmental Laboratory Accreditation Program

(NELAP) and other certifications (http://nwql.usgs.gov/Public/lab_cert.shtml). In addition, the Branch of Quality Systems within the USGS's Office of Water Quality maintains independent oversight of quality assurance at NWQL and laboratories contracted by NWQL. The Branch of Quality Systems also runs a National Field Quality Assurance program that includes annual testing of all USGS field personal for proficiency in making field water-quality measurements (http://bqs.usgs.gov/nfqa/). Results for analyses made at NWQL or by laboratories contracted by NWQL are uploaded directly into NWIS by NWQL.

Data Reporting

Laboratory Reporting Conventions

NWQL uses the LRL as a threshold for reporting analytical results. The LRL is set to minimize the reporting of false negatives (not detecting a compound when it is actually present in a sample) to less than 1 percent (Childress and others, 1999). The LRL is set at two-times the long-term method detection level (LT-MDL). The LT-MDL is derived from the standard deviation of at least 24 MDL determinations made over an extended period of time. LT-MDLs are continually monitored and updated. The method detection limit (MDL) is the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the concentration is greater than zero (at the MDL, there is less than 1 percent chance of a false positive) (Childress and others, 1999; U.S. Environmental Protection Agency, 2002a). NWQL updates LRL values regularly, and the values listed in this report were in effect during the period analyses were made for ground-water samples from the MSACV study (June to September, 2006).

Detections between the LRL and the LT-MDL are reported as estimated concentrations (designated with an "E" before the value in the tables and text). For information-rich methods, detections below the LT-MDL have high certainty of detection, but the precise concentration is uncertain. Information-rich methods are those that utilize gas chromatography or high-performance liquid chromatography (HPLC) with mass spectrometry detection (VOCs, gasoline oxygenates and degradates, and pesticides and pesticide degradates). For these methods, compounds are identified by presence of characteristic fragmentation patterns in their mass spectra in addition to being quantified by measurement of peak areas at their associated chromatographic retention times. E-coded values also may result from detections outside the range of calibration standards for detections that did not meet all laboratory QC criteria and for samples that were diluted prior to analysis (Childress and others, 1999).

Some compound concentrations in this study are reported using minimum reporting levels (MRLs) or method uncertainties. The MRL is the smallest measurable concentration of a constituent that may be reliably reported using a given analytical method (Timme, 1995). The method uncertainty generally indicates the precision of a particular analytical measurement; it gives a range of values wherein the true value will be found.

The reporting levels for radiochemical constituents (gross-alpha radioactivity, gross-beta radioactivity, radium-226, and radium-228) are based on a sample-specific minimum detectable concentration (SSMDC), a sample-specific critical value, and the combined standard uncertainty (CSU) (Bennett and others, 2006; U.S. Environmental Protection Agency, 2004). A result above the critical value represents a greater-than-95-percent certainty that the result is greater than zero (significantly different from the instrument's background response to a blank sample), and a result above the SSMDC represents a greater-than-95-percent certainty that the result is greater than the critical value. Using these reporting level elements, three unique cases were possible when screening the raw analytical data, as described in Bennett and others (2006). If the analytical result was less than the critical value (case 1), the analyte was considered not detected, and the concentration was reported as less than the SSMDC. If the analytical result was greater than the critical value, the ratio of the CSU to the analytical result was calculated as a percent (percent relative CSU). For those samples with percent relative CSU greater than 20 percent (case 2), concentrations were reported as estimated values (designated by an "E" preceding the value). For those samples with percent relative CSU less than 20 percent, concentrations were reported unqualified (case 3). For table clarity, only the screened results were reported in table 14; the raw analytical results with their corresponding SSMDCs, critical values, and CSUs, are on file at the USGS California Water Science Center.

Stable isotopic compositions of oxygen, hydrogen, carbon, and nitrogen are reported as relative isotope ratios in units of per mil using the standard delta notation $\delta^i E$ (Coplen and others, 2002):

$$\delta^{i}E = \left[\frac{R_{sample}}{R_{reference}} - 1\right] \bullet 1{,}000 \text{ per mil}, \quad (1)$$

where

^{i}E is the heavier isotope (^{18}C, ^{13}C, or ^{2}H),

R_{sample} is the ratio of the abundance of the heavier isotope to the lighter isotope (^{16}O, ^{12}C, or ^{1}H) in the sample, and

$R_{reference}$ is the ratio of the abundance of the heavier isotope to the lighter isotope (^{16}O, ^{12}C, or ^{1}H) in the reference material.

The reference material for oxygen and hydrogen is Vienna Standard Mean Ocean Water (VSMOW), which is assigned $\delta^{18}O$ and $\delta^{2}H$ values of 0 per mil (note than $\delta^{2}H$ is also written as δD because the common name of the heavier isotope of hydrogen, hydrogen-2, is deuterium). The reference material for carbon is Vienna Peedee Belemnite (VPDB), which is assigned a $\delta^{13}C$ value of 0 per mil. Positive values indicate enrichment of the heavier isotope and negative values indicate depletion of the heavier isotope, compared with the ratios observed in the standard reference material.

Constituents on Multiple Analytical Schedules

Eighteen constituents targeted in this study are measured by more than one analytical schedule or more than one laboratory (table A2). The preferred methods for these constituents were selected on the basis of the procedure recommended by NWQL (http://wwwnwql.cr.usgs.gov/USGS/Preferred_method_selection_procedure.html). Methods with full approval are preferred over those with provisional approval and approved methods are favored over research methods. The method with greater accuracy and precision and lower LRLs for the overlapping constituents is generally preferred. However, the method with higher LRLs may be selected as the preferred method to provide consistency with historical data analyzed by the same method.

Five constituents appear on NWQL Schedules 2020 and 4024, and the preferred method is Schedule 2020 to provide consistency. All samples collected for the GAMA Priority Basin Assessment project are analyzed using Schedule 2020, whereas, only a subset are analyzed using Schedule 4024. Six constituents appear on NWQL Schedules 2032/2033 and 2060, and the preferred method is Schedule 2032/2033 because it has greater precision and accuracy for the six overlapping constituents. For constituents that appear on two NWQL schedules, only the values determined by the preferred method are reported.

The water-quality indicators pH, specific conductance, and alkalinity were measured in the field and at NWQL. The field measurements are the preferred method for all three constituents; however, both are reported because the laboratory alkalinity measurements were made on a greater number of samples.

The field and laboratory data were compared using the Wilcoxon signed-rank test, a nonparametric statistical test that is analogous to the parametric statistical test the paired t-test (Helsel and Hirsch, 2002). A nonparametric test was used because the data are not normally distributed. The Wilcoxon signed-rank test evaluates the null hypothesis that the median of the paired differences between the two datasets is zero. Results are reported as the probability, P, of obtaining the observed distribution of data, or one even less likely, when the null hypothesis is true. Therefore, a P value of 0.01 indicates 99 percent confidence that the two datasets are different.

Specific conductance was measured in both the field and the laboratory for 82 samples, and there was no statistical significance between the two datasets (P = 0.1035). Both laboratory and field pH measurements were made for 80 samples, and the two datasets were systematically different (P = <0.0001). Field pH values were lower by a median of 0.3 pH units. The increase in pH between field and laboratory measurement may be explained by equilibration of the sample with the atmosphere after collection. The partial pressure of CO_2 in ground water is often greater than the atmospheric partial pressure (Appelo and Postma, 2005); thus, CO_2 degasses from the ground water when it is brought in contact with the atmosphere. CO_2 loss results in increased pH. Field and laboratory alkalinities were measured for seven samples, and the two datasets were significantly different (P = 0.0156). Field alkalinity values were lower by a median of 11 mg/L as $CaCO_3$. The differences between the field and laboratory values were greater than 5 percent for all but two samples.

For arsenic, chromium, and iron concentrations, the standard methods used by NWQL are preferred over the research methods used by the USGS National Research Program (NRP) Trace Metal Laboratory (TML) in Boulder, Colorado. The concentrations measured by TML are used only to calculated ratios of redox species for each element, $\frac{As(V)}{As(III)}$ for arsenic, $\frac{Cr(VI)}{Cr(III)}$ for chromium, and $\frac{Fe(III)}{Fe(II)}$ for iron. For example:

$$\frac{Fe(III)}{Fe(II)} = \frac{Fe(T) - Fe(II)}{Fe(II)}, \quad (2)$$

where

Fe(T) is the total iron concentration (measured),

Fe(II) is the concentration of ferrous iron (measured), and

Fe(III) is the concentration of ferric iron (calculated).

