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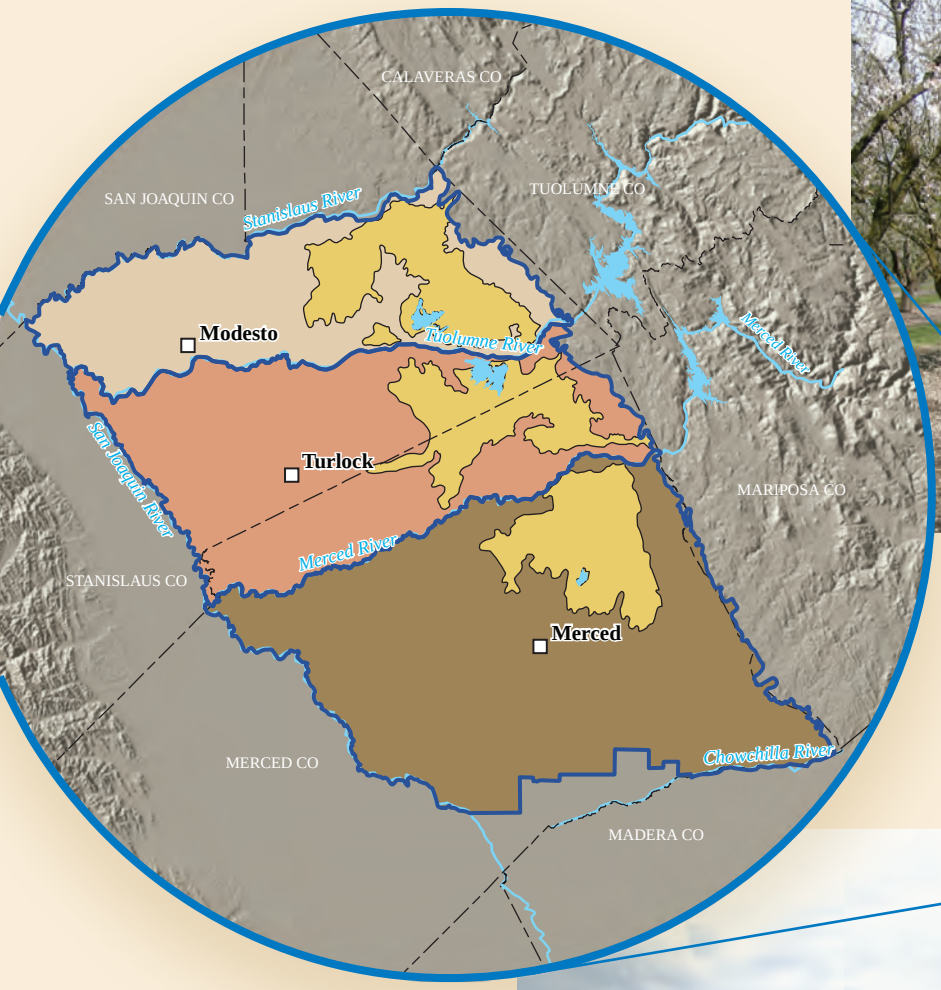
Ground-Water Quality Data in the Central Eastside San Joaquin Basin 2006: Results from the California GAMA Program



Data Series 325

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Cover Photographs:
Top: Almond orchard in Stanislaus County, California. (Photograph taken by Isabel Pimentel, U.S. Geological Survey.)
Bottom: Monitoring well next to irrigation canal in Stanislaus County, California. (Photograph taken by Tyler Johnson, U.S. Geological Survey.)

Ground-Water Quality Data in the Central Eastside San Joaquin Basin 2006: Results from the California GAMA Program

By Matthew K. Landon and Kenneth Belitz

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Conversion Factors, Abbreviations and Acronyms, Datum, Organizations, Selected Chemical Names, and Units of Measure

Conversion Factors

Multiply	By	To obtain
foot (ft)	0.3048	meter
inch (in.)	2.54	centimeter
inch (in.)	25.4	millimeter
mile (mi)	1.609	kilometer

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

$$°F = (1.8 \times °C) + 32.$$

Datum

Vertical coordinate information is referenced to the National Geodetic Vertical Datum of 1988 (NGVD 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).

Abbreviations and Acronyms

Abbreviations and Acronyms	Definition
AB	Assembly Bill (through the California State Assembly)
AL-US	U.S. Environmental Protection Agency action level
CAS	Chemical Abstract Service (American Chemical Society)
CE-QPC	Central Eastside Upland Basin study area grid well
CE-QPCFP	Central Eastside Upland Basin study area flow-path well
CESJO	Central Eastside San Joaquin Basin GAMA study unit
CSU	one-sigma combined standard uncertainty
D	detected
E	estimated or having a higher degree of uncertainty
GAMA	Groundwater Ambient Monitoring and Assessment program
GPS	Global Positioning System
HAL-US	U.S. Environmental Protection Agency lifetime health advisory level
HPLC	high-performance liquid chromatography
LRL	laboratory reporting level
LSD	land-surface datum
LT-MDL	long-term method detection level
MCL-CA	California Department of Public Health maximum contaminant level
MCL-US	U.S. Environmental Protection Agency maximum contaminant level
MDL	method detection limit
MER	Merced study area grid well

Conversion Factors, Abbreviations and Acronyms, Datum, Organizations, Selected Chemical Names, and Units of Measure—Continued

Abbreviations and Acronyms–Continued

Abbreviations and Acronyms	Definition
MERFP	Merced study area flow-path well
MERMW	Merced study area monitoring well (not necessarily on flow path)
MI agar	supplemental nutrient agar in which coliforms (total and Escherichia) produce distinctly different fluorescence under ultraviolet lighting
MIMS	Membrane Inlet Mass Spectrometry
MOD	Modesto study area grid well
MODFP	Modesto study area flow-path well
MODMW	Modesto study area monitoring well (not necessarily on flow path)
MRL	minimum reporting level
MU	method uncertainty
N	Normal (1-gram-equivalent per liter of solution)
NAVD88	North American Vertical Datum 1988
na	not available
nc	not collected
nd	no data because of field collection or laboratory analysis problem
nm	not measurable
nr	data not received at time of publication
NL-CA	California Department of Public Health notification level
NWIS	National Water Information System (USGS)
PCFF-GAMA	Personal Computer Field Forms program designed for GAMA sampling
QC	quality control
QPC	Quaternary Pleistocene age semiconsolidated deposits
RPD	relative percent difference
RSD	relative standard deviation
RSD5-US	U.S. Environmental Protection Agency risk-specific dose at a risk factor of 10^{-5}
SMCL-CA	California Department of Public Health secondary maximum contaminant level
SMCL-US	U.S. Environmental Protection Agency secondary maximum contaminant level
SSMDC	sample-specific minimum detectable concentration
TRLK	Turlock study area grid well
TRLKFP	Turlock study area flow-path well
TRLKMW	Turlock study area monitoring well (not necessarily on flow path)
TT-US	U.S. Environmental Protection Agency Treatment Technique
US	United States
UV	ultraviolet
V	value censored due to possible blank contamination and was not included in ground-water quality analyses
VSMOW	Vienna Standard Mean Ocean Water

Conversion Factors, Abbreviations and Acronyms, Datum, Organizations, Selected Chemical Names, and Units of Measure—Continued

Organizations

Abbreviations and Acronyms	Definition
CADPH	California Department of Public Health (was California Department of Health Services prior to July 1, 2007)
CADWR	California Department of Water Resources
LLNL	Lawrence Livermore National Laboratory
MWH	Montgomery Watson-Harza Laboratory
NAWQA	National Water Quality Assessment (USGS)
TML	National Research Program Trace Metal Laboratory (USGS)
NWQL	National Water Quality Laboratory (USGS)
SWRCB	State Water Resources Control Board (California)
USEPA	U.S. Environmental Protection Agency
USGS	U. S. Geological Survey

Selected Chemical Names

Abbreviations and Acronyms	Definition
$CaCO_3$	calcium carbonate
DBCP	1,2-dibromo-3-chloropropane
DOC	dissolved organic carbon
EDB	1,2-dibromomethane
HCl	hydrochloric acid
NDMA	*N*-nitrosodimethylamine
PCE	tetrachloroethene
1,2,3-TCP	1,2,3-trichloropropane
TDS	total dissolved solids
THM	trihalomethane
VOC	volatile organic compound

Conversion Factors, Abbreviations and Acronyms, Datum, Organizations, Selected Chemical Names, and Units of Measure—Continued

Units of Measure

Abbreviations and Acronyms	Definition
cm^3 STP g^{-1}	cubic centimeters at standard temperature and pressure per gram
δ	delta notation; the ratio of a heavier isotope to the more common lighter isotope of an element, relative to a standard reference material, expressed as per mil
kg	kilogram
L	liter
mg/L	milligrams per liter (parts per million)
mL	milliliter
mm	millimeter
NTU	nephelometric turbidity unit
µg/L	micrograms per liter (parts per billion)
µS/cm	microsiemens per centimeter
pCi/L	picocuries per liter
per mil	parts per thousand
pmc	percent modern carbon
TU	tritium unit
>	greater than
<	less than
–	not detected

Ground-Water-Quality Data in the Central Eastside San Joaquin Basin, 2006: Results from the California GAMA Program

By Matthew K. Landon and Kenneth Belitz

Abstract

Ground-water quality in the approximately 1,695-square-mile Central Eastside study unit (CESJO) was investigated from March through June 2006 as part of the Statewide Basin Assessment Project of the Groundwater Ambient Monitoring and Assessment (GAMA) Program. The GAMA Statewide Basin Assessment project was developed in response to the Groundwater Quality Monitoring Act of 2001 and is being conducted by the California State Water Resources Control Board (SWRCB) in collaboration with the U.S. Geological Survey (USGS) and the Lawrence Livermore National Laboratory (LLNL).

The study was designed to provide a spatially unbiased assessment of raw ground-water quality within CESJO, as well as a statistically consistent basis for comparing water quality throughout California. Samples were collected from 78 wells in Merced and Stanislaus Counties. Fifty-eight of the 78 wells were selected using a randomized grid-based method to provide statistical representation of the study unit (grid wells). Twenty of the wells were selected to evaluate changes in water chemistry along selected lateral or vertical ground-water flow paths in the aquifer (flow-path wells).

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

Quality-control samples (blanks, replicates, samples for matrix spikes) were collected for approximately one-sixth of the wells, and the results for these samples were used to evaluate the quality of the data for the ground-water samples. Assessment of the quality-control results showed that the environmental data were of good quality, with low bias and low variability, and resulted in censoring of less than 0.3 percent of the detections found in ground-water samples.

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 (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 (CADPH) and thresholds established for aesthetic concerns (secondary maximum contaminant levels, SMCL-CA) by CADPH.

VOCs and pesticides were detected in approximately half of the grid wells, and all detections in samples from CESJO wells were below health-based thresholds. All detections of nutrients and major elements in grid wells also were below health-based thresholds. Most detections of constituents of special interest, trace elements, and radioactive constituents in samples from grid wells were below health-based thresholds. Exceptions included two detections of arsenic that were above the USEPA maximum contaminant level (MCL-US), one detection of lead above the USEPA action level (AL-US), and one detection of vanadium and three detections of 1,2,3-TCP that were above the CADPH notification levels (NL-CA). All detections of radioactive constituents were below health-based thresholds, although fourteen samples had activities of radon-222 above the lower proposed MCL-US. Most of the samples from CESJO grid wells had concentrations of major elements, total dissolved solids, and trace elements below the non-enforceable thresholds set for aesthetic concerns. A few samples contained manganese or total dissolved solids at concentrations above the SMCL-CA thresholds.

Introduction

Ground water comprises nearly half of the water used for public-supply in California (Hutson and others, 2004). To assess the quality of ground water in aquifers used for drinking-water supply and establish a program for monitoring trends in ground-water quality, the State Water Resources Control Board (SWRCB), in collaboration with the U.S. Geological Survey (USGS) and Lawrence Livermore National Laboratory (LLNL), implemented the Groundwater Ambient Monitoring and Assessment (GAMA) Program (http://www.waterboards.ca.gov/gama). The GAMA program consists of three projects: Statewide 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 Statewide 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. The USGS, as part of the AB 599 process and in collaboration with the SWRCB, developed the monitoring plan for the project (Belitz and others, 2003; State Water Resources Control Board, 2003). A key aspect of the project is inter-agency collaboration and cooperation with local water agencies and well owners. Local participation in the project is entirely voluntary.