Quality Assurance

The purpose of quality-assurance is to identify which data best represent environmental conditions and which may have been affected by contamination or bias during sample collection, processing, storage, transportation, or laboratory analysis. Four types of QC tests were used in this study: blank samples were collected to assess contamination; replicate samples were collected to assess reproducibility; matrix spike tests were done to assess accuracy of laboratory analytical methods; and surrogate compounds were added to samples analyzed for organic constituents to assess bias of laboratory analytical methods. In the tables of this report, detections of organic constituents in ground-water samples that may have resulted from contamination were flagged with a “V” remark code, and were not considered detections for calculations

of detection frequencies in water-quality assessments. Detections of inorganic constituents in ground-water samples that may have resulted from contamination were flagged with a "V" remark code to indicate that the amount of potential contamination may have been sufficient to change a nondetection into a detection relative to the stated reporting level.

The quality-assurance used for this study followed the protocols used by the USGS's NAWQA program (Koterba and others, 1995) and described in the National Field Manual (U.S. Geological Survey, variously dated). The quality assurance plan followed by NWQL, the primary laboratory used to analyze samples for this study, is described in Maloney (2005) and Pirkey and Glodt (1998).

Blanks

Blank samples (blanks) were collected using two types of water certified by NWQL to contain less than the LRL or MRL of the analytes investigated in the study. First, inorganic blank water (IBW) was used to collect sample blanks of perchlorate, major ions and trace elements, nutrients, arsenic and iron speciation, and chromium speciation. All other blanks were collected using VOC-free (nitrogen-purged) blank water (VBW). Two types of blanks were collected: source-solution and field blanks. Source-solution blanks were collected to verify that the blank water used for the field blanks was free of analytes. Field and source solution blanks were collected at approximately 10 percent of the wells sampled to determine if equipment or procedures used in the field or laboratory introduced contamination. Field blanks were analyzed for VOCs, gasoline oxygenates and their degradates, pesticides and pesticide degradates, pharmaceuticals, perchlorate, NDMA, 1,2,3-TCP, nutrients, DOC, major and minor ions, trace elements, iron, arsenic, and chromium speciation, and radioactive constituents (table A3). NWQL-certified blank water is not available for tritium or noble gases; thus, source solution and field blanks were not collected for these constituents.

Field blanks were collected by pumping or pouring blank water through the sampling equipment (fittings and tubing) used to collect ground water, then processing and transporting the blank samples using the same protocols for the ground-water samples. The equipment used to collect samples from monitoring wells was significantly different than that used to collect samples from production wells; thus, the field blanks were separated into monitoring well and production well groups for comparison with ground-water data. Source-solution blanks were collected at the sampling site by pouring blank water directly into sample containers that were preserved, stored, shipped, and analyzed in the same manner as the ground-water samples. Source-solution blanks were not divided into two classes because they were not collected using the field sampling equipment.

If a constituent was detected in field or source-solution blanks, the data for that constituent in ground-water samples were examined for potential contamination. Detections in ground-water samples with concentrations less than the highest concentration measured in a blank plus the LT-MDL were marked with a "V" in the data tables (LRL equals twice the LT-MDL). The highest concentration measured in a blank was assumed to represent the highest potential amount of contamination. Thus, the V remark code flags results that could have changed from a nondetection to a detection relative to the LT-MDL because of contamination. For example, if the LT-MDL for a constituent is 0.10 µg/L, the measured concentration in a ground-water sample with a true concentration of 0.05 µg/L would be reported as a nondetection. But, if the ground-water sample was contaminated with 0.20 µg/L of the constituent, the measured concentration would be reported as 0.25 µg/L, a detection. If the maximum potential amount of contamination is 0.20 µg/L, then ground-water samples with measured concentrations less than 0.30 µg/L may actually have true concentrations less than the LT-MDL.

For organic constituents, results with V codes are not considered to be detections of the constituent when calculating detection frequencies for ground-water quality assessments. For inorganic constituents, results with V codes are considered to have concentrations less than the reported value (including the possibility of the concentration being less than the LT-MDL).

Replicates

Sequential replicate samples were collected to assess variability that may result from the processing and analyses of inorganic and organic constituents. RSD of the measured values was used to express the variability between replicate pairs for each compound (table A4). The RSD is defined as the standard deviation divided by the mean concentration for each replicate pair of samples, multiplied by 100 percent. If one value in a sample pair was reported as a nondetection and the other value was reported as an estimated value below the LRL or MRL, the RSD was set to zero because the values are analytically identical. If one value in a sample pair was reported as a nondetection and the other value was greater than the LRL or MRL, then the nondetection value was set equal to one-quarter of the LRL, and the RSD was calculated (Hamlin and others, 2002). Values of RSD less than 20 percent are considered acceptable in this study. An RSD value of 20 percent corresponds to a relative percent difference (RPD) value of 29 percent. High RSD values for a compound may indicate analytical uncertainty at low concentrations, particularly for concentrations within an order of magnitude of LT-MDL or MDL. Sequential replicate samples were collected at approximately 10 percent of the wells sampled.

Matrix Spikes

Addition of a known concentration of a constituent ("spike") to a replicate environmental sample enables the laboratory to determine the effect of the matrix, in this case ground water, on the analytical technique used to measure the constituent. The compounds added as matrix spikes are the same as those being analyzed in the method. This enables an analysis of matrix interferences on a compound by compound basis. Matrix spikes were added at the laboratory performing the analysis. Compounds with low recoveries are of particular concern if environmental concentrations are close to the MCLs; a concentration below an MCL could be above this threshold. Conversely, compounds with high recoveries are of potential concern if the environmental concentrations exceed MCLs; a high recovery could falsely indicate a concentration above the MCL.

Acceptable ranges for matrix-spike recoveries are based on the acceptable ranges established for laboratory "set" spike recoveries. Laboratory set spikes are aliquots of laboratory blank water to which the same spike solution used for the matrix spikes has been added. One set spike is analyzed with each set of samples. Acceptable ranges for set spike recoveries are 70 to 130 percent for NWQL Schedules 2020 and 4024 (VOCs and gasoline additives; Connor and others, 1998; Rose and Sandstrom, 2003; Zaugg and others, 2002), 60 to 120 percent for NWQL Schedules 2032, 2033, and 2060 (pesticides; Sandstrom and others, 2001), and 60 to 130 percent for Schedule 2080 (pharmaceuticals; Kolpin and others, 2002). On the basis of these ranges, we defined 70 to 130 percent as the acceptable range for matrix-spike recoveries for organic compounds in this study.

Laboratory matrix spikes were performed for VOCs, gasoline oxygenate and their degradates, pesticide compounds, pharmaceutical compounds, NDMA, and 1,2,3-TCP because the analytical methods for these constituents are chromatographic methods that may be susceptible to matrix interferences. Replicate samples for matrix-spike additions were collected at approximately 10 percent of the wells sampled, although not all analyte classes were tested for every well (tables A5A–D).

Surrogates

Surrogate compounds are added to environmental samples in the laboratory prior to analysis to evaluate the recovery of similar constituents. Surrogate compounds were added to all ground-water and QC samples that were analyzed for VOCs, gasoline oxygenates and their degradates, pesticide compounds, NDMA, and 1,2,3-TCP (table A6). Most of the surrogate compounds are deuterated analogs of compounds being analyzed. For example, the surrogate toluene-*d*8 used in the VOC analytical method has the same chemical structure as toluene, except that the eight hydrogen-1 atoms on the molecule have been replaced by deuterium (hydrogen-2). Toluene-*d*8 and toluene behave very similarly in the analytical procedure, but the small mass difference between the two results in slightly different chromatographic retention times; thus, the use of a toluene-*d*8 surrogate does not interfere with the analysis of toluene. Only 0.015 percent of hydrogen atoms are deuterium (Firestone and others, 1996); thus, deuterated compounds like toluene-*d*8 do not occur naturally and are not found in environmental samples. Surrogates are used to identify general problems that may arise during sample analysis that could affect the analysis results for all compounds in that sample. Potential problems include matrix interferences (such as high levels of dissolved organic carbon) that produce a positive bias, or incomplete laboratory recovery (possibly attributed to improper maintenance and calibration of analytical equipment) that produces a negative bias. A 70 to 130 percent recovery of surrogates is generally considered acceptable. Values outside this range indicate possible problems with the processing and analysis of samples (Connor and others, 1998; Sandstrom and others, 2001).

Quality-Control Sample Results

Detections in Field and Source-Solution Blanks

Field blanks were collected at approximately 10 percent of the sites sampled in MSACV. Table A3 presents a summary of compound detections in field blanks. Field blank results were grouped according to sampling methods (see "Sample Collection and Analysis" section) and analyzed to determine how field blank detections affected environmental data.

Seven source-solution blanks, seven field blanks at production wells, and five field blanks at monitoring wells were collected for analysis of VOCs. Eleven VOC constituents were detected in field blanks collected at production wells or in source-solution blanks (table A3). Only 2 of these 11 VOCs—chloroform and 1,2,4-trimethylbenzene—were detected in ground-water samples collected at production wells. Chloroform was detected in one field blank at a concentration of E0.04 µg/L. Three detections in ground-water samples with concentrations less than 0.05 µg/L (E0.04 µg/L plus one-half of the LRL of 0.02 µg/L) were flagged with a V code (table 5). 1,2,4-trimethlybenzene was detected in one source-solution blank at a concentration of E0.04 µg/L. Four detections in production well samples with concentrations less than 0.07 µg/L (E0.04 µg/L plus one-half the LRL of 0.056 µg/L) were flagged with a V code (table 5). The V-coded results were counted as nondetections for calculation of the detection frequency of chloroform and 1,2,4-trimethylbenzene in the grid wells.

Three VOC constituents were detected in field blanks collected at monitoring wells or in source-solution blanks (table A3), and all three were detected in ground-water samples collected at monitoring wells. 1,2,4-trimethlybenzene was detected in one source-solution blank and one field blank with a maximum concentration of E0.04 µg/L. A single detection in a ground-water sample with a concentration less than 0.07 µg/L (E0.04 µg/L plus one-half the LRL of 0.056 µg/L) was flagged with a V code (table 5). *m*- and *p-Xylene* was detected was detected in two fields with a maximum concentration of E0.07 µg/L. *m*- and *p-Xylene* was detected in one ground-water sample collected from a monitoring well. The concentration of *m- and p-Xylene* detected in the sample was less than 0.10 µg/L (0.07 µg/L plus one-half the LRL of 0.06 µg/L) and was, therefore, flagged with a V code. Toluene was detected in three source solution blanks and three field blanks with a maximum concentration of E0.07 µg/L. Low levels of toluene were detected in source-solution and field blanks in many of the earlier GAMA study units (Bennett and others, 2006; Dawson and others, 2008; Fram and Belitz, 2007; Kulongoski and Belitz, 2007; Kulongoski and others, 2006; Wright and others, 2005). Toluene was detected in one ground-water sample collected from a monitoring well. The concentration of toluene detected in the sample was less than 0.08 µg/L (0.07 µg/L plus one-half the LRL of 0.02 µg/L), and was, therefore, flagged with a V code. Seven field blanks were collected at production wells and four field blanks were collected at monitoring wells for analysis of pesticides and pesticide degradates. Three pesticide compounds were detected in one field blank collected at a production well (table A3), and one of these compounds, bromacil, was detected in ground-water samples collected from production wells. The concentration of bromacil detected in the field blank was E0.11 µg/L. All three detections of bromacil in ground-water samples were less than 0.012 µg/L (0.11 µg/L plus one-half the LRL of 0.018 µg/L), and were, therefore, flagged with a V code (table 6). The V-coded results were counted as nondetections for calculation of the detection frequency of bromacil in the grid wells.

Constituents of special interest (perchlorate, 1,2,3-TCP, and NDMA) and radioactive constituents (radium isotopes and gross alpha and beta radiation) were not detected in any source-solution or field blanks. One field blank was collected at a production well for analysis of radium isotopes and gross alpha and beta radiation. Eleven source-solution blanks, seven field blanks at production wells, and four field blanks at monitoring wells were collected for analysis of perchlorate. Six source solution-blanks, five field blanks at production wells, and one field blank at a monitoring well were collected for analysis of 1,2,3-TCP and NDMA.

DOC was analyzed in one field blank collected at a production well and three field blanks collected at monitoring wells. DOC was detected in all three field blanks collected at monitoring wells, with a maximum concentration of 0.7 mg/L. Six ground-water samples collected at monitoring wells had detections of DOC at concentrations less than 0.9 mg/L (0.7 mg/L plus one-half the LRL of 0.33 mg/L). These six samples were flagged with V codes (table 8), indicating that the concentration of DOC in the samples may be as high as the reported value, but may also be as low as a nondetection relative to the stated detection limit (one-half the LRL).

Nutrients were analyzed in five field blanks collected at production wells and four field blanks collected at monitoring wells. Nitrate and nitrite were not detected in any of the field blanks. Orthophosphate was detected at a concentration of E0.003 mg/L in one field blank collected at a production well, and in two field blanks collected at monitoring wells. One production well sample had an orthophosphate concentration less than 0.006 mg/L (0.003 plus one-half the LRL of 0.006 µg/L); this result was flagged with a V code. Ammonia was detected in two field blanks collected at monitoring wells, with a maximum concentration of E0.007 mg/L. Seventeen ground-water samples collected from monitoring wells had ammonia concentrations less than 0.012 mg/L (E0.007 mg/L plus one-half the LRL of 0.01 mg/L). These results were flagged with V codes, indicating that the ammonia concentration in the samples could be as high as the reported value if no contamination had occurred, but also be as low as a nondetection relative to the LT-MDL of 0.005 mg/L if the maximum potential amount of contamination (0.003 mg/L) had occurred. Total nitrogen was detected in three field blanks collected at production wells, with a maximum concentration of 0.26 mg/L, and in two field blanks collected at monitoring wells with a maximum concentration of 0.45 mg/L. The LRL for total nitrogen is 0.06 mg/L; thus, the threshold concentration for flagging results with V codes was 0.29 mg/L for ground-water samples collected at production wells and 0.48 mg/L for ground-water sampled collected at monitoring wells. Total nitrogen results for the 10 ground-water samples collected from production wells and the 14 collected from monitoring wells with concentrations less than these threshold concentrations were flagged with V codes.

Major ions were analyzed in five field blanks collected at production wells and four collected at monitoring wells. Calcium, chloride, magnesium, and silica were each detected in at least one field blank (table A3). However, for all four ions, the maximum concentration detected in the field blanks plus one-half the LRL was less than the minimum concentrations detected in ground-water samples. Therefore, no data were flagged with V codes.

Trace elements were analyzed in five field blanks collected at production wells and in five field blanks collected at monitoring wells. Maximum concentrations for the three trace elements detected in field blanks collected at production wells were: chromium, 0.04 µg/L; nickel, 0.05 µg/L; and zinc, 1.0 µg/L (table A3). The threshold concentration for flagging results with V codes in table 10 was the maximum concentration of the constituent detected in a field blank plus one-half the LRL for that constituent. Nine detections of chromium with concentrations less than 0.06 µg/L, 10 detections of nickel with concentrations less than 0.08 µg/L, and 16 detections of zinc with concentrations less than 1.3 µg/L in ground-water samples collected from production wells were flagged with V codes, indicating that the concentration in the ground-water sample may be as high as the reported concentration, but also may be as low as a nondetection. In all cases, the results flagged with V codes had concentrations far below health-based or other drinking-water quality thresholds (the MCL-CA for chromium is 50 µg/L; the MCL-CA for nickel is 100 µg/L; and the SMCL-CA for zinc is 5,000 µg/L).