The GAMA Statewide 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 Statewide Basin Assessment project will analyze a broader suite of constituents than required by the California Department of Public Health (CADPH, formerly California Department of Health Services (CADHS)). 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 ten 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 hydrogeologic provinces. These ground-water basins, defined by the California Department of Water Resources (CADWR), 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.

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 the natural and human factors affecting ground-water quality (Kulongoski and Belitz, 2004). This report is one of a series of reports presenting the *status* of current water-quality conditions in each study unit; previous reports in the series include Wright and others (2005), Kulongoski and others (2006), Bennett and others (2006), and Kulongoski and Belitz (2007). Subsequent assessment reports will address the *trends* and *understanding* aspects of the water-quality assessments.

The Central Eastside San Joaquin Basin GAMA study unit, hereafter referred to as CESJO, lies in the Central Valley Hydrogeologic province (fig. 1), and contains three ground-water subbasins considered high priority on the basis of the number of public-supply wells, location, agricultural use, and pesticide applications within each basin (Belitz and others, 2003).

Shaded relief derived from U.S. Geological Survey
National Elevation Dataset, 2006.
Albers Equal Area Conic Projection

Figure 1. The hydrogeologic provinces of California and the location of the Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study unit. (Modified from Belitz and others, 2003.)

Purpose and Scope

The purposes of this report are: (1) to briefly describe the hydrogeologic setting of CESJO, (2) to describe the sampling and analytical methods, and quality-assurance methods used during the study, (3) to present the results of quality-control tests, and (4) to present the analytical results for ground-water samples collected in CESJO. Ground-water samples were analyzed for organic, inorganic, and microbial constituents, field parameters, and chemical tracers. For the purposes of providing context, the chemical and microbial data presented in this report were evaluated by comparison to state and federal drinking-water regulatory thresholds and other health-based standards that were developed for application to treated drinking water. 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.

Acknowledgements

The authors thank the following cooperators for their support: the SWRCB, CADPH, CADWR, and LLNL. We especially thank the cooperating well owners and water purveyors for their generosity in allowing the USGS to collect samples from their wells. In addition, reviewers Timothy Frick and Matthew Ferrari provided comments to improve this work. Funding for this work was provided by State bonds authorized by Proposition 50 and administered by the SWRCB.

Hydrogeologic Setting

The CESJO lies within the Central Valley Hydrogeologic Province described by Belitz and others (2003), and includes three CADWR San Joaquin Valley ground-water subbasins: Modesto, Turlock, and Merced (California Department of Water Resources, 2003). Combined, these subbasins define the extent of CESJO, and cover an area of approximately 1,695 square miles (mi^2), primarily in Merced and Stanislaus Counties (fig. 2). The study unit is bounded by the San Joaquin River to the west, the Sierra Nevada Mountains to the east, the Stanislaus River to the north, and the Chowchilla ground-water subbasin to the south.

The CESJO has a Mediterranean climate, with hot and dry summers, and winters that are cool and moist. Average rainfall across the study unit ranges from 11 inches (in.) in the southern and western portions of the study unit to 15 in. in the eastern to northeastern portions study unit (California Department of Water Resources, 2004a, 2004b, and 2006).

The CESJO is divided into four separate study areas: the Modesto study area (MOD), the Turlock study area (TRLK), the Merced study area (MER), and the Uplands study area (CE-QPC) (fig. 2). The exterior boundaries of the Modesto, Turlock, and Merced study areas correspond to the CADWR ground-water subbasins of the same names. However, these study areas differ from the CADWR subbasins in that the Quaternary-Pleistocene age semiconsolidated (QPC) deposits in upland areas in the eastern part of these subbasins were designated as a separate study area, the Uplands study area.

The Uplands study area (fig. 2) is defined as those portions of the CADWR defined subbasins that represent the exposed areal extent of the Pliocene and Pleistocene-age semiconsolidated deposits west of the consolidated bedrock of the Sierra Nevada. These Pliocene and Pleistocene-age deposits also have been mapped as "Quaternary Pleistocene age semiconsolidated deposits," or "QPC" by Jennings (1977). The mapped surficial extent of these QPC deposits defines the boundaries of the Uplands study area.

The main water-bearing units within the Modesto, Turlock, and Merced study areas include the unconsolidated alluvial-fan deposits of the Pleistocene-age Modesto and Riverbank Formations, and the deeper unconsolidated Pleistocene-age Turlock Lake and Pliocene-age Laguna Formations and consolidated Miocene-Pliocene-age Mehrten Formation (Burow and others, 2004; California Department of Water Resources, 2004a, 2004b, 2006). The main water-bearing units within the Uplands study area include the unconsolidated alluvial-fan deposits of the Pleistocene-age Turlock Lake and Pliocene-age Laguna Formations and consolidated Miocene-Pliocene-age Mehrten Formation (Burow and others, 2004; California Department of Water Resources, 2004a).

Additional features of the four study areas are discussed below in north to south order except for the Uplands study area, which is discussed last.

Modesto Study Area

The GAMA-defined boundaries of the Modesto (MOD) study area (fig. 2) closely match those defined by the CADWR for the Modesto subbasin, and are defined as the areal extent of unconsolidated to semiconsolidated sedimentary deposits south of the Stanislaus River, east of the San Joaquin River, north of the Tuolumne River, and west of the consolidated bedrock of the Sierra Nevada (California Department of Water Resources, 2004a). The Modesto study area excludes the Pliocene and Pleistocene-age semiconsolidated deposits that occur in the eastern portion of the study area; these deposits are included in the Uplands study area. The study area covers approximately 277 mi^2 and is located in Stanislaus County with small portions in Tuolumne County (fig. 2).

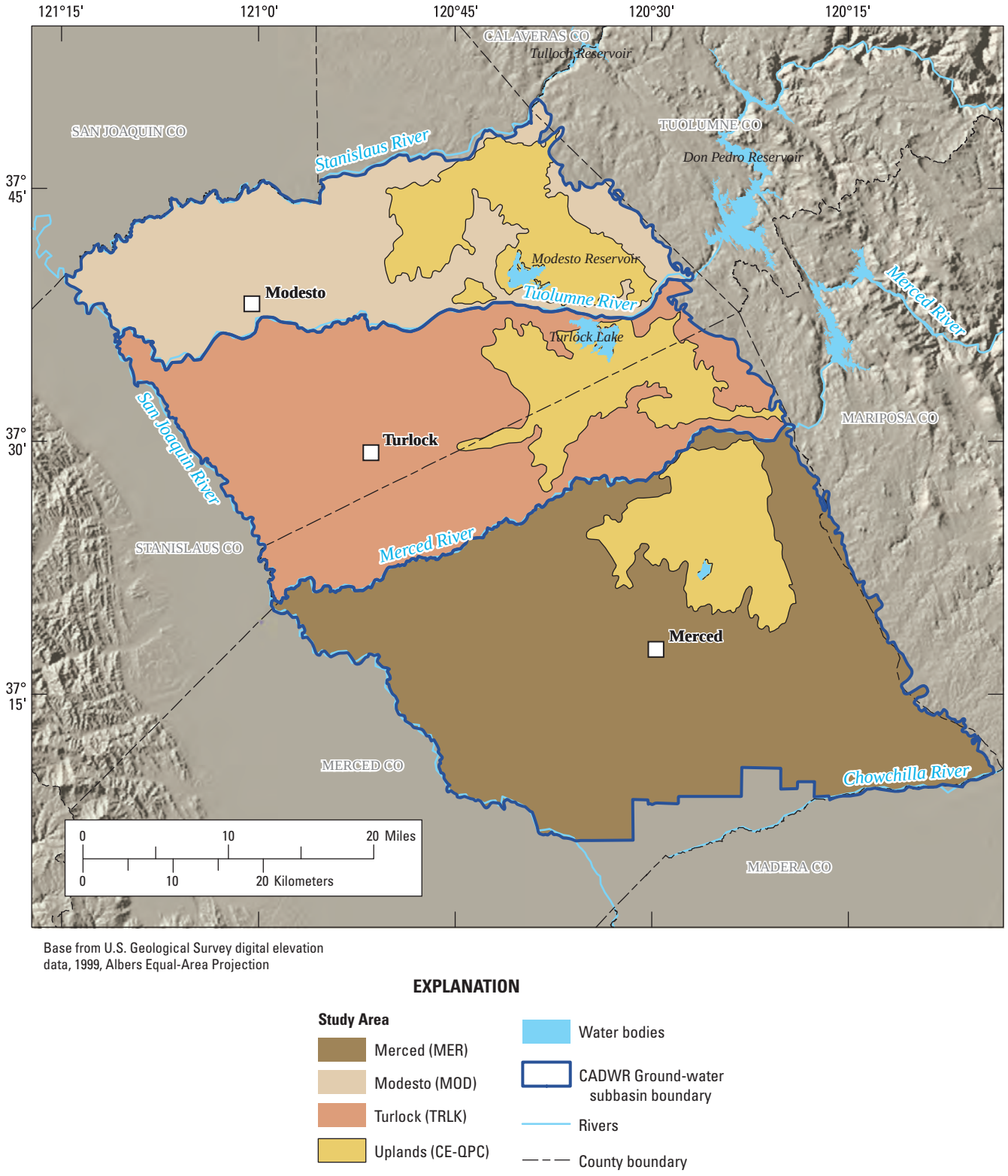


Figure 2. The Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study unit showing the California Department of Water Resources defined ground-water subbasins within the study unit, and major hydrologic features.

Turlock Study Area

The GAMA-defined boundaries of the Turlock (TRLK) study area (fig. 2) closely match those defined by the CADWR for the Turlock subbasin, and are defined as the areal extent of unconsolidated to semiconsolidated sedimentary deposits south of the Tuolumne River, east of the San Joaquin River, north of the Merced River, and west of the consolidated bedrock of the Sierra Nevada (California Department of Water Resources, 2006). The Turlock study area excludes the Pliocene and Pleistocene age semiconsolidated deposits that occur in the eastern portion of the study area; these deposits are included in the Uplands study area. The study area covers approximately 446 mi^2 and is located in Stanislaus and Merced Counties (fig. 2).

Merced Study Area

The GAMA-defined boundaries of the Merced (MER) study area (fig. 2) closely match those defined by the CADWR for the Merced subbasin, and are defined as the areal extent of unconsolidated to semiconsolidated sedimentary deposits south of the Merced River, east of the San Joaquin River, north of the Chowchilla subbasin, and west of the consolidated bedrock of the Sierra Nevada (California Department of Water Resources, 2004b). The Merced study area excludes the Pliocene and Pleistocene age semiconsolidated deposits that occur in the eastern portion of the study area; these deposits are included in the Uplands study area. The study area covers approximately 668 mi^2 and is located in Merced County with small portions in Mariposa County (fig. 2).

Uplands Study Area

The Uplands (CE-QPC) study area (fig. 2), as described earlier, is defined by the exposed areal extent of the Pliocene and Pleistocene-age semiconsolidated deposits within the CADWR Modesto, Turlock, and Merced subbasins. The study area covers approximately 304 mi^2 and is located in Stanislaus and Merced Counties (fig. 2). There are three major areas of Uplands study area, one within the eastern portions of each of the Modesto, Turlock, and Merced study areas.

Methods

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. Fifty-eight wells were selected to provide a statistically unbiased, spatially distributed assessment of the quality of ground-water resources used for public drinking-water supply, and twenty additional wells were selected to provide greater sampling density in several areas to address specific ground-water quality issues in the study unit.

The spatially-distributed wells were selected using a randomized grid-based method (Scott, 1990). Each of the study areas was subdivided into grid cells approximating 30 mi^2 (fig. 3). This grid-cell size met GAMA objectives for the Central Valley hydrogeologic province of a sampling density of no greater than one well per 38.6 mi^2 (100 square kilometers) while having at least 10 grid cells per study area (Bennett and others, 2006). For this assessment, the Modesto study area was divided into 10 grid cells, the Turlock study area into 16 grid cells, the Merced study area into 24 grid cells, and the Upland Basins study area into 10 grid cells. Locations of wells listed in statewide databases maintained by the CADPH and USGS were plotted (fig. 3). The objective was to randomly select one public-supply well per grid cell. If a grid cell contained more than one public-supply well, each well was randomly assigned a rank. The lowest 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 did not contain accessible public-supply wells, then commercial, irrigation, or domestic wells were considered for sampling. In this fashion, one well was selected in each cell to provide a spatially distributed, randomized monitoring network for each study area. Wells sampled as part of the randomized grid-cell network are hereafter referred to as “grid wells”. Grid wells in CESJO were numbered in the order of sample collection with the prefix varying by study area: the Modesto study area (MOD), the Turlock study area (TRLK), the Merced study area (MER), and the Upland Basins study area (CE-QPC).