Maximum concentrations for the 11 trace elements detected in at least one field blank collected at a monitoring well were: aluminum, E1 µg/L; barium, E0.9 µg/L; chromium, 0.10 µg/L; copper, 1.80 µg/L; iron, 8 µg/L; manganese, 0.7 µg/L; nickel, 0.20 µg/L; strontium, 0.55 µg/L; tungsten, E0.04 µg/L; vanadium, E0.08 µg/L; and zinc, 2.4 µg/L (table A3). The threshold concentration for flagging results with V codes in table 10 was the maximum concentration of the constituent detected in a field blank plus one-half the LRL for that constituent. Sixteen detections of aluminum, 6 detections of chromium, 18 detections of copper, 7 detections of iron, 5 detections of manganese, 2 detections of nickel, 2 detections of tungsten, and 23 detections of zinc in ground-water samples collected from monitoring wells were flagged with V codes, indicating that the concentration in the ground-water sample may be as high as the reported concentration, but also may be as low as a nondetection. In all cases, the results flagged with V codes had concentrations far below health-based or other drinking-water quality thresholds (table 10). No detections of barium, strontium, or vanadium were flagged with V codes because the maximum concentration detected in the field blanks plus one-half the LRL was less than the minimum concentration detected in ground-water samples.

Arsenic and iron were detected in field blank samples analyzed by the NRP (table A3). Arsenic was detected in two of five field blanks collected at production wells and in two of five field blanks collected at monitoring wells. The maximum concentration of arsenic detected in a field blank analyzed by the NRP laboratory was 4.5 µg/L. Arsenic was not detected in any field blank samples analyzed by NWQL; therefore, the arsenic detected in field blanks analyzed at the NRP laboratory were considered to have originated in the laboratory. Because the arsenic contamination was not related to sampling equipment, there was no basis for assessing NRP arsenic data differently for the two different types of sampling equipment. Because the arsenic concentration data from NWQL Schedule 1948 are preferred over the concentration data from the NRP laboratory, comparisons between the two sets of data were used in conjunction with the detections in the field blanks analyzed at the NRP laboratory to assess the NRP arsenic data. Arsenic concentrations from the NRP were greater than those from NWQL for 27 of the 82 ground-water samples analyzed, and for 19 of the 27, the difference was greater than 20 percent RSD, the criteria for acceptable replicate pairs. The NRP arsenic concentrations were up to 3.5 µg/L greater than the NWQL arsenic concentration in these 19 ground-water samples, a difference that is comparable to the maximum concentration of arsenic detected in the field blanks. Arsenic results from the NRP laboratory for these 19 ground-water samples were flagged with V codes (table 11) to indicate that disagreement between the NWQL and NRP arsenic concentrations may be due to contamination of ground-water samples analyzed at the NRP laboratory. The ratio of arsenic species, $\frac{As(V)}{As(III)}$, for these 19 samples may not be representative of the redox conditions in the ground water.

Iron was detected in 2 of 10 field blanks analyzed by the NRP laboratory, with a maximum concentration of 15 µg/L. For eight ground-water samples with iron concentrations greater than 6 µg/L (the NWQL LRL for iron), iron concentrations measured by the NRP laboratory were higher than those measured by NWQL. However, all eight pairs differed by less than 10 percent RSD; thus, none of the NRP iron results were flagged with V codes.

Variability in Replicate Samples

Most of the replicate sample pairs collected during the MSACV study had relative standard deviations (RSDs) of less than 20 percent (table A4). Replicate sample pairs for analytes not detected in any ground-water samples are not reported in table A4. Thirty replicate sample pairs, representing 20 chemical constituents, had RSDs greater than 20 percent; see table A4 for details. However, the replicate sample pairs with high RSDs had very low concentrations. At low concentrations, small deviations in measured values account for large RSDs. Because the variability in measurements occurred at low concentrations, well below regulatory thresholds, this variability was not of QC concern, and no detections were censored as a result of variability in replicate samples.

Matrix Spike Recoveries

Tables A5A–D present a summary of matrix-spike recoveries for the MSACV study. The addition of a spike or known concentration of a constituent to an environmental sample enables the laboratory to determine the effect of the matrix, in this case ground water, on the analytical technique used to measure the constituent. Thirteen environmental samples were spiked with VOCs to calculate matrix-spike recoveries (table A5A). Seventy-one of the 85 VOCs had matrix-spike recoveries in the acceptable range between 70 and 130 percent. Eleven VOCs had at least one-matrix spike recovery greater than 130 percent; however, of these compounds, 6 were not detected in ground-water samples. Seven VOCs had a recoveries below 70 percent; however, of these compounds, 4 were not detected in ground-water samples. The three VOCs that had recoveries less than 70 percent and were detected in ground water included carbon disulfide, 1,2,3,4-tetramethylbenzene, and 1,2,3,5-tetramethylbenzene, with recoveries of 67, 69, and 62 percent, respectively. The four VOCs that had recoveries less than 70 percent, but were not detected in ground water included dichloromethane, 2,2-dichloropropane, styrene, and 1,2,3-trichlorobenzene, with recoveries of 28, 62, 69, and 56 percent, respectively (NOTE: low recoveries may indicate that these compounds may not have been detected if they were present at very low levels).

Twelve environmental samples were spiked with pesticide and pesticide degradate compounds to calculate matrix-spike recoveries, although the number of spiked samples varied depending on laboratory procedures (table A5B). Forty-one of the 136 spike compounds had recoveries in the acceptable range between 70 and 130 percent. Eighteen of the compounds detected in ground-water samples had spike recoveries that exceeded the acceptable range. Twenty-three spike compounds had at least one recovery greater than 130 percent. Ninety-one spike compounds had at least one recovery below 70 percent, with recovery of phosmet being particularly poor. (NOTE: low recoveries may indicate that the compound might not have been detected in some samples if it was present at a very low concentration).

One, 7, and 5 ground-water samples were spiked with perchlorate, 1,2,3-TCP, and NDMA, respectively (table A5C). All spike recoveries were within the acceptable range of 70 to 130 percent.

Two ground-water samples were spiked with radium-226 and radium-228 (table A5D). All spike recoveries were within the acceptable range of 70 to 130 percent with the exception of gross alpha 72-hour and gross alpha 30-day counts for one of the samples. The spiked sample (WSAC-08) that had poor recovery of alpha radioactivity had relatively high concentration of calcium (table 9). Because calcium is known to interfere with alpha counts (Sinojmeri, 1999), this sample and WSAC-18, which had similar major-ion chemistry, were coded as having the potential to be biased low for gross alpha 72-hour and gross alpha 30-day counts.

Surrogate Compound Recoveries

Surrogate compounds were added to environmental samples in the laboratory and analyzed to evaluate the recovery of similar constituents. Table A6 lists each surrogate, the analytical schedule on which it was applied, the number of analyses for blank and nonblank samples, the number of surrogate recoveries below 70 percent, and the number of surrogate recoveries above 130 percent for the blanks and environmental samples. Blanks and environmental samples were considered separately to assess whether the matrices present in ground water affect surrogate recoveries. No systematic differences between surrogate recoveries in blanks and environmental samples were observed. Ninety-one percent of the surrogate recoveries in analyses of VOC and gasoline oxygenate and degradates were in the acceptable range of 70 to 130 percent recovery, as were 96 percent of the surrogate recoveries for pesticides and pesticide degradates, and 89 percent for NDMA and 1,2,3-TCP analyses.

Table A1. Analytical methods used for the determination of organic, inorganic, and microbial constituents by the U.S. Geological Survey's (USGS) National Water Quality Laboratory (NWQL) and additional contract laboratories.