One grid well was sampled in 58 of the 60 grid cells, including 10 of the 10 grid cells in the Modesto study area, 16 of the 16 grid cells in the Turlock study area, 23 of the 24 grid cells in the Merced study area, and 9 of the 10 grid cells in the Upland Basins study area (fig. 4). The two grid cells where samples were not collected had few wells, and permission to sample was not obtained for wells in those cells.

Twenty additional wells were sampled to evaluate changes in water chemistry along selected ground-water flow paths or from shallow to deeper depths in the aquifer. These wells were sampled to assess movement of water and dissolved constituents along ground-water flow paths in these areas, particularly with respect to nitrate, uranium, and arsenic.

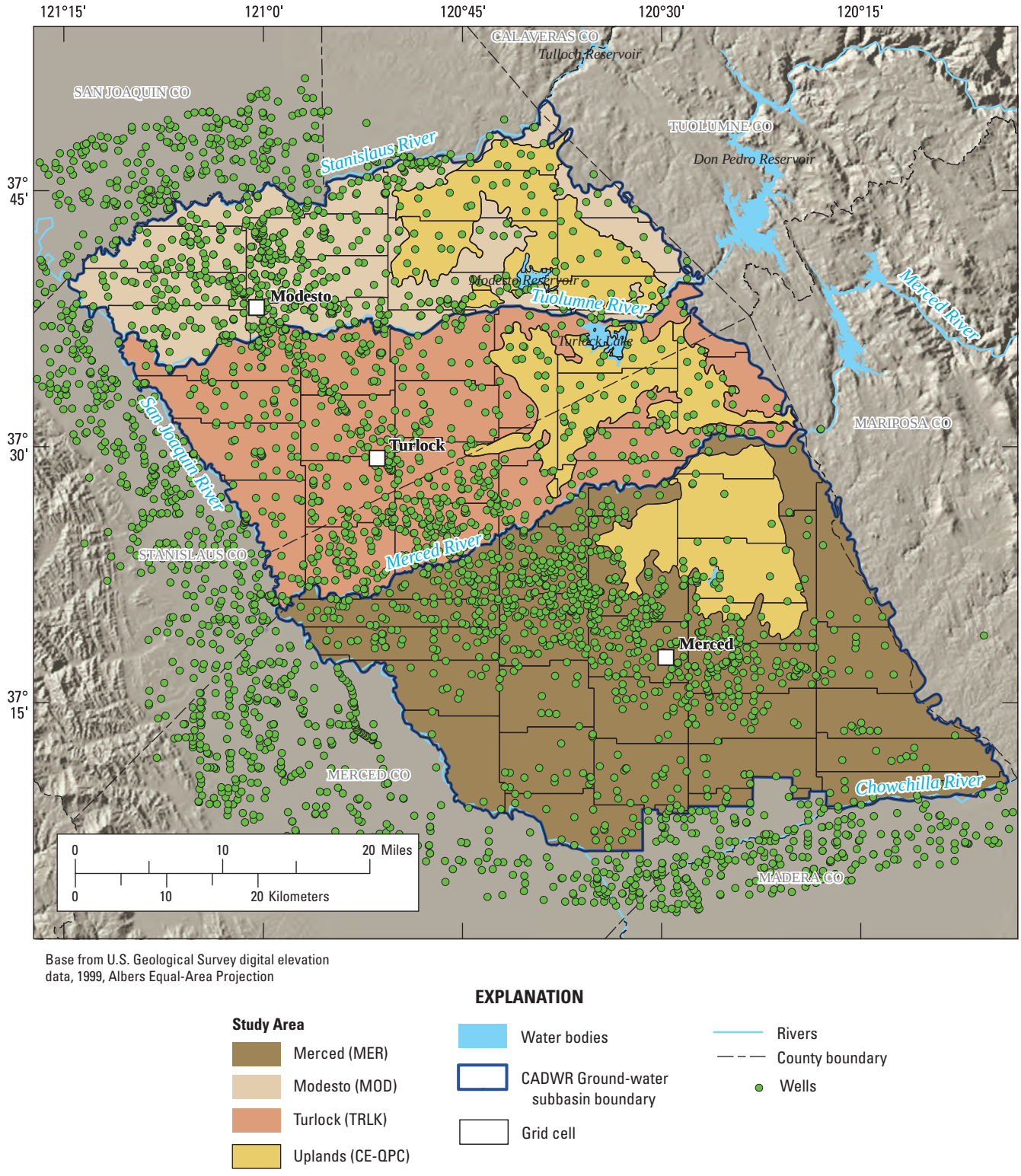
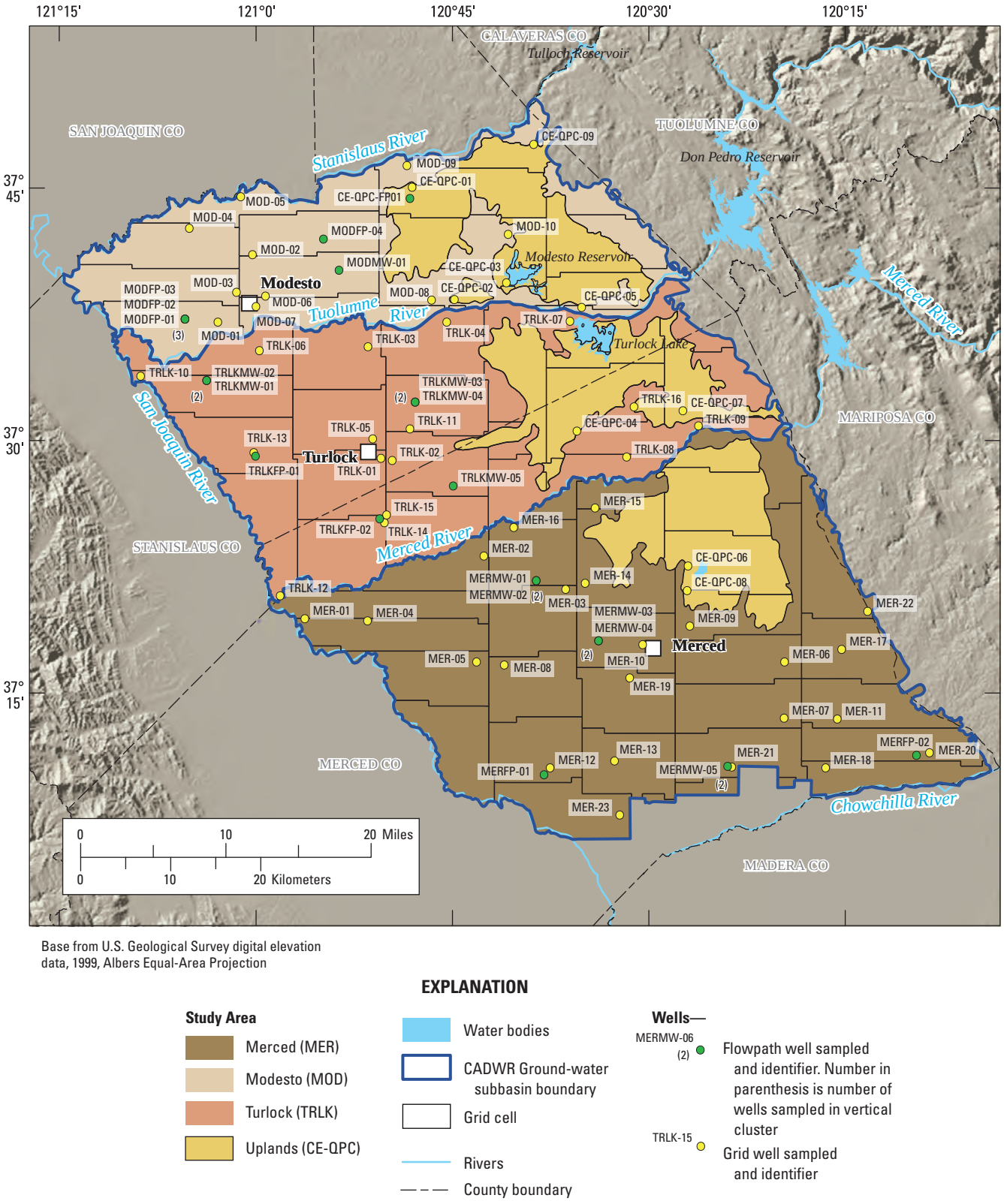


Figure 3. The Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study unit showing the locations of known wells and the distribution of study area grid cells.



Base from U.S. Geological Survey digital elevation data, 1999, Albers Equal-Area Projection

EXPLANATION

Study Area
- Merced (MER)
- Modesto (MOD)
- Turlock (TRLK)
- Uplands (CE-QPC)

- Water bodies
- CADWR Ground-water subbasin boundary
- Grid cell
- Rivers
- County boundary

Wells—
- MERMW-06 (2) — Flowpath well sampled and identifier. Number in parenthesis is number of wells sampled in vertical cluster
- TRLK-15 — Grid well sampled and identifier

Figure 4. The Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study unit, the locations of sampled grid wells and flow-path wells, and the distribution of study area grid cells.

Wells sampled as part of these studies for better understanding were not included in the statistical characterization of water quality in CESJO, as the inclusion of these wells would have caused overrepresentation of certain cells and of shallow ground water. Additional (nonrandomized) wells sampled in the four study areas were designated as either *flow-path* (MODFP, TRLKFP, and MERFP) or other *monitoring wells* (MODMW, TRLKMW, and MERMW) but collectively are referred to as *flow-path wells* in the text of this report. One monitoring well, MER-21, was included in the grid wells because no public-supply, irrigation, commercial, or domestic wells were available for sampling in the grid cell, and this monitoring well had perforations of comparable length and depths to other grid wells used in the study.

Table 1 (at back of report) provides the GAMA-ID (alphanumeric identification number) for each well, along with the date sampled, sampling schedule, and well-construction information. The wells were sampled during March through June 2006. The 58 grid wells sampled included 43 public-supply, 8 domestic, 3 commercial, 3 irrigation wells, and one monitoring well. The twenty flow-path wells sampled for additional understanding purposes included 14 monitoring, 3 irrigation, and 2 drain wells and 1 domestic well. Of the flow-path wells sampled, 5 were in the Modesto study area, 7 were in the Turlock study area, 7 were in the Merced study area, and one was in the Upland Basins study area.

Well locations and identifications were verified using a Global Positioning System (GPS), 1:24,000 scale USGS topographic maps, comparison with existing well information in USGS and CADPH databases, and information provided by well owners. Driller's 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 National Water Information System (NWIS). In order to maintain confidentiality of well owners and well locations, the standard USGS protocol for identifying sites in NWIS with a site-id containing latitude and longitude was modified, and all data associated with the sites were made inaccessible to the public.

The wells in CESJO were sampled using a tiered analytical approach. All wells were sampled for a standard set of constituents, including dissolved oxygen, temperature, and specific conductance, VOCs, 1,2-dibromo-3-chloropropane (DBCP) and 1,2-dibromomethane (EDB), pesticides and pesticide degradates, perchlorate, stable isotopes of water, and dissolved noble gases and tritium/helium age dates. The standard set of constituents was termed the "fast" schedule (table 2; at back of report). Wells on the "intermediate" schedule were sampled for all the constituents on the *fast* schedule, plus pH, alkalinity, nutrients and dissolved organic carbon, major and minor ions and trace elements, chromium abundance and speciation, arsenic and iron abundances and speciation, stable isotopes of nitrogen and oxygen of nitrate, stable isotopes of sulfur and oxygen of sulfate, stable isotopes of carbon and carbon-14 abundance, tritium and dissolved gases. Wells on the "slow" schedule were sampled for all the constituents on the *intermediate* schedule, plus turbidity, gasoline oxygenates and degradates, polar pesticides and degradates, *N*-nitrosodimethylamine (NDMA), 1,2,3-trichloropropane (1,2,3-TCP), and radioactive and microbial constituents (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* or two *intermediate* or three *fast* wells could be sampled in one day. In CESJO, 39 of the wells were sampled on the *fast* schedule, 24 were sampled on the *intermediate* schedule, and 15 on the *slow* schedule.

Sample Collection and Analysis

Samples were collected in accordance with the protocols established by the USGS National Water Quality Assessment (NAWQA) program (Koterba and others, 1995) and the USGS 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 of samples and (or) cross contamination between samples collected at wells. The methods used for sample collection are described in the Appendix.

Tables 3A-M (at back of report) list the compounds analyzed in each constituent class. Ground-water samples were analyzed for 85 VOCs (table 3A), 8 gasoline oxygenates and degradates (table 3B), fumigants DBCP and EDB (table 3C), 115 pesticides and pesticide degradates (tables 3D, 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), arsenic, iron, and chromium species (table 3I), 10 radioactive constituents, tritium, and carbon-14 (table 3J), 7 stable isotope constituents (table 3J), five dissolved noble gases, and helium stable isotope ratios (table 3K), 3 dissolved gases (table 3L), and 4 microbial constituents (table 3M). The methods used for sample analysis are described in the Appendix.

Data Reporting

The methods and conventions used for reporting the data are described in the Appendix. Eleven constituents analyzed in this study were measured by more than one method at the USGS National Water Quality Laboratory (NWQL) and argon was measured using two different methods by LLNL. For these constituents, only the results from the preferred method are reported. Arsenic, iron, and chromium concentrations, tritium activities, and concentrations of 1,2,3-TCP were measured by more than one laboratory; both sets of results are reported.

Quality-Assurance

The quality-assurance methods used for this study follow the protocols of the U.S. Geological Survey National Field Manual (U.S. Geological Survey, variously dated) and the USGS NAWQA program (Koterba and others, 1995). Standard quality-control procedures were followed at the USGS NWQL (Maloney, 2005; Pirkey and Glodt, 1998). Quality-control (QC) samples collected in the CESJO study include source-solution blanks, field blanks, replicates, and matrix and surrogate spikes. QC samples were collected to evaluate bias and variability of the water-quality data that may have resulted from sample collection, processing, storage, transportation, and laboratory analysis. The quality-assurance methods are described in the Appendix. The results of analysis of the QA/QC samples are presented in tables A1-A6 (at back of report).

Water-Quality Results

The results of analyses of quality-control and ground-water samples are briefly described in the sections below. Thresholds compared to concentrations in ground-water samples also are described.

Quality-Control-Sample Results

Results of quality-control analyses (blanks, replicates, matrix spikes, and surrogates) were used to evaluate the quality of the data for the ground-water samples. Assessment of the quality-control data from blanks resulted in censoring of less than 0.3 percent of the data for the ground-water samples. Data from replicates indicated that variability between measurements was acceptably low, confirming that the procedures used to collect the samples were consistent. Matrix spike recoveries for 31 of 203 organic 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. Three of these 31 constituents were detected in ground-water samples. Surrogate recoveries were all within acceptable limits for the analyses that use surrogates. The quality-control results are described in the Appendix.

Comparison Thresholds

Concentrations in ground-water samples were compared with CADPH (formerly CADHS) and USEPA drinking-water health-based thresholds (U.S. Environmental Protection Agency, 2006; California Department of Health Services, 2007a). The chemical and microbial data presented in this report are meant to characterize the quality of the untreated ground-water resources within CESJO 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. 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. CADPH 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 and adopted by CADPH is labeled “MCL-US”, and one set by CADPH that is more stringent than the MCL-US is labeled “MCL-CA”. CADPH is notified when constituents are detected at concentrations exceeding MCL-US or MCL-CA thresholds in samples collected for the GAMA Statewide Basin Assessment.

- **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 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 the 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. TT requirements are applied when water delivered to consumers exceeds specified action levels. Detections of microbial constituents above thresholds trigger requirements for mandatory additional disinfection during water treatment. The action levels established by the USEPA and CADPH 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. Both the USEPA and CADPH define SMCLs, but unlike MCLs, SMCLs established

by CADPH are not required to be at least as stringent as those established by USEPA (SMCL-US). SMCLs established by CADPH 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 CADPH for some of the constituents in drinking water that lack MCLs (NL-CA). If a constituent is detected above its NL-CA, 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 2 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 established by the USEPA (RSD5-US).

For constituents with MCLs, detections in ground-water samples were compared to the MCL-US or MCL-CA. Constituents with SMCLs were compared with the SMCL-CA. For chloride, sulfate, specific conductance, and total dissolved solids, CADPH 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 to 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. The comparison thresholds used in this report are listed in tables 3A–M for all constituents and in tables 4–16 for constituents detected in ground-water samples from CESJO.

Concentrations greater than their selected comparison thresholds are marked with asterisks in tables 4–16 (at back of report). In this study, of the 157 constituents analyzed for having health-based thresholds, only 6 constituents (1,2,3-TCP, arsenic, lead, vanadium, radon-222, and total coliforms) were detected at concentrations higher than health-based thresholds in grid wells. These detections occurred in 14 of the 58 grid wells. Three additional constituents (total dissolved solids, specific conductance, and manganese) were detected at concentrations above thresholds set for aesthetic concerns, in grid wells. These detections occurred in 5 of the 58 grid wells.

Ground-Water-Sample Results

Results from analyses of raw (untreated) ground water for CESJO are presented in tables 4-16. Ground-water samples collected in CESJO were analyzed for up to 287 constituents, and 174 of those constituents were not detected in any of the samples (table 3A-M). 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, for each study area, the number of wells in 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 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 the flow paths.

Table 4 includes water-quality indicators measured in the field and at the NWQL, while tables 5–16 present the results of laboratory ground-water analyses organized by classes of chemical compounds:

- 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)
  - Arsenic, iron, and chromium speciation (table 11)
- Radioactive constituents (table 12)
- Inorganic tracer constituents
  - Uranium isotopes (table 13)
  - Stable isotopes and tritium and carbon-14 activities (table 14)
  - Tritium, noble gases, and dissolved gases (table 15)
- Microbial indicators (table 16)

Field Parameters

Field and laboratory measurements of dissolved oxygen, pH, specific conductance, alkalinity, and associated parameters are presented in table 4. Dissolved oxygen and alkalinity are used as indicators of natural processes that control water chemistry. Specific conductance is a measure of electrical conductivity of the water and is proportional to amount of dissolved salts in the water. The pH value indicates the acidity of the water. Four grid wells had specific conductance values above the recommended SMCL-CA, although no wells were above the upper threshold.

Organic Constituents

Volatile organic compounds (VOCs) can be present 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. All detections of VOCs in samples from CESJO were below health-based thresholds, and were one-half to less than one-hundredth of the threshold values (table 5). On table 5, constituents are presented in order of decreasing detection frequency within each class of primary use or source. Sixty-three of the 88 VOCs analyzed were not detected. Approximately 48 percent of the 58 grid wells sampled had at least one detection of a VOC. Five VOCs detected in more than 10 percent of the grid wells, including chloroform, bromoform, bromodichloromethane, and dibromochloromethane, byproducts of drinking-water disinfection, and tetrachloroethene (PCE), a solvent used for dry cleaning and other purposes. Five samples had chloroform detections that were censored due to the possibility of contamination based on blank results (table A3), and these data were not used for summary statistical calculations. Censored values are preceded by a V in table 5.

Pesticides include herbicides, insecticides, and fungicides and are used to control weeds, insects, fungi, and other pests in agricultural, urban, and suburban settings. All detections of pesticides in samples from CESJO were below health-based thresholds (table 6). Of the 115 pesticides and pesticide degradates investigated, 104 were not detected. Approximately 59 percent of the grid wells sampled had at least one detection of a pesticide. On table 6, constituents are grouped by analytical schedule and are listed in order of decreasing detection frequency. Ground-water samples for pesticides and pesticide degradates, determined using analytical schedule 2003, were collected at 58 grid wells. Of these pesticides, the only ones detected in more than 10 percent of the grid wells were the herbicides deethylatrazine, a degradate of atrazine, simazine, atrazine, and metolachlor. These pesticides and degradates are among the most commonly detected pesticide compounds in ground water nationally (Gilliom and others, 2006). The fumigant DBCP was detected in 9 percent of the grid wells at concentrations that were below the MCL-US. Use of the fumigant DBCP was discontinued in the early 1970s. No other schedule 2003 pesticides had concentrations greater than one-hundredth of health-based thresholds. Ground-water samples for polar pesticides and pesticide degradates, determined using analytical schedule 2060, were collected at 15 grid wells. Compounds that were detected in 10 percent or more of these 15 grid wells include deisopropylatrazine, a degradate of atrazine, and the herbicides diruon and norflurazon.

Constituents of Special Interest

Perchlorate, 1,2,3-TCP, and NDMA are constituents of special interest in California because they recently have been found in, or are considered to have the potential to reach water supplies (California Department of Health Services, 2007b). Perchlorate was detected in approximately 22 percent of the 58 grid wells, and all concentrations measured in CESJO wells were less than the NL-CA (table 7). 1,2,3-TCP was detected in 3 of 15 grid wells sampled using the *slow* schedule where samples were analyzed with a method reporting level of 0.005 µg/L (table 7), which also is the NL-CA. NDMA was not detected in any of the 15 grid wells sampled using the *slow* schedule where it was analyzed.

Inorganic Constituents

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

The nutrients, nitrogen and phosphorus, and the 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. All concentrations of nitrate, nitrite, and ammonia measured in samples from CESJO grid wells were below health-based thresholds (table 8).

The major-ion composition, total dissolved solids (TDS) content, and levels of certain trace elements in ground water affect the aesthetic properties of water, such as taste, color, and odor, and the technical properties, such as scaling and staining. Although there are no adverse health effects associated with these properties, they may reduce consumer satisfaction with the water or may have economic impacts. CADPH has established non-enforceable thresholds (SMCL-CAs) that are based on aesthetic or technical properties rather than health-based concerns for the major ions chloride and sulfate, TDS, and several trace elements.

The concentrations of chloride and sulfate measured in samples from CESJO wells were all below the recommended SMCL-CAs (table 9). Samples from two grid wells contained TDS above the recommended SMCL-CA, but neither was above the upper SMCL-CA.

Eighteen of the twenty-five trace elements analyzed in this study have health-based thresholds. Fifteen of the trace elements were detected at concentrations below health-based thresholds in samples from CESJO grid wells; three were detected above: arsenic, lead, and vanadium (table 10). Samples from two grid wells had arsenic concentrations above the MCL-US of 10 µg/L. A sample from one grid well had a lead concentration above the USEPA action level (AL-US) of 15 µg/L. One grid-well sample contained vanadium above the NL-CA of 50 µg/L.

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. Concentrations of manganese in CESJO grid wells were typically below 0.5 µg/L, but one well had concentrations above the SMCL-CA of 50 µg/L (table 10). Concentrations of iron in CESJO grid wells were typically below 6 µg/L, and were not detected above the SMCL-CA of 300 µg/L.

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 also are used to aid in interpretation of the oxidation–reduction state of the aquifer. Concentrations of total arsenic, chromium, and iron, and the concentrations of either the reduced or the oxidized species of each element are reported on table 11. The concentration of the other species can be calculated by difference. Concentrations of total arsenic, chromium, and iron from the USGS Trace Metal Laboratory (table 11) were generally similar to those from NWQL (table 10); minor differences could be due to the different analytical methods (Appendix); concentrations reported on table 10 are considered to be more accurate.

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 in 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 risk of getting cancer.

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 fifteen CESJO samples on the *slow* schedule were analyzed for radioactive constituents and had activities of radium, gross-alpha radioactivity (72-hour and 30-day counts), and gross-beta radioactivity (72-hour and 30-day counts) less than established health-based standards (table 12). Activities of radon-222 in samples from 14 wells were above the proposed MCL-US of 300 pCi/L; however, no samples had an activity above 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 in indoor air (U.S. Environmental Protection Agency, 1999a).

At 19 CESJO grid wells, samples were analyzed for different isotopes of uranium, including uranium-234, -235, and -238 (table 13). These isotopic data can be used to better understand the sources and processes affecting uranium concentrations, which is beyond the scope of this report. There are no health-based thresholds for the individual isotopes of uranium.

Inorganic Tracer Constituents

Stable isotope ratios, tritium and carbon-14 activities, noble gas concentrations, and dissolved gas concentrations can be used as tracers of natural processes affecting ground-water composition. Hydrogen and oxygen stable isotope ratios of water (table 14) can be use to aid in interpretation of ground-water recharge sources. The stable isotope ratios of water depend on the altitude, latitude, and temperature of precipitation and on the extent of evaporation of surface water or soil water. Additional stable isotope ratios of nitrogen and oxygen of dissolved nitrate, and of sulfur and oxygen of dissolved sulfate (table 14) can be used to aid in interpretation of sources and processes affecting these solutes in aquifers. Noble gas concentrations (table 15) can be used to aid in interpretation of ground-water recharge sources because the concentrations of the different noble gases depend on water temperature. Concentrations of additional dissolved gases nitrogen, argon, and methane (table 15) can be used to aid

in interpretations of ground-water recharge temperature and whether reactions affecting nitrate concentrations and producing nitrogen gas, such as denitrification, may be occurring in the aquifer.