[MI agar, supplemented nutrient agar in which coliforms (total and *Escherichia*) produce distinctly different fluorescence under ultraviolet lighting; RSIL, Reston Stable Isotope Laboratory (USGS); UV, ultraviolet; VOCs, volatile organic compounds]

Analyte	Analytical Method	Laboratory and analytical schedule or lab code	Citation(s)
Organic constituents			
VOCs	Purge and trap capillary gas chromatography/mass spectrometry	NWQL, Schedule 2020	Connor and others, 1998
Gasoline oxygenates	Heated purge and trap/gas chromatography/mass spectrometry	NWQL, Schedule 4024	Rose and Sandstrom, 2003
Pesticides	Solid-phase extraction and gas chromatography/mass spectrometry	NWQL, Schedules 2032, 2033, and 2060	Furlong and others, 2001; Lindley and others, 1996; Madsen and others, 2003; Sandstrom and others, 2001; Zaugg and others, 1995
Pharmaceuticals	Solid-phase extraction and HPLC/mass spectrometry	NWQL, Schedule 2080	Kolpin and others, 2002
Constituents of special interest			
Perchlorate	Chromatography and mass spectrometry	Montgomery Watson Harza laboratory[1]	Hautman and others, 1999
N-nitrosodimethylamine (NDMA)	Chromatography and mass spectrometry	Montgomery Watson Harza laboratory[1]	U.S. Environmental Protection Agency, 1996; U.S. Environmental Protection Agency, 1999b
1,2,3-Trichloropropane	Gas chromatography/electron capture detector	Montgomery Watson Harza laboratory[1]	U.S. Environmental Protection Agency, 1995
Inorganic constituents			
Nutrients	Alkaline persulfate digestion, Kjedahl digestion	NWQL, Schedule 2755	Fishman, 1993; Patton and Kryskalla, 2003
Dissolved organic carbon	UV-promoted persulfate oxidation and infrared spectrometry	NWQL, Lab Code 2613	Brenton and Arnett, 1993
Major and minor ions, trace elements and nutrients	Atomic absorption spectrometry, colorimetry, ion-exchange chromatography, inductively-coupled plasma atomic-emission spectrometry and mass spectrometry	NWQL, Schedule 1948	American Public Health Association, 1998; Faires, 1993; Fishman, 1993; Fishman and Friedman, 1989; Garbarino, 1999; Garbarino and Damrau, 2001; Garbarino and others, 2006; McLain, 1993
Chromium, arsenic and iron speciation	Various techniques of ultraviolet visible (UV-VIS) spectrophotometry and atomic-absorbance spectroscopy	USGS Trace Metal Laboratory, Boulder, Colorado[1]	Ball and McCleskey, 2003a,b; McCleskey and others, 2003; Stookey, 1970; To and others, 1998
Stable isotopes			
Stable isotopes of water	Gaseous hydrogen and carbon dioxide-water equilibration and stable-isotope mass spectrometry	USGS Stable Isotope Laboratory, Reston, Virginia, Schedule 1142	Coplen, 1994; Coplen and others, 1991; Epstein and Mayeda, 1953
Nitrogen and oxygen isotopes of nitrate	Denitrifier method and mass spectrometry	USGS Stable Isotope Laboratory, Reston, Virginia, RSIL Lab Code 2900	Révész, K., and Casciotti, K., 2007
Carbon isotopes	Accelerator mass spectrometry	University of Waterloo, Environmental Isotope Lab[1]; University of Arizona Accelerator Mass Spectrometry Lab[1]	Donahue and others, 1990; Jull and others, 2004

Table A1. Analytical methods used for the determination of organic, inorganic, and microbial constituents by the U.S. Geological Survey's (USGS) National Water Quality Laboratory (NWQL) and additional contract laboratories.—Continued

[MI agar, supplemented nutrient agar in which coliforms (total and *Escherichia*) produce distinctly different fluorescence under ultraviolet lighting; RSIL, Reston Stable Isotope Laboratory (USGS); UV, ultraviolet; VOCs, volatile organic compounds]

Analyte	Analytical Method	Laboratory and analytical schedule or lab code	Citation(s)
Radioactivity and gases			
Tritium	Electrolytic enrichment-liquid scintillation	USGS Stable Isotope and Tritium Laboratory, Menlo Park, California, Lab Code 1565	Thatcher and others, 1977
Tritium and noble gases	Helium-3 in-growth and mass spectrometry	Lawrence Livermore National Laboratory[1]	Eaton and others, 2004; Moran and others, 2002
Radon-222	Liquid scintillation counting	NWQL, Schedule 1369	American Society for Testing and Materials, 1998; U.S. Environmental Protection Agency, 1999a
Radium 226/228	Alpha activity counting	Eberline Analytical Services, NWQL method 1262	U.S. Environmental Protection Agency, 1980 (USEPA methods 903 and 904)
Gross alpha and beta radioactivity	Alpha and beta activity counting	Eberline Analytical Services, NWQL method 1792	U.S. Environmental Protection Agency, 1980 (USEPA method 900.0)
Microbial constituents			
F-specific and somatic coliphage	Single-agar layer (SAL) and two-step enrichment methods	USGS Ohio Water Microbiology Laboratory[1]	U.S. Environmental Protection Agency, 2001
Total and *Escherichia* coliform	Membrane filter technique with "MI agar"	USGS field measurement	U.S. Environmental Protection Agency, 2002b

[1] The analytes have no schedule or lab code assigned to them.

Table A2. Preferred analytical schedules/methods for constituents appearing on multiple schedules/methods for samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September 2006.

[Preferred analytical schedules are the methods of analysis with the greatest accuracy and precision out of the ones used for the compound in question. MWH, Montgomery Watson Harza laboratory; TML, U.S. Geological Survey's (USGS) Trace Metal Laboratory in Boulder, Colorado; VOC, volatile organic compound]

Constituent	Primary constituent classification	Analytical schedules/method	Preferred analytical schedule/method
Results from preferred method reported			
Acetone	VOC, gasoline degradate	2020, 4024	2020
Diisopropyl ether	VOC, gasoline degradate	2020, 4024	2020
Ethyl *tert*-Butyl ether (ETBE)	VOC, gasoline degradate	2020, 4024	2020
Methyl *tert*-butyl ether (MTBE)	VOC, gasoline degradate	2020, 4024	2020
Methyl *tert*-pentyl ether	VOC, gasoline degradate	2020, 4024	2020
Atrazine	Pesticide	2032/2033, 2060	2032/2033
Carbaryl	Insecticide	2032/2033, 2060	2032/2033
Carbofuran	Herbicide	2032/2033, 2060	2032/2033
Deethlyatrazine	Pesticide degradate	2032/2033, 2060	2032/2033
Metalaxyl	Fungicide	2032/2033, 2060	2032/2033
Tebuthiuron	Pesticide	2032/2033, 2060	2032/2033
Results from both methods reported			
Alkalinity	Water-quality indicator	1948, field	field
Arsenic(Total)	Trace element	1948, TML[1]	1948
Chromium(Total)	Trace element	1948, TML[1]	1948
Iron(Total)	Trace element	1948, TML[1]	1948
pH	Water-quality indicator	1948, field	field
Specific conductance	Water-quality indicator	1948, field	field
1,2,3-Trichloropropane (1,2,3-TCP)	VOC	2020, MWH[1]	MWH[1]

[1] In the USGS's National Water Information System (NWIS), the laboratory entity code for TML is USGSTMCO and for MWH is CA-MWHL.

Table A3. Constituents detected in field blanks collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.

[E, estimated value; mg/L, milligrams per liter; µg/L, micrograms per liter; —, not detected]