Tritium activities (table 14), carbon-14 activities (table 14), and helium isotope ratios (table 15) can provide information about the age of the ground-water. Tritium is a radioactive isotope of hydrogen that is incorporated into the water molecule. Low levels of tritium are continuously produced by cosmic ray bombardment of water in the 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 generally indicate the presence of water recharged since the early 1950's (Izbicki, 1996).

Helium isotope ratios (table 15) can be used in conjunction with tritium concentrations to estimate more exact ages for young ground water. Carbon-14 (table 14) is a radioactive isotope of carbon that is incorporated into dissolved carbonate species in water. Low levels of carbon-14 are continuously produced by cosmic ray bombardment of nitrogen in 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 (Kalin, 2000).

Of the isotopic and gas tracer constituents analyzed for this study, the only one with a health-based threshold is tritium. All measured tritium activities in samples from CESJO wells were less than one-hundredth of the MCL-CA (table 14).

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 to the water.

Samples from fifteen CESJO grid wells were analyzed for microbial indicators (table 16). No samples contained the viral indicators F-specific and somatic coliphage and none contained the bacterial indicator *Escherichia coli* (*E.coli*), but there were two detections of low levels of the bacterial indicator total coliforms (table 16). The threshold for total coliforms is based on recurring detections in treated drinking water, thus, the detections reported here do not constitute an exceedance of the MCL-US. Total coliforms will be monitored during future sampling.

Future Work

The data presented in this report will be interpreted as part of future work using a variety of statistical, qualitative, and quantitative approaches to assess the natural and human factors affecting ground-water quality. Water-quality data contained in the CADPH (formerly CADHS) and USGS NWIS databases, and water-quality data available from other State and local water agencies will be compiled, evaluated, and used to complement the data that was presented in this report; the results of these efforts will be presented in future publications.

Summary

Ground-water quality in the approximately 1,695 square-mile Central Eastside San Joaquin Basin study unit (CESJO) was investigated in March-June 2006 as part of the Statewide 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 (USGS) and the Lawrence Livermore National Laboratory, is implementing the GAMA Program (http://www.waterboards.ca.gov/gama/). The Statewide 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. CESJO was the ninth study unit sampled as part of the project.

CESJO is in the Central Valley hydrogeologic province and includes within it three ground-water subbasins, as defined by the California Department of Water Resources (California Department of Water Resources, 2003). The CESJO study included assessment of the ground-water quality from 78 wells in Merced and Stanislaus Counties. Fifty-eight of the wells were selected using a randomized grid approach to achieve statistically unbiased representation of ground-water used for public drinking-water supplies. Twenty of the wells were selected to provide additional sampling density in aid to understanding processes affecting ground-water quality. Ground-water samples were analyzed for VOCs, pesticides and pesticide degradates, nutrients, major and minor ions, trace elements, radioactivity, and microbial indicators. Naturally occurring isotopes (stable isotopes of hydrogen, oxygen, carbon, nitrogen, and sulfur, and activities of tritium and carbon-14) and dissolved noble and other gases also were measured to provide a data set that will be used to help interpret the sources and ages of the sampled ground

water. This report described the hydrogeologic setting of the CESJO region, the sampling, analytical, and quality-assurance methods used in the study, and the results of the chemical and microbial analyses made of the ground-water samples collected during March to June 2006.

Quality-control samples (blanks, replicates, samples for matrix spikes) were collected to evaluate the quality of the data for the ground-water samples. Assessment of the quality-control information showed that the environmental data were of good quality and resulted in censoring of less than 0.3 percent of the ground-water quality data.

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 California Department of Public Health (CADPH, formerly the California Department of Health Services).

All detections of VOCs and pesticides in CESJO grid wells were below health-based thresholds, and most were less than one-hundredth of the threshold values. All detections of perchlorate, nitrate, and radioactive constituents in CESJO grid wells were below established thresholds. Only one constituent, arsenic, was detected above a maximum contaminant level (MCL-US), although radon-222 was detected above the proposed MCL-US. Vanadium and 1,2,3-TCP had one and three detections, respectively, above the CADPH notification level (NL-CA). Lead was detected above the USEPA action level (AL-US) in one sample. Total dissolved solids, specific conductance, and manganese were detected at concentrations above secondary maximum contaminant levels (SMCL-CAs), non-enforceable thresholds set for aesthetic concerns, in samples from four or fewer of the wells. Future work will interpret the data presented in this report using a variety of statistical, qualitative, and quantitative approaches to assess the natural and human factors affecting ground-water quality.

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Table 1. Identification, sampling, and construction information for wells sampled for the Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.

[GAMA **well identification No.:** CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Sampling schedule:** Well schedules are described in table 2. **Elevation of LSD**, 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 of 1988 (NAVD88). **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; ft, feet; na, not available]

GAMA well identification No.	Sampling information		Elevation of LSD (ft above NAVD88)	Construction information		
	Date	Sampling schedule		Well depth (ft below LSD)	Top of perforations (ft below LSD)	Bottom of perforations (ft below LSD)
Grid wells						
CE-QPC-01	03-20-06	Slow	228	280	na	na
CE-QPC-02	03-22-06	Fast	174	300	[1]124	na
CE-QPC-03	03-28-06	Fast	232	285	[1]228	na
CE-QPC-04	04-06-06	Fast	252	[2]336	[1]252	na
CE-QPC-05	04-19-06	Fast	152	117	97	117
CE-QPC-06	04-19-06	Fast	226	358	[1]183	na
CE-QPC-07	04-20-06	Intermediate	317	380	270	380
CE-QPC-08	05-02-06	Fast	227	109	na	na
CE-QPC-09	05-03-06	Intermediate	317	100	na	na
MER-01	03-27-06	Fast	72	130	110	130
MER-02	03-29-06	Slow	140	na	na	na
MER-03	03-30-06	Slow	159	526	305	515
MER-04	03-30-06	Fast	84	75	na	na
MER-05	04-03-06	Fast	102	268	248	268
MER-06	04-06-06	Fast	223	178	130	150
MER-07	04-06-06	Fast	222	na	na	na
MER-08	04-06-06	Fast	106	380	130	380
MER-09	04-10-06	Slow	182	266	174	249
MER-10	04-11-06	Slow	167	294	102	294
MER-11	04-12-06	Slow	257	630	234	620
MER-12	04-13-06	Intermediate	109	210	110	210
MER-13	04-13-06	Fast	130	355	110	350
MER-14	04-17-06	Fast	168	734	261	730
MER-15	04-18-06	Fast	227	185	na	185
MER-16	04-18-06	Fast	162	167	152	167
MER-17	04-18-06	Fast	318	na	na	na
MER-18	04-19-06	Fast	237	200	na	na
MER-19	04-20-06	Fast	146	na	na	na
MER-20	05-01-06	Intermediate	324	923	335	909
MER-21	04-05-06	Intermediate	182	345	225	345
MER-22	05-02-06	Fast	362	130	na	na
MER-23	06-11-06	Fast	126	485	350	475
MOD-01	03-13-06	Slow	72	81	[1]81	na
MOD-02	03-14-06	Slow	91	395	91	366
MOD-03	03-20-06	Fast	84	255	180	255
MOD-04	03-20-06	Fast	73	304	164	276
MOD-05	03-20-06	Fast	98	292	139	271
MOD-06	03-21-06	Fast	91	216	128	192
MOD-07	03-21-06	Fast	95	231	155	231
MOD-08	03-21-06	Fast	166	296	200	292
MOD-09	03-23-06	Slow	203	338	307	338
MOD-10	05-03-06	Fast	192	815	159	815
TRLK-01	03-15-06	Slow	104	348	280	348
TRLK-02	03-16-06	Slow	107	272	180	252
TRLK-03	03-21-06	Slow	127	497	230	460
TRLK-04	03-22-06	Fast	174	332	[1]104	na

Table 1. Identification, sampling, and construction information for wells sampled for the Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.—Continued

[GAMA **well identification No.:** CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Sampling schedule:** Well schedules are described in table 2. **Elevation of LSD**, 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 of 1988 (NAVD88). **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; ft, feet; na, not available]

GAMA well identification No.	Sampling information		Elevation of LSD (ft above NAVD88)	Construction information		
	Date	Sampling schedule		Well depth (ft below LSD)	Top of perforations (ft below LSD)	Bottom of perforations (ft below LSD)
Grid wells—Continued						
TRLK-05	03-22-06	Slow	107	472	204	457
TRLK-06	03-22-06	Fast	75	221	105	213
TRLK-07	03-23-06	Fast	227	200	100	196
TRLK-08	03-23-06	Fast	187	128	[1]72	na
TRLK-09	03-23-06	Fast	262	338	[1]76	na
TRLK-10	03-27-06	Slow	47	116	72	112
TRLK-11	03-28-06	Slow	121	410	210	400
TRLK-12	04-03-06	Fast	68	158	[1]108	na
TRLK-13	04-03-06	Fast	60	104	84	104
TRLK-14	04-04-06	Fast	97	360	160	355
TRLK-15	04-04-06	Fast	100	400	330	390
TRLK-16	05-02-06	Fast	225	na	na	na
Flow-path wells						
CE-QPC-FP01	05-03-06	Fast	232	611	315	606
MERFP-01	04-13-06	Intermediate	107	368	na	na
MERFP-02	05-01-06	Intermediate	314	na	na	na
MERMW-01	03-27-06	Intermediate	155	88	78	83
MERMW-02	03-27-06	Intermediate	155	148	138	143
MERMW-03	03-28-06	Intermediate	148	56	46	51
MERMW-04	03-28-06	Intermediate	148	168	158	163
MERMW-05	04-05-06	Intermediate	187	68	23	68
MODFP-01	03-13-06	Intermediate	64	280	269	274
MODFP-02	03-13-06	Intermediate	64	183	174	179
MODFP-03	03-14-06	Intermediate	64	35	25	30
MODFP-04	03-30-06	Intermediate	134	275	116	275
MODMW-01	03-30-06	Intermediate	132	260	100	260
TRLKFP-01	04-05-06	Intermediate	62	80	na	na
TRLKFP-02	04-05-06	Intermediate	96	58	na	na
TRLKMW-01	03-15-06	Intermediate	59	113	103	108
TRLKMW-02	03-15-06	Intermediate	59	46	36	41
TRLKMW-03	03-16-06	Intermediate	131	171	161	166
TRLKMW-04	03-16-06	Intermediate	131	101	91	96
TRLKMW-05	03-29-06	Intermediate	130	97	87	92

[1]Top of perforations determined from depth to bottom of solid (unperforated) casing reported on driller's log.

[2]Well depth determined from hole depth reported on driller's log.

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

Analyte classes	Analyte list table	Schedule		
		Slow	Intermediate	Fast
Water-quality indicators				
Dissolved oxygen, temperature, specific conductance		X	X	X
pH, alkalinity		X	X	
Turbidity		X		
Organic constituents				
Volatile organic compounds	3A	X	X	X
Gasoline oxygenates and degradates	3B	X		
1,2-Dibromo-3-chloropropane (DBCP) and 1,2-Dibromomethane (EDB)	3C	X	X	X
Pesticides and pesticide degredates	3D	X	X	X
Polar pesticides and degradates	3E	X		
Constituents of special interest				
N-Nitrosodimethylamine (NDMA)	3F	X		
Perchlorate	3F	X	X	X
1,2,3-Trichloropropane	3F	X		
Inorganic constituents				
Nutrients and dissolved organic carbon	3G	X	X	
Major and minor ions and trace elements	3H	X	X	
Chromium abundance and speciation	3I	X	X	
Arsenic and iron abundances and speciation	3I	X	X	
Stable isotopes				
Stable isotopes of hydrogen and oxygen in water	3J	X	X	X
Stable isotopes of nitrogen and oxygen in nitrate	3J	X	X	
Stable isotopes of sulfur and oxygen in sulfate	3J	X	X	
Stable isotopes of carbon and carbon-14 abundance	3J	X	X	
Radioactivity and gases				
Radium isotopes	3J	X		
Radon-222	3J	X		
Gross alpha and beta radiation	3J	X		
Uranium isotopes	3J	X	X	
Tritium	3J	X	X	
Tritium and noble gases	3K	X	X	X
Dissolved gases	3L	X	X	
Microbial constituents				
Microbial constituents	3M	X		

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

[**USGS parameter code:** the five-digit code is used to uniquely identify a specific constituent or property. **Primary use or source:** THM, trihalomethane. **Threshold type:** maximum contaminant level thresholds are listed as 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. **Threshold type:** HAL-US, U.S. Environmental Protection Agency lifetime health advisory; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; NL-CA, California Department of Public Health notification level; RSD5-US, U.S. Environmental Protection Agency risk-specific dose at a risk factor of 10^{-5}. **Detection:** D, detected; –, not detected. **Abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; USGS, U.S. Geological Survey; µg/L, micrograms per liter; na, not available]

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	–
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	D
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	–
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	D
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	[3]D
1,1-Dichloroethane	Solvent	34496	75-34-3	0.035	MCL-CA	5	–
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	D
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	–
Dichloromethane (Methylene chloride)	Solvent	34423	75-09-2	0.06	MCL-US	5	D
1,2-Dichloropropane	Fumigant	34541	78-87-5	0.029	MCL-US	5	D
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	D
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 National Water Quality Laboratory Schedule 2020.—Continued

[**USGS parameter code:** the five-digit code is used to uniquely identify a specific constituent or property. **Primary use or source:** THM, trihalomethane. **Threshold type:** maximum contaminant level thresholds are listed as 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. **Threshold type:** HAL-US, U.S. Environmental Protection Agency lifetime health advisory; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; NL-CA, California Department of Public Health notification level; RSD5-US, U.S. Environmental Protection Agency risk-specific dose at a risk factor of 10^{-5}. **Detection:** D, detected; –, not detected. **Abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; USGS, U.S. Geological Survey; µg/L, micrograms per liter; na, not available]

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	–
Hexachlorobutadiene	Organic synthesis	39702	87-68-3	0.14	RSD5-US	9	–
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	–
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	–
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	D
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	–
1,2,3,5-Tetramethylbenzene	Gasoline hydrocarbon	50000	527-53-7	0.18	na	na	–
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 (1,1,1-TCA)	Solvent	34506	71-55-6	0.032	MCL-CA	200	–
1,1,2-Trichloroethane (1,1,2-TCA)	Solvent	34511	79-00-5	0.04	MCL-CA	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	D
1,1,2-Trichloro-1,2,2-trifluoroethane (CFC-113)	Refrigerant	77652	76-13-1	0.038	MCL-CA	1,200	D
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	–
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 thresholds for trihalomethanes are the sum of chloroform, bromoform, bromodichloromethane, and dibromochloromethane.

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

[3]The median matrix-spike recovery was less than 70 percent. Low recoveries may indicate that the compound might not have been detected in some samples if it was present at very low concentrations.

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

[**USGS parameter code:** the five-digit code is used to uniquely identify a specific constituent or property. **Threshold type:** maximum contaminant level thresholds are listed as 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. **Threshold type:** MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; NL-CA, California Department of Public Health notification level. **Detection:** D, detected; –, not detected. **Abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; USGS, U.S. Geological Survey; µg/L, micrograms per liter; na, not available]

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	1.2	na	na	–
tert-Amyl alcohol	Gasoline oxygenate	77073	75-85-4	1.0	na	na	–
tert-Butyl alcohol (TBA)	Degradate	77035	75-65-0	1	NL-CA	12	–
Diisopropyl ether	Gasoline oxygenate	81577	108-20-3	0.06	na	na	–
Ethyl *tert*-butyl ether (ETBE)	Gasoline oxygenate	50004	637-92-3	0.06	na	na	–
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	–
Methyl *tert*-pentyl ether (TAME)	Gasoline oxygenate	50005	994-05-8	0.05	na	na	–

Table 3C. 1,2-Dibromo-3-chloropropane (DBCP) and 1,2-dibromoethane (EDB), primary use or source, comparative thresholds, and reporting information for the U.S. Geological Survey National Water Quality Laboratory, Schedule 1306.

[**USGS parameter code:** the five-digit code is used to uniquely identify a specific constituent or property. **Threshold type:** maximum contaminant level thresholds are listed as MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA (California Department of Public Health maximum contaminant level) is lower than the MCL-US or no MCL-US exists; MCL-US, U.S. Environmental Protection Agency maximum contaminant level. **Detection:** D, detected; –, not detected. **Abbreviations:** CAS, Chemical Abstract Service; USGS, U.S. Geological Survey; µg/L, micrograms per liter]

Constituent	Primary use or source	USGS parameter code	CAS number	LRL (µg/L)	Threshold type	Threshold value (µg/L)	Detection
1,2-Dibromo-3-chloropropane (DBCP)	Fumigant	82625	96-12-8	0.030	MCL-US	0.2	D
1,2-Dibromoethane (EDB)	Fumigant	77651	106-93-4	0.040	MCL-US	0.05	–

Table 3D. Pesticides and pesticide degradates, primary uses or sources, comparative thresholds, and reporting information for the U.S. Geological Survey National Water Quality Laboratory Schedule 2003.

[**USGS parameter code:** the five-digit code is used to uniquely identify a specific constituent or property. **Threshold type:** maximum contaminant level thresholds are listed as 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; HAL-US, U.S. Environmental Protection Agency lifetime health advisory; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; RSD5-US, U.S. Environmental Protection Agency risk-specific dose at a risk factor of 10^{-5}. **Detection:** D, detected; –, not detected. **Abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; USGS, U.S. Geological Survey; µg/L, micrograms per liter; not available]

Constituent	Primary use or source	USGS parameter code	CAS number	LRL (µg/L)	Threshold type	Threshold value (µg/L)	Detection
Acetochlor	Herbicide	49260	34256-82-1	0.006	na	na	–
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	[1]–
Azinphos-methyl-oxon	Insecticide degradate	61635	961-22-8	0.042	na	na	[1]–
Benfluralin	Herbicide	82673	1861-40-1	0.01	na	na	–
Carbaryl	Insecticide	82680	63-25-2	0.041	RSD5-US	400	–
2-Chloro-2,6-diethylacetanilide	Herbicide degradate	61618	6967-29-9	0.0065	na	na	–
4-Chloro-2-methylphenol	Herbicide degradate	61633	1570-64-5	0.0050	na	na	[1]–
Chlorpyrifos	Insecticide	38933	2921-88-2	0.005	HAL-US	2	–
Chlorpyrofos, oxygen analog	Insecticide degradate	61636	5598-15-2	0.0562	na	na	[1]–
Cyfluthrin	Insecticide	61585	68359-37-5	0.053	na	na	[1]–
Cypermethrin	Insecticide	61586	52315-07-8	0.046	na	na	[1]–
Dacthal (DCPA)	Herbicide	82682	1861-32-1	0.003	HAL-US	70	–
Deethylatrazine (2-Chloro-4-isopropylamino-6-amino-*s*-triazine)	Herbicide degradate	04040	6190-65-4	0.014	na	na	[1] D
Desulfinylfipronil	Insecticide degradate	62170	na	0.012	na	na	–
Desulfinylfipronil amide	Insecticide degradate	62169	na	0.029	na	na	–
Diazinon	Insecticide	39572	333-41-5	0.005	HAL-US	1	–
Diazinon, oxon	Insecticide degradate	61638	962-58-3	0.006	na	na	–
3,4-Dichloroaniline	Herbicide degradate	61625	95-76-1	0.0045	na	na	D
Dichlorvos	Insecticide	38775	62-73-7	0.013	na	na	[1]–
Dicrotophos	Insecticide	38454	141-66-2	0.0843	na	na	[1]–
Dieldrin	Insecticide	39381	60-57-1	0.009	RSD5-US	0.02	–
2,6-Diethylaniline	Herbicide degradate	82660	579-66-8	0.006	na	na	–
Dimethoate	Insecticide	82662	60-51-5	0.0061	na	na	[1]–
Ethion	Insecticide	82346	563-12-2	0.016	na	na	–
Ethion monoxon	Insecticide degradate	61644	17356-42-2	0.021	na	na	–
2-Ethyl-6-methylaniline	Herbicide degradate	61620	24549-06-2	0.010	na	na	–
Fenamiphos	Insecticide	61591	22224-92-6	0.029	HAL-US	0.7	–
Fenamiphos sulfone	Insecticide degradate	61645	31972-44-8	0.053	na	na	[1]–
Fenamiphos sulfoxide	Insecticide degradate	61646	31972-43-7	0.040	na	na	[1]–
Fipronil	Insecticide	62166	120068-37-3	0.016	na	na	–
Fipronil sulfide	Insecticide degradate	62167	120067-83-6	0.013	na	na	–
Fipronil sulfone	Insecticide degradate	62168	120068-36-2	0.024	na	na	–
Fonofos	Insecticide	04095	944-22-9	0.0053	HAL-US	10	–
Hexazinone	Herbicide	04025	51235-04-2	0.026	HAL-US	400	D
Iprodione	Fungicide	61593	36734-19-7	0.026	na	na	[1]–
Isofenphos	Insecticide	61594	25311-71-1	0.011	na	na	–
Malaoxon	Insecticide degradate	61652	1634-78-2	0.039	na	na	–
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	–
Metolachlor	Herbicide	39415	51218-45-2	0.006	HAL-US	700	D
Metribuzin	Herbicide	82630	21087-64-9	0.028	HAL-US	70	–
Myclobutanil	Fungicide	61599	88671-89-0	0.033	na	na	–
1-Naphthol	Insecticide degradate	49295	90-15-3	0.0882	na	na	[1]–

Table 3D. Pesticides and pesticide degradates, primary uses or sources, comparative thresholds, and reporting information for the U.S. Geological Survey National Water Quality Laboratory Schedule 2003.—Continued

[**USGS parameter code:** the five-digit code is used to uniquely identify a specific constituent or property. **Threshold type:** maximum contaminant level thresholds are listed as 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; HAL-US, U.S. Environmental Protection Agency lifetime health advisory; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; RSD5-US, U.S. Environmental Protection Agency risk-specific dose at a risk factor of 10^{-5}. **Detection:** D, detected; –, not detected. **Abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; USGS, U.S. Geological Survey; µg/L, micrograms per liter; not available]

Constituent	Primary use or source	USGS parameter code	CAS number	LRL (µg/L)	Threshold type	Threshold value (µg/L)	Detection
1-Naphthol	Insecticide degradate	49295	90-15-3	0.0882	na	na	[1]–
Paraoxon-methyl	Insecticide degradate	61664	950-35-6	0.019	na	na	[1]–
Parathion-methyl	Insecticide	82667	298-00-0	0.015	HAL-US	1	–
Pendimethalin	Herbicide	82683	40487-42-1	0.022	na	na	–
cis-Permethrin	Insecticide	82687	54774-45-7	0.006	na	na	[1]–
Phorate	Insecticide	82664	298-02-2	0.055	na	na	[1]–
Phorate oxon	Insecticide degradate	61666	2600-69-3	0.027	na	na	–
Prometon	Herbicide	04037	1610-18-0	0.01	HAL-US	100	D
Prometryn	Herbicide	04036	7287-19-6	0.0059	na	na	–
Pronamide (Propyzamide)	Herbicide	82676	23950-58-5	0.004	RSD5-US	20	–
Simazine	Herbicide	04035	122-34-9	0.005	MCL-US	4	D
Tebuthiuron	Herbicide	82670	34014-18-1	0.016	HAL-US	500	[2]–
Terbufos	Insecticide	82675	13071-79-9	0.017	HAL-US	0.4	–
Terbufos oxon sulfone	Insecticide degradate	61674	56070-15-6	0.045	na	na	–
Terbuthylazine	Herbicide	04022	5915-41-3	0.0083	na	na	–
Trifluralin	Herbicide	82661	1582-09-8	0.009	HAL-US	10	–

[1]The median matrix-spike recovery was less than 70 percent. Low recoveries may indicate that the compound might not have been detected in some samples if it was present at very low concentrations.

[2]The median matrix-spike recovery was greater than 130 percent.