Constituent	Source-solution blanks		Field blanks at production wells		Field blanks at monitoring wells		Number of ground-water data affected
	Number of detections/ analyses	Detected concentrations	Number of detections/ analyses	Detected concentrations	Number of detections/ analyses	Detected concentrations	
Volatile organic compounds (µg/L)							
Acetone	0/7	—	3/7	E3, 6, 11	0/5	—	0
Benzene	0/7	—	1/7	E0.01	0/5	—	0
Dichloromethane	0/7	—	1/7	E0.1	0/5	—	0
2-Butanone (MEK, Methyl ethyl ketone)	0/7	—	2/7	E1.4, 5.9	0/5	—	0
Ethylbenzene	0/7	—	2/7	E0.01, E0.02	0/5	—	0
1,2,4-Trimethyl-benzene	1/7	E0.04	0/7	—	1/5	E0.02	6
m- and *p*-Xylene	0/7	—	3/7	E0.04, E0.06, E0.06	2/5	E0.03, E0.07	1
o-Xylene	0/7	—	1/7	E0.03	0/5	—	0
Styrene	0/7	—	3/7	E0.01, E0.02, E0.02	0/5	—	0
Toluene	3/7	E0.01, E0.01, E0.02	3/7	E0.08, 0.10, 0.16	3/5	E0.02, E0.02, E0.07	1
Chloroform	0/7	—	1/7	E0.04	0/5	—	3
Pesticide and pesticide degradates (µg/L)							
Bromacil			1/7	E0.11	0/4	—	3
2,4-D and 2,4-D methyl ester			1/7	0.28	0/4	—	0
Diuron			1/7	0.03	0/4	—	0
Nutrients and dissolved organic carbon (DOC) (mg/L)							
Ammonia (as nitrogen)			0/5	—	2/4	E0.006, E0.007	17
Dissolved organic carbon (DOC)			0/1	—	3/3	E0.2, E0.7, 0.7	6
Orthophosphate (as phosphorus)			1/5	E0.003	2/4	E0.003, E0.003	1
Total nitrogen			3/5	E0.04, E0.04, 0.26	2/4	E0.04, 0.45	24
Major and minor ions (mg/L)							
Calcium			0/5	—	2/4	E0.01, 0.08	0
Chloride			0/5	—	1/4	E0.13	0
Magnesium			1/5	E0.005	2/4	E0.004, 0.039	0
Silica			0/5	—	1/4	E0.03	0
Trace elements (µg/L)							
Aluminum			0/5	—	2/5	E0.9, E1	16
Barium			0/5	—	2/5	E0.8, E0.9	0
Chromium			4/5	E0.03, E0.03, 0.04, 0.04	4/5	0.04, 0.05, 0.08, 0.10	15
Copper			0/5	—	2/5	0.73, 1.80	18
Iron			0/5	—	1/4	8	7
Manganese			0/5	—	1/5	0.7	5
Nickel			1/5	E0.05	4/5	0.08, 0.16, 0.17, 0.20	12
Strontium			0/5	—	2/5	E0.23, 0.55	0
Tungsten			0/5	—	2/2	E0.03, E0.04	2
Vanadium			0/5	—	2/5	E0.08, E0.08	0
Zinc			2/5	E0.3, 1.0	3/5	1.2, 1.6, 2.4	39
Trace element species (µg/L)							
Inorganic arsenic(Total)			2/5	3.3, 4.5	2/5	0.6, 0.7	19
Iron(Total)			1/5	3	1/5	15	0

Table A4. Quality-control summary of replicate samples for constituents collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.

[The laboratory entity codes for the laboratories in the U.S. Geological Survey's (USGS) National Water Infomation System (NWIS) listed in the footnotes are shown in parentheses following the laboratory name. E, estimated value; mg/L, milligrams per liter; pCi/L, picocuries per liter; RSD, relative standard deviation; TU, tritium unit; µg/L, micrograms per liter; <, less than; —, no value]

Constitutent	Number of RSDs greater than 20 percent/number of replicates	Maximum RSD (percent)	Median RSD (percent)	Concentrations for replicates with RSDs greater than zero (environmental, replicate)
Volatile organic compounds, gasoline oxygenates and additives from Schedules 2020 and 4024				
1,2,4-Trimethylbenzene (g/L)	2/15	40.4	23.6	(E0.07, E0.05), (0.10, 0.18)
Toluene (µg/L)	1/15	47.1	47.1	(E0.02, E0.01)
Chloroform (Trichloromethane) (µg/L)	2/15	28.3	16.5	(E0.08, E0.06), (E0.02, E0.03)
All other VOCs from Schedules 2020 and 4024	0/15	< 20	—	—
Pesticides and pesticide degradates from Schedules 2032, 2033, and 2060				
All pesticides and pesticide degradates from Schedule 2032	0/12	< 20	—	—
All pesticides and pesticide degradates from Schedule 2033	0/2	< 20	—	—
All pesticides and pesticide degradates from Schedule 2060	0/13	< 20	—	—
Pharmaceuticals				
All pharmaceuticals from Schedule 2080	0/9	< 20	—	—
Constituents of special interest[1]				
Perchlorate	0/15	< 20	—	—
1,2,3-Trichloropropane (1,2,3-TCP)	0/7	< 20	—	—
N-Nitrosodimethylamine (NDMA)	0/5	< 20	—	—
Major ions, minor ions, trace elements, and nutrients				
Ammonia (mg/L)	1/11	23.6	23.6	(E0.005, E0.007)
Dissolved organic carbon (DOC) (mg/L)	1/5	26.2	5.2	(1.6, 1.1)
Bromide (mg/L)	2/10	122.6	1.3	(0.03, E0.02), (0.07, 0.005)
Aluminum (µg/L)	1/6	47.1	47.1	(2, E1)
Cadmium (µg/L)	1/8	47.1	47.1	(0.04, E0.02)
Cobalt (µg/L)	4/8	101	18.0	(0.01, 0.06), (0.07, E0.03), (0.06, E0.02), (E0.03, 0.04)
Copper (µg/L)	1/8	32.9	3.4	(E0.28, 0.45)
Iron (µg/L)	2/10	47.1	3.3	(E3, 6), (6, E3)
Lead (µg/L)	1/8	97.9	2.9	(0.10, 0.08)
Nickel (µg/L)	1/8	60.6	1.8	(1.10, 0.44)
Selenium (µg/L)	1/8	20.2	20.2	(0.08, E0.06)
Tungsten (µg/L)	1/8	28.3	28.3	(0.09, 0.06)
Zinc (µg/L)	1/8	41.9	2.2	(E0.51, 0.94)
All other nutrients from Schedule 2755	0/11	< 20	—	—
All other major ions from Schedule 1948	0/10	< 20	—	—
All other trace elements from Schedule 1948	0/8	< 20	—	—

Table A4. Quality-control summary of replicate samples for constituents collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.—Continued

[The laboratory entity codes for the laboratories in the U.S. Geological Survey's (USGS) National Water Infomation System (NWIS) listed in the footnotes are shown in parentheses following the laboratory name. E, estimated value; mg/L, milligrams per liter; pCi/L, picocuries per liter; RSD, relative standard deviation; TU, tritium unit; µg/L, micrograms per liter; <, less than; —, no value]

Constitutent	Number of RSDs greater than 20 percent/number of replicates	Maximum RSD (percent)	Median RSD (percent)	Concentrations for replicates with RSDs greater than zero (environmental, replicate)
Isotopes and radioactivity				
$\delta^{18}O$ of nitrate[2] (per mil)	1/4	84.8	7.2	(0.01, 0.04)
Tritium[3] (TU)	4/12	141.4	10.9	(0.3, 0), (0.3, 0), (1.3, 1.9), (1.3, 0.7)
Gross-beta radioactivity, 72-hour count[4] (pCi/L)	1/2	39.0	39	(E1.12, E1.97)
Gross-beta radioactivity, 30-day count[4] (pCi/L)	1/2	33.8	21.7	(E1.62, 2.64)
All additional isotopes and radioactivity	0/2	< 20	—	—
Microbial indicators				
F-specific and somatic coliphage	0/1	< 20	0	—
E. coli, and total coliforms	0/30	< 20	0	—

[1] Analyses performed at Montgomery Watson Harza laboratory, Monrovia, California (CA-MWHL).

[2] USGS Stable Isotope Laboratory, Reston, Virginia (USGSSIVA).

[3] USGS Stable Isotope and Tritium Laboratory, Menlo Park, California (USGSH3CA).

[4] Analyses performed at Eberline Analytical Services, Richmond, California (CA-EBERL).

Table A5A. Quality-control summary for matrix-spike recoveries of volatile organic compounds (VOCs) and gasoline oxygenates and their degradates in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.