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

[**USGS parameter code:** the five-digit code is used to uniquely identify a specific constituent or property. **Threshold type:** maximum contaminant level thresholds arelisted as 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; HAL-US, U.S. Environmental Protection Agency lifetime health advisory; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; RSD5-US, U.S. Environmental Protection Agency risk-specific dose at a risk factor of 10^{-5}. **Detection:** D, detected; na, –, not detected. **Abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; USGS, U.S. Geological Survey; µg/L, micrograms per liter; not available]

Constituent	Primary use or source	USGS parameter code	CAS number	LRL (µg/L)	Threshold type	Threshold value (µg/L)	Detection
Acifluorfen	Herbicide	49315	50594-66-6	0.028	na	na	[2]–
Aldicarb[3]	Insecticide	49312	116-06-3	0.04	MCL-US	3	–
Aldicarb sulfone	Insecticide/degradate	49313	1646-88-4	0.018	MCL-US	3	–
Aldicarb sulfoxide	Degradate	49314	1646-87-3	0.022	MCL-US	4	–
Atrazine	Herbicide	39632	1912-24-9	0.008	MCL-CA	1	D
Bendiocarb	Insecticide	50299	22781-23-3	0.020	na	na	–
Benomyl	Fungicide	50300	17804-35-2	0.022	na	na	–
Bensulfuron-methyl	Herbicide	61693	83055-99-6	0.018	na	na	–
Bentazon	Herbicide	38711	25057-89-0	0.012	MCL-CA	18	–
Bromacil	Herbicide	04029	314-40-9	0.018	HAL	70	–
Bromoxynil	Herbicide	49311	1689-84-5	0.028	na	na	–
Caffeine	Beverages	50305	58-08-2	0.018	na	na	–
Carbaryl	Herbicide	49310	63-25-2	0.018	RSD5-US	400	–
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	–
3-(4-Chlorophenyl)-1-methyl urea	Degradate	61692	5352-88-5	0.036	na	na	–
Clopyralid	Herbicide	49305	1702-17-6	0.024	na	na	[1]–
Cycloate	Herbicide	04031	1134-23-2	0.014	na	na	–
2,4-D (2,4-Dichlorophenoxyacetic acid) plus 2,4-D methyl ester[4]	Herbicide	39732	94-75-7	0.016	MCL-US	70	–
2,4-DB (4-(2,4-Dichlorophenoxy) butyric acid)	Herbicide	38746	94-82-6	0.020	na	na	–
DCPA (Dacthal) monoacid	Degradate	49304	887-54-7	0.028	na	na	[2]–
Deethylatrazine (2-Chloro-4-isopropylamino-6-amino-*s*-triazine)	Degradate	04040	6190-65-4	0.028	na	na	[2] D
Deisopropyl atrazine (2-chloro-6-ethylamino-4-amino-*s*-triazine)	Degradate	04038	1007-28-9	0.08	na	na	[2] D
Dicamba	Herbicide	38442	1918-00-9	0.036	HAL-US	4,000	–
Dichlorprop	Herbicide	49302	120-36-5	0.028	na	na	[2]–
Dinoseb	Herbicide	49301	88-85-7	0.038	MCL-CA	7	–
Diphenamid	Herbicide	04033	957-51-7	0.010	HAL-US	200	–
Diuron	Herbicide	49300	330-54-1	0.015	HAL-US	10	D
Fenuron	Herbicide	49297	101-42-8	0.019	na	na	–
Flumetsulam	Herbicide	61694	98967-40-9	0.040	na	na	[2]–
Fluometuron	Herbicide	38811	2164-17-2	0.016	HAL-US	90	–
Hydroxyatrazine (2-Hydroxy-4-isopropylamino-6-ethylamino-*s*-triazine)	Degradate	50355	2163-68-0	0.032	na	na	–
3-Hydroxycarbofuran	Degradate	49308	16655-82-6	0.008	na	na	–
Imazaquin	Herbicide	50356	81335-37-7	0.036	na	na	[2]–
Imazethapyr	Herbicide	50407	81335-77-5	0.038	na	na	[2]–
Imidacloprid	Insecticide	61695	138261-41-3	0.020	na	na	–
Linuron	Herbicide	38478	330-55-2	0.014	na	na	–
MCPA (2-Methyl-4-chlorophenoxyacetic acid)	Herbicide	38482	94-74-6	0.030	HAL-US	30	–
MCPB (4-(2-Methyl-4-chlorophenoxy) butyric acid)	Herbicide	38487	94-81-5	0.010	na	na	–

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

[**USGS parameter code:** the five-digit code is used to uniquely identify a specific constituent or property. **Threshold type:** maximum contaminant level thresholds arelisted as 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; HAL-US, U.S. Environmental Protection Agency lifetime health advisory; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; RSD5-US, U.S. Environmental Protection Agency risk-specific dose at a risk factor of 10^{-5}. **Detection:** D, detected; na, –, not detected. **Abbreviations:** CAS, Chemical Abstract Service; USGS, U.S. Geological Survey; µg/L, micrograms per liter; not available]

Constituent	Primary use or source	USGS parameter code	CAS number	LRL (µg/L)	Threshold type	Threshold value (µg/L)	Detection
Metalaxyl	Fungicide	50359	57837-19-1	0.012	na	na	–
Methiocarb	Insecticide	38501	2032-65-7	0.010	na	na	–
Methomyl	Insecticide	49296	16752-77-5	0.020	HAL-US	200	–
Metsulfuron methyl[3]	Herbicide	61697	74223-64-6	0.025	na	na	–
Neburon	Herbicide	49294	555-37-3	0.012	na	na	–
Nicosulfuron	Herbicide	50364	111991-09-4	0.04	na	na	[2]–
Norflurazon	Herbicide	49293	27314-13-2	0.020	na	na	D
Oryzalin	Herbicide	49292	19044-88-3	0.012	na	na	–
Oxamyl	Insecticide	38866	23135-22-0	0.030	MCL-CA	50	–
Picloram	Herbicide	49291	1918-02-01	0.032	MCL-US	500	–
Propham	Herbicide	49236	122-42-9	0.030	HAL-US	100	–
Propiconazole	Fungicide	50471	60207-90-1	0.010	na	na	–
Propoxur	Insecticide	38538	114-26-1	0.008	na	na	–
Siduron	Herbicide	38548	1982-49-6	0.020	na	na	–
Sulfometuron-methyl	Herbicide	50337	74222-97-2	0.038	na	na	–
Tebuthiuron	Herbicide	82670	34014-18-1	0.026	HAL-US	500	–
Terbacil	Herbicide	04032	5902-51-2	0.016	HAL-US	90	–
Triclopyr	Herbicide	49235	55335-06-3	0.026	na	na	[2]–

[1]The median matrix-spike recovery was less than 70 percent. Low recoveries may indicate that the compound might not have been detected in some samples if it was present at very low concentrations.

[2]The median matrix-spike recovery was greater than 130 percent.

[3] Although listed as an LRLs, these constitiuents are reported using method reporting levels (MRLs).

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

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

[**Threshold type:** NL-CA, California Department of Public Health notification level. **Detection:** D, detected; –, not detected. **Abbreviations:** CAS, Chemical Abstract Service; MRL, minimum reporting level; µg/L, micrograms per liter]

Constituent	Primary use or source	CAS number	MRL (µg/L)	Threshold type	Threshold value (µg/L)	Detection
N-Nitrosodimethylamine (NDMA)	Rocket fuel, plasticizer, disinfection by-product	62-75-9	0.002	NL-CA	0.010	–
Perchlorate	Rocket fuel, fireworks, flares	14797-73-0	0.5	NL-CA	6	D
1,2,3-Trichloropropane (TCP)	Industrial solvent, organic synthesis	96-18-4	0.005	NL-CA	0.005	D

Table 3G. Nutrients and dissolved organic carbon, comparative thresholds, and reporting information for the U.S. Geological Survey National Water Quality Laboratory Schedule 2755 and parameter code 2612.

[**USGS parameter code:** the five-digit code is used to uniquely identify a specific constituent or property. **Threshold type:** maximum contaminant level thresholds are listed as MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA (California Department of Public Health maximum contaminant level) is lower than the MCL-US or no MCL-US exists. **Threshold type:** HAL-US, U.S. Environmental Protection Agency lifetime health advisory level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level. **Detection:** D, detected. **Abbreviations:** CAS, Chemical Abstract Service; USGS, U.S. Geological Survey; mg/L, milligrams per liter; na, not available]

Constituent	USGS parameter code	CAS number	LRL (µg/L)	Threshold type	Threshold value (mg/L)	Detection
Ammonia (as nitrogen)	00608	7664-41-7	0.010	HAL-US	30	D
Nitrite (as nitrogen)	00613	14797-65-0	0.002	MCL-US	1	D
Nitrate plus nitrite (as nitrogen)	00631	na	0.060	MCL-US	10	D
Total nitrogen (ammonia, nitrite, nitrate, organic nitrogen)	62854	17778-88-0	0.06	na	na	D
Phosphorus, phosphate, 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 National Water Quality Laboratory Schedule 1948.

[**USGS parameter code:** the five-digit code is used to uniquely identify a specific constituent or property. **Threshold type:** maximum contaminant level thresholds are listed as 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. **Threshold type:** AL-US, U.S. Environmental Protection Ageny action level; HAL-US, U.S. Environmental Protection Agency lifetime health advisory; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; NL-CA, California Department of Public Health notification level; SMCL-CA, California Department of Public Health secondary maximum contaminant level; SMCL-US, U.S. Environmental Protection Agency secondary maximum contaminant level; **Threshold value:** the recommended SMCL-CA thresholds for chloride, sulfate, and total dissolved solids (TDS) are listed with the upper SMCL-CA thresholds in parentheses. **Detection:** D, detected; –, not detected. **Abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; USGS, U.S. Geological Survey; mg/L, milligrams per liter; µg/L, micrograms per liter; na, not available]

Constituent	USGS parameter code	CAS number	LRL (µg/L)	Threshold type	Threshold value (mg/L)	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)	D
Fluoride	00950	16984-48-8	0.10	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	0.20	na	na	D
Sulfate	00945	14808-79-8	0.18	SMCL-CA	250 (500)	D
Residue on evaporation (total dissolved solids, TDS)	70300	na	10	SMCL-US	500 (1,000)	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	0.04	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	0.010	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	0.08	MCL-US	50	D
Silver	01075	7440-22-4	0.20	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	0.10	NL-CA	50	D
Zinc	01090	7440-66-6	0.6	HAL-US	2,000	D

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

[**USGS parameter code:** the five-digit code is used to uniquely identify a specific constituent or property. **Threshold type:** maximum contaminant level thresholds are listed as 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. MCL-CA, California Department of Public Health maximum contaminant level; HAL-US, U.S. Environmental Protection Agency lifetime health advisory; MCL-US, U.S. Environmental Protection Agency maximum contaminant level. **Detection:** D, detected. **Abbreviations:** CAS, Chemical Abstract Service; MD, method detection level; USGS, U.S. Geological Survey; µg/L, micrograms per liter; na, not available]

Constituent	USGS parameter code	CAS number	MD (µg/L)	Threshold type	Threshold level (µg/L)	Detection
Arsenic(III)	99034	22569-72-8	1	na	na	D
Arsenic(total)	01000	7440-38-2	0.5	MCL-US	10	D
Chromium(VI), hexavalent	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	HAL-US	300	D

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

[Stable isotope ratios are reported in the standard delta notation (d), the ratio of a heavier isotope to more common lighter isotope of that element, relative to a standard reference material. **USGS parameter code:** the five-digit code is used to uniquely identify a specific constituent or property. **Reporting level type:** MRL, minimum reporting level; MU, method uncertainty; SSMDC, sample specific minimum detectable concentration. **Threshold type:** maximum contaminant level thresholds are listed as 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; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level. **Detection:** D, detected; –, not detected. **Abbreviations:** CAS, Chemical Abstract Service; USGS, U.S. Geological Survey; mg/L, milligrams per liter; pCi/L, picocuries per liter; na, not available]