[Acceptable recovery range is between 70 and 130 percent]

Constituent	Number of spike samples	Minimum recovery (percent)	Maximum recovery (percent)	Median recovery (percent)
Acetone[1,2]	13	83	122	99
Acrylonitrile	13	93	104	102
tert-Amyl alcohol	2	97	107	102
Benzene[1]	13	91	109	104
Bromobenzene	13	98	115	102
Bromochloromethane[1]	13	83	115	105
Bromodichloromethane	13	91	130	104
Bromoform (Tribromomethane)[1]	13	85	123	98
2-Butanone (MEK, Methyl ethyl ketone)[1]	13	90	112	97
n-Butylbenzene	13	75	108	91
tert-Butyl alcohol (TBA)	2	94	104	99
sec-Butylbenzene	13	83	115	98
tert-Butylbenzene	13	89	126	107
Carbon disulfide[1]	13	67	125	82
Carbon tetrachloride (Tetrachloromethane)[1]	13	87	157	106
Chlorobenzene	13	92	115	102
Chloroethane	13	83	128	106
Chloroform (Trichloromethane)[1]	13	87	130	111
Chloromethane[1]	13	88	128	113
3-Chloro-1-propene	13	99	131	116
2-Chlorotoluene	13	91	109	102
4-Chlorotoluene	13	84	109	98
Dibromochloromethane[1]	13	85	122	101
1,2-Dibromo-3-chloropropane (DBCP)	13	84	113	96
1,2-Dibromoethane (EDB)	13	91	126	104
Dibromomethane	13	83	121	104
1,2-Dichlorobenzene	13	87	111	100
1,3-Dichlorobenzene	13	87	109	102
1,4-Dichlorobenzene	13	91	106	100
trans-1,4-Dichloro-2-butene	13	82	114	96
Dichlorodifluoromethane (CFC-12)	13	70	123	106
1,1-Dichloroethane[1]	13	97	142	112
1,2-Dichloroethane	13	90	132	111
1,1-Dichloroethene (DCE)	13	87	117	104
cis-1,2-Dichloroethene[1]	13	96	117	106
trans-1,2-Dichloroethene[1]	13	94	117	106
Dichloromethane (Methylene chloride)	13	28	128	106
1,2-Dichloropropane	13	94	119	106
1,3-Dichloropropane	13	92	126	106
2,2-Dichloropropane	13	62	124	96
1,1-Dichloropropene	13	93	145	104
cis-1,3-Dichloropropene	13	79	108	97
trans-1,3-Dichloropropene	13	80	116	92
Diethyl ether	13	91	118	102
Diisopropyl ether (DIPE)[2]	13	85	110	102
Ethylbenzene	13	89	115	100
Ethyl *tert*-butyl ether (ETBE)[2]	13	81	119	100
Ethyl methacrylate	13	82	107	96
1-Ethyl-2-methylbenzene (*o*-Ethyl toluene)[1]	13	82	106	94
Hexachlorobutadiene	13	70	108	85
Hexachloroethane	13	86	118	102

Table A5A. Quality-control summary for matrix-spike recoveries of volatile organic compounds (VOCs) and gasoline oxygenates and their degradates in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006. —Continued

[Acceptable recovery range is between 70 and 130 percent]

Constituent	Number of spike samples	Minimum recovery (percent)	Maximum recovery (percent)	Median recovery (percent)
2-Hexanone (*n*-Butyl methyl ketone)	13	92	112	99
Isopropylbenzene (Cumene)	13	91	119	104
4-Isopropyl-1-methylbenzene[1]	13	81	110	97
Methyl acetate	2	11	112	111
Methyl acrylate	13	95	111	99
Methyl acrylonitrile	13	86	110	104
Methyl bromide (Bromomethane)	13	81	179	111
Methyl *tert*-butyl ether (MTBE)[1,2]	13	86	123	102
Methyl iodide (Iodomethane)	13	75	145	108
Methyl isobutyl ketone (MIBK)	13	85	110	96
Methyl methacrylate	13	73	106	94
Methyl *tert*-pentyl ether (*tert*-Amyl methyl ether, TAME)[2]	13	89	124	100
Naphthalene	13	80	117	96
n-Propylbenzene	13	87	111	98
Styrene	13	69	104	94
1,1,1,2-Tetrachloroethane	13	83	121	102
1,1,2,2-Tetrachloroethane	13	89	116	104
Tetrachloroethene (PCE)[1]	13	91	119	106
Tetrahydrofuran	13	96	112	106
1,2,3,4-Tetramethylbenzene[1]	13	69	126	98
1,2,3,5-Tetramethylbenzene[1]	13	62	135	106
Toluene[1]	13	88	115	104
1,2,3-Trichlorobenzene	13	56	113	106
1,2,4-Trichlorobenzene	13	77	126	99
1,1,1-Trichloroethane (TCA)	13	96	133	106
1,1,2-Trichloroethane	13	84	113	104
Trichloroethene (TCE)[1]	13	91	121	104
Trichlorofluoromethane (CFC-11)[1]	13	96	143	118
1,2,3-Trichloropropane (1,2,3-TCP)	13	89	115	103
1,1,2-Trichloro-1,2,2-trifluoroethane (CFC-113)	13	79	113	98
1,2,3-Trimethylbenzene	13	84	116	105
1,2,4-Trimethylbenzene[1]	13	86	117	102
1,3,5-Trimethylbenzene[1]	13	85	108	100
Vinyl bromide (Bromoethene)	13	96	128	117
Vinyl chloride (Chloroethene)	13	90	128	117
m- and *p*-Xylene[1]	13	86	171	102
o-Xylene	13	82	113	98

[1] Constituents detected in ground-water samples.

[2] Constituents on schedules 2020 and 4024; only values from schedule 2020 are reported because it is the preferred analytical schedule.

Table A5B. Quality-control summary for matrix-spike recoveries of pesticides and pesticide degradates in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.

[Acceptable recovery range is between 70 and 130 percent]

Constituent	Number of spike samples	Minimum recovery (percent)	Maximum recovery (percent)	Median recovery (percent)
Acetochlor[1,2]	11	78	99	87
Acifluorfen	12	42	88	68
Alachlor[2]	11	83	97	91
Aldicarb	12	57	86	59
Aldicarb sulfone	12	28	103	65
Aldicarb sulfoxide	12	68	112	85
Atrazine[1,2,3]	11	87	98	92
Azinphos-methyl[2]	11	63	103	74
Azinphos-methyl oxon[2]	9	29	104	56
Bendiocarb	11	49	93	73
Benfluralin[2]	11	48	62	54
Benomyl	12	45	91	72
Bensulfuron-methyl[1]	12	91	146	108
Bentazon[1]	12	46	202	70
Bromacil[1]	12	51	109	86
Bromoxyni[1]	12	36	62	52
Caffeine	12	55	101	77
Carbaryl[1,2,3]	11	84	108	98
Carbofuran[2,3]	11	74	94	86
Chloramben, methyl ester	12	42	91	81
Chlorimuron-ethyl[1]	12	69	139	108
2-Chloro-2,6-diethylacetanilide[2]	11	80	98	93
2-Chloro-6-ethylamino-4-amino-*s*-triazine (deisopropylatrazine)[1]	12	24	95	76
2-Chloro-4-isopropylamino-6-amino-*s*-triazine (deethylatrazine)[1,2]	11	36	51	44
4-Chloro-2-methylphenol[2]	11	43	74	64
3-(4-Chlorophenyl)-1-methyl urea	12	42	115	76
Chlorpyrifos[1,2]	11	83	100	90
Chlorpyrifos, oxygen analog[2]	11	9	80	29
Clopyralid	12	55	81	69
Cyanazine	2	82	110	96
Cycloate	12	23	83	76
Cyfluthrin[2]	11	31	93	52
λ-Cyhalothrin[2]	11	16	53	37
Cypermethrin[2]	11	34	86	50
DCPA (Dacthal) monoacid	12	61	86	72
DCPA	11	88	104	97
Desulfinylfipronil[1,2]	11	73	97	87
Desulfinylfipronil amide[2]	11	50	108	76
Diazinon[2]	11	78	96	85
Dicamba	12	49	79	57
3,4-Dichloroaniline[1,2]	11	65	89	81
3,5-Dichloroaniline	2	81	95	88
2,4-D and 2,4-D methyl ester, summed on molar basis, reported as 2,4-D[1,4]	12	64	172	79
4-(2,4-Dichlorophenoxy)butyric acid (2,4-DB)	12	53	82	64
Dichlorprop	12	57	90	75
Dichlorvos[2]	11	9	60	30
Dicrotophos[2]	10	20	37	30
Dieldrin[2]	11	76	101	83
2,6-Diethylaniline[2]	11	87	105	96
Dimethoate[2]	11	27	34	29

Table A5B. Quality-control summary for matrix-spike recoveries of pesticides and pesticide degradates in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.—Continued

[Acceptable recovery range is between 70 and 130 percent]

Constituent	Number of spike samples	Minimum recovery (percent)	Maximum recovery (percent)	Median recovery (percent)
Dinoseb[1]	12	54	73	61
Diphenamid	12	42	101	90
Disulfoton	2	60	98	79
Disulfoton sulfone	2	100	118	109
Diuron[1]	12	71	97	88
α-Endosulfan	2	89	114	101
Endosulfan sulfate	2	89	125	107
EPTC	2	92	94	93
Ethion[2]	11	58	80	67
Ethion monoxon[2]	11	66	80	74
Ethoprophos	2	103	108	105
2-Ethyl-6-methylaniline[2]	11	81	108	92
Fenamiphos[2]	11	56	91	77
Fenamiphos sulfone[2]	11	40	172	70
Fenamiphos sulfoxide[2]	10	29	70	44
Fenuron	12	38	99	79
Fipronil[1,2]	11	60	105	81
Fipronil sulfide[1,2]	11	70	97	81
Fipronil sulfone[1,2]	11	52	127	71
Flumetsulam	12	75	158	86
Fluometuron	12	53	103	92
Fonofos[2]	11	77	93	83
Hexazinone[1,2]	11	61	112	77
3-Hydroxy carbofuran	11	52	95	74
2-Hydroxy-4-isopropylamino-6-ethylamino-*s*-triazine (hydroatrazine)[1]	12	13	106	97
Imazaquin	12	50	126	82
Imazethapyr	12	47	99	81
Imidacloprid	12	65	108	80
Isofenphos[2]	11	86	108	91
Linuron	12	65	97	90
Malaoxon[2]	11	67	93	80
Malathion[2]	11	82	103	92
Metalaxyl[2,3]	11	80	98	88
Methidathion[2]	11	71	108	93
Methiocarb	11	47	98	82
Methomyl	12	61	105	79
2-Methyl-4-chlorophenoxyacetic acid (MCPA)[1]	12	61	90	76
4-(2-Methyl-4-chlorophenoxy) butyric acid (MCPB)	12	53	82	65
Methyl paraoxon[2]	11	38	70	48
Methyl parathion[2]	11	57	83	65
Metolachlor[1,2]	11	96	110	102
Metribuzin[2]	11	57	239	70
Metsulfuron methyl[1]	12	55	150	80
Molinate[1,2]	11	87	110	93
Myclobutanil[2]	11	63	93	85
1-Naphthol[2]	11	20	70	30
Neburon	12	73	105	82
Nicosulfuron	12	61	154	96
Norflurazon	12	68	113	89
Oryzalin	12	19	85	76
Oxamyl	11	67	102	81

Table A5B. Quality-control summary for matrix-spike recoveries of pesticides and pesticide degradates in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.—Continued

[Acceptable recovery range is between 70 and 130 percent]

Constituent	Number of spike samples	Minimum recovery (percent)	Maximum recovery (percent)	Median recovery (percent)
Oxyfluorfen	2	58	88	73
Pendimethalin[2]	11	72	91	80
cis-Permethrin[2]	11	41	71	57
Phorate[2]	11	58	84	76
Phorate oxygen analog[2]	11	60	100	80
Phosmet[2]	6	8	8	8
Phosmet oxon[2]	6	47	50	50
Picloram	12	44	111	66
Prometon[2]	11	80	93	85
Prometryn[2]	11	84	104	94
Pronamide[2]	11	76	96	82
Propanil[1,2]	11	73	118	95
Propargite	2	90	137	113
Propham	12	39	99	87
Propiconazole	12	46	122	84
cis-Propiconazole[1,2]	11	84	109	90
trans-Propiconazole[1,2]	11	67	94	86
Propoxur	11	51	97	86
Siduron	12	61	105	93
Simazine[1,2]	11	81	115	94
Sulfometuron-methyl	12	94	141	106
Tebuconazole	2	70	98	84
Tebuthiuron[1,2,3]	11	56	230	101
Tefluthrin	2	53	67	60
Terbacil	12	55	104	87
Terbufos[2]	11	77	131	101
Terbufos oxygen analog sulfone[2]	11	60	101	77
Terbuthylazine[2]	11	85	102	95
Thiobencarb[2]	11	89	116	111
Tribuphos[2]	11	44	68	57
Triclopyr[1]	9	68	86	75
Trifluralin[2]	11	52	72	60

[1] Constituents detected in ground-water samples.

[2] Constituents on Schedules 2032 and 2033; only values from Schedule 2032 are reported because it is the preferred analytical schedule.

[3] Constituents on Schedules 2032 and 2060; only values from Schedule 2032 are reported because it is the preferred analytical schedule.

[4] 2,4-D and 2,4-D methyl ester summed on a molar basis and reported as 2,4-D.

Table A5C. Quality-control summary for matrix-spike recoveries of constituents of special interest in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.

[Acceptable recovery range is between 70 and 130 percent]

Constituent	Number of spike samples	Minimum recovery (percent)	Maximum recovery (percent)	Median recovery (percent)
Perchlorate[1]	1	99	99	99
1,2,3-Trichloropropane (1,2,3-TCP)	7	88	106	100
N-Nitrosodimethylamine (NDMA)	5	85	106	93

[1] Constituent detected in ground-water samples.

Table A5D. Quality-control summary for matrix-spike recoveries of radioactive constituents in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.

[Acceptable recovery range is between 70 and 130 percent. hr, hour]

Constituent	Number of spike samples	Minimum recovery (percent)	Maximum recovery (percent)	Median recovery (percent)
Radium-226[1]	2	102	104	103
Radium-228[1]	2	105	117	111
Gross-alpha radioactivity, 72-hr count[1]	2	55	118	86
Gross-alpha radioactivity, 30-day count[1]	2	85	95	90
Gross-beta radioactivity, 72-hr count[1]	2	68	100	84
Gross-beta radioactivity, 30-day count[1]	2	96	98	97

[1] Constituents detected in ground-water samples.

Table A6. Quality-control summary of surrogate recoveries of volatile organic compounds, and gasoline oxygenates and their degradates, pesticides and pesticide degradates, and constituents of special interest in samples collected for the Middle Sacramento Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, June to September, 2006.

[The laboratory entity code for the Montgomery Watson Harza laboratory in the U.S. Geological Survey's National Water Information System (NWIS) is CA-MWHL. 1,2,3-TCP, 1,2,3-Trichloropropane; MWH, Montgomery Watson Harza laboratory; NDMA, *N*-nitrosodimethylamine; VOC, volatile organic compound]

Surrogate	Analytical schedule	Constitutent or constituent class analyzed	Number of blank analyses	Median recovery in blanks (percent)	Number of surrogate recoveries below 70 percent in blanks	Number of surrogate recoveries above 130 percent in blanks	Number of environmental sample analyses	Median recovery in environmental samples (percent)	Number of surrogate recoveries below 70 percent in environmental samples	Number of surrogate recoveries above 130 percent in environmental samples
1-Bromo-4-fluorobenzene	2020, 4024	VOC	21	98	1	0	139	97	14	0
1,2-Dichloroethane-*d*4	2020, 4024	VOC	21	116	0	1	139	118	0	27
Isobutyl alcohol-*d*6	4024	VOC	1	132	0	1	10	103	0	1
Toluene-*d*8	2020, 4024	VOC	21	100	0	0	139	99	0	0
Diazinon-*d*10	2032, 2033	Pesticide	11	106	0	0	137	95	4	1
α-HCH-*d*6	2032, 2033	Pesticide	11	89	0	0	138	92	0	0
2,4,5-T	2060	Pesticide	11	78	1	0	136	81	2	0
Barban	2060	Pesticide	11	94	1	0	136	89	4	0
Caffeine-^{13}C	2060	Pesticide	11	101	2	0	135	92	15	0
Toluene-*d*8	MWH	Special interest (1,2,3-TCP)	12	98	0	0	63	96	0	0
NDMA-*d*6	MWH	Special interest (NDMA)	12	86	3	0	59	87	13	0

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