Constituent	USGS parameter code	CAS number	Reporting level type	Reporting level or uncertainty	Threshold type	Threshold value (mg/L)	Detection
Stable isotope ratios (per mil)							
δ^{2}H of water[1]	82082	na	MU	2	na	na	D[10]
δ^{18}O of water[1]	82085	na	MU	0.20	na	na	D[10]
δ^{13}C of dissolved inorganic carbon[2]	82081	na	1 sigma	0.05	na	na	D[11]
δ^{15}N of nitrate[3]	82690	na	MU	0.30	na	na	D[11]
δ^{18}O of nitrate[3]	63041	na	MU	0.50	na	na	D[11]
δ^{34}S of sulfate[1]	49932	na	MU	0.40	na	na	D[11]
δ^{18}O of sulfate[1]	na	na	MU	0.40	na	na	D[11]
Radioactive constituents (percent modern)							
[4]Carbon-14	49933	14762-75-5	1 sigma	0.0015	na	na	D
Radioactive constituents (pCi/L)							
Gross-alpha radioactivity, 72-hour and 30-day counts[8]	62636	12587-46-1	SSMDC	see table 12	MCL-US	15	D
Gross-beta radioactivity, 72-hour and 30-day counts[8]	62642	12587-47-2	SSMDC	see table 12	MCL-CA	50	D
Radium-226[8]	09511	13982-63-3	SSMDC	see table 12	MCL-US	[9]5	D
Radium-228[8]	81366	15262-20-1	SSMDC	see table 12	MCL-US	[9]5	D
Radon-222[5]	82303	14859-67-7	SSMDC	see table 12	Proposed MCL-US[6]	300, 4,000	D
Uranium-234[8]	22610	13966-29-5	SSMDC	see table 13	na	na	D
Uranium-235[8]	22620	15117-96-1	SSMDC	see table 13	na	na	D
Uranium-238[8]	22603	7440-61-1	SSMDC	see table 13	na	na	D
Tritium[7]	07000	10028-17-8	MRL	1	MCL-CA	20,000	D

[1]U.S. Geological Survey Stable Isotope Laboratory, Reston, Virginia.
[2]University of Waterloo (contract laboratory).
[3]Lawrence Livermore National Laboratory.
[4]University of Arizona, Accelerator Mass Spectrometry Laboratory (contract laboratory).
[5]U.S. Geological Survey National Water Quality Laboratory.
[6]Two MCL-US thresholds have been proposed, 300 pCi/L and 4,000 pCi/L.
[7]U.S. Geological Survey Stable Isotope and Tritium Laboratory, Menlo Park, California.
[8]Eberline Analytical Services (contract laboratory).
[9]The MCL-US threshold for radium is the sum of radium-226 and radium-228.
[10]Stable isotope ratio is an inherent property of water that always has a value.
[11]Stable isotope ratio of dissolved solute has a value as long at the solute is at detectable quantities.

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

[**Detection:** D, detected. **Abbreviations:** CAS, Chemical Abstract Service; MU, method uncertainty; cm^3STP/g, cubic centimeters of gas at standard temperature and pressure per gram of water; pCi/L, picocuries per liter; na, not available]

Constituent	CAS number	MU (percent)	Reporting units	Threshold type	Threshold level (pCi/L)	Detection
Argon	7440-37-1	2	cm^3STP/g	na	na	D
Helium-3 / Helium-4	na / 7440-59-7	0.75	atom ratio	na	na	D
Helium-4	7440-59-7	2	cm^3STP/g	na	na	D
Krypton	7439-90-9	2	cm^3STP/g	na	na	D
Neon	7440-01-09	2	cm^3STP/g	na	na	D
Xenon	7440-63-3	2	cm^3STP/g	na	na	D
Tritium	10028-17-8	1	pCi/L	MCL-CA	20,000	D

Table 3L. Dissolved gases analyzed with Membrane Inlet Mass Spectrometry, comparison thresholds, and reporting information for the Lawrence Livermore National Laboratory.

[**Detection:** D, detected. **Abbreviations:** CAS, Chemical Abstract Service; MD, method detection level; cm^3STP/g, cubic centimeters of gas at standard temperature and pressure per gram of water; na, not available]

Constituent	CAS number	MU (percent)	Reporting units	Threshold type	Threshold level (µg/L)	Detection
Argon	7440-37-1	2	cm^3STP/g	na	na	D
Nitrogen	7727-37-9	2	cm^3STP/g	na	na	D
Methane	74-82-8	7	cm^3STP/g	na	na	D

Table 3M. Microbial constituents, comparison thresholds, and reporting information for the U.S. Geological Survey Ohio Microbiology Laboratory parameter codes 90901, 90900, 99335 and 99332.

[**USGS parameter code:** the five-digit code is used to uniquely identify a specific constituent or property. Reporting units. **Threshold type:** maximum contaminant level thresholds are listed as MCL-US and MCL-CA are identical, and as MCL-CA (MCL-CA, California Department of Public Health maximum contaminant level) when the MCL-CA is lower than the MCL-US or no MCL-US exists; ; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; TT-US, U.S. Environmental Protection Agency treatment technique - a required process intended to reduce the level of contamination in drinking water. **Detection:** D, detected; –, not detected. **Abbreviations:** *E, coli*, *Escherichia coli*; MDL, method detection limit; MU, method uncertainty; USGS, U.S. Geological Survey; mL, milliliters; na, not available]

Constituent	USGS parameter code	Primary source	MDL	Threshold type	Threshold vaue	Detection
Escherichia coli	90901	Sewage and animal waste indicator	1 colony / 100 mL	TT-US	Zero	–
Total coliform - including fecal coliform and *E. coli*)	90900	Sewage and animal waste indicator	1 colony / 100 mL	MCL-US	5 percent of samples positive per month	D
F-specific coliphage	99335	Sewage and animal waste indicator	na	TT-US	99.99 percent killed / inactivated	–
Somatic coliphage	99332	Sewage and animal waste indicator	na	TT-US	99.99 percent killed / inactivated	–

Table 4. Water-quality indicators determined in the field and laboratory for the Cental Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.

[The five-digit code below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. **GAMA identification no:** CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well; SMCL-CA, California Department of Public Health secondary maximum contaminant level; SMCL-US, U.S. Environmental Proctection Agency secondary maximum contaminant level; TT-US, U.S. Environmental Protection Agency treatment technique - a required process intended to reduce the level of contamination in drinking water. **Threshold type/level:** The SMCL-CA for specific conductance hs recommended and upper threshold values. The upper value is shown in parentheses. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; C°, degrees celsius; $CaCO_3$, calcium carbonate; nc, sample not collected; NTU, nephelometric turbidity unit; mg/L, milligrams per liter; mm, millimeter; µS/cm, microsiemens per centimeter; *, value exceeds threshold; **, value exceeds upper threshold; <, less than; na, not available]

GAMA Identification No.	Turbidity (NTU) (63676)	Dissolved oxygen (mg/L) (00300)	Water temperature (°C) (00010)	pH (standard units)		Specific conductance (µS/cm@25°C)		Alkalinity (mg/L as $CaCO_3$)	
				Lab (00403)	Field (00400)	Lab (90095)	Field (00095)	Lab (29801)	Field (29802)
Threshold type	TT-US	na	na	SMCL-US	SMCL-US	SMCL-CA	SMCL-CA	na	na
Threshold level	5	na	na	6.5 - 8.5	6.5 - 8.5	900 (1,600)	900 (1,600)	na	na
Grid wells									
CE-QPC-01	0.1	7.2	18.5	7.4	7.7	265	266	102	98
CE-QPC-02	nc	4.7	18.0	nc	nc	nc	308	nc	nc
CE-QPC-03	nc	nc	14.5	nc	nc	nc	105	nc	nc
CE-QPC-04	nc	6.0	20.5	nc	nc	nc	115	nc	nc
CE-QPC-05	nc	8.0	20.5	nc	nc	nc	271	nc	nc
CE-QPC-06	nc	8.0	24.0	nc	nc	nc	284	nc	nc
CE-QPC-07	nc	3.0	22.5	7.8	nc	243	263	75	nc
CE-QPC-08	nc	4.5	20.5	nc	nc	nc	173	nc	nc
CE-QPC-09	nc	7.2	20.0	7.2	nc	249	247	93	nc
MER-01	nc	0.3	20.0	nc	7.8	nc	*1,580	nc	nc
MER-02	0.1	4.4	21.0	7.7	7.8	282	293	88	85
MER-03	0.2	4.7	22.0	8.0	7.8	288	287	104	102
MER-04	nc	1.0	20.5	nc	nc	nc	430	nc	nc
MER-05	nc	0.2	21.0	nc	nc	nc	364	nc	nc
MER-06	nc	2.6	22.0	nc	nc	nc	367	nc	nc
MER-07	nc	5.7	20.5	nc	nc	nc	336	nc	nc
MER-08	nc	0.1	21.0	nc	nc	nc	559	nc	nc
MER-09	<0.1	5.8	20.0	7.2	7.1	373	386	150	144
MER-10	<0.1	3.3	20.0	7.3	7.1	371	383	168	161
MER-11	<0.1	1.5	20.0	7.1	7.6	276	285	117	116
MER-12	nc	0.5	18.5	7.5	nc	*921	*945	341	nc
MER-13	nc	3.1	20.0	nc	nc	nc	597	nc	nc
MER-14	nc	1.1	26.0	nc	nc	nc	306	nc	nc
MER-15	nc	7.7	19.0	nc	nc	nc	302	nc	nc
MER-16	nc	5.1	22.5	nc	nc	nc	252	nc	nc
MER-17	nc	3.2	21.5	nc	nc	nc	696	nc	nc
MER-18	nc	5.3	20.5	nc	nc	nc	254	nc	nc
MER-19	nc	2.6	19.5	nc	nc	nc	655	nc	nc
MER-20	nc	<0.2	23.5	7.3	nc	497	463	100	nc
MER-21	*5.9	0.2	23.0	8.1	nc	254	262	114	nc
MER-22	nc	1.8	23.5	nc	nc	nc	473	nc	nc
MER-23	nc	<0.2	22.5	nc	8.1	nc	320	nc	nc

Table 4. Water-quality indicators determined in the field and laboratory for the Cental Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.—Continued

[The five-digit code below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. **GAMA identification no:** CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well; SMCL-CA, California Department of Public Health secondary maximum contaminant level; SMCL-US, U.S. Environmental Proctection Agency secondary maximum contaminant level; TT-US, U.S. Environmental Protection Agency treatment technique - a required process intended to reduce the level of contamination in drinking water. **Threshold type/level:** The SMCL-CA for specific conductance hs recommended and upper threshold values. The upper value is shown in parentheses. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; C°, degrees celsius; $CaCO_3$, calcium carbonate; nc, sample not collected; NTU, nephelometric turbidity unit; mg/L, milligrams per liter; mm, millimeter; µS/cm, microsiemens per centimeter; *, value exceeds threshold; **, value exceeds upper threshold; <, less than; na, not available<, less than; na, not available]

GAMA Identification No.	Turbidity (NTU) (63676)	Dissolved oxygen (mg/L) (00300)	Water temperature (°C) (00010)	pH (standard units)		Specific conductance (µS/cm@25°C)		Alkalinity (mg/L as $CaCO_3$)	
				Lab (00403)	Field (00400)	Lab (90095)	Field (00095)	Lab (29801)	Field (29802)
Threshold type	TT-US	na	na	SMCL-US	SMCL-US	SMCL-CA	SMCL-CA	na	na
Threshold level	5	na	na	6.5 - 8.5	6.5 - 8.5	900 (1,600)	900 (1,600)	na	na
Grid wells—Continued									
MOD-01	0.1	6.7	17.5	7.5	7.6	448	439	164	159
MOD-02	0.1	6.5	19.5	7.1	7.5	579	588	243	238
MOD-03	nc	8.5	13.0	nc	nc	nc	160	nc	nc
MOD-04	nc	3.8	19.0	nc	nc	nc	354	nc	nc
MOD-05	nc	3.2	19.5	nc	nc	nc	321	nc	nc
MOD-06	nc	4.8	20.0	nc	nc	nc	588	nc	nc
MOD-07	nc	3.4	20.5	nc	nc	nc	874	nc	nc
MOD-08	nc	5.6	20.0	nc	nc	nc	310	nc	nc
MOD-09	0.3	5.6	20.0	7.9	8.1	251	256	89	83
MOD-10	nc	5.7	19.0	nc	nc	nc	307	nc	nc
TRLK-01	0.2	3.5	21.0	8.0	8.2	276	273	87	83
TRLK-02	0.1	3.9	20.5	7.9	8.0	266	269	108	104
TRLK-03	0.4	2.4	22.0	8.2	8.3	324	320	142	141
TRLK-04	nc	3.1	20.0	nc	nc	nc	352	nc	nc
TRLK-05	0.1	3.1	21.5	8.0	8.2	261	264	98	95
TRLK-06	nc	3.8	19.0	nc	nc	nc	572	nc	nc
TRLK-07	nc	5.6	16.0	nc	nc	nc	115	nc	nc
TRLK-08	nc	5.2	19.0	nc	nc	nc	138	nc	nc
TRLK-09	nc	3.5	19.0	nc	nc	nc	164	nc	nc
TRLK-10	0.1	3.8	19.0	7.7	7.6	*1,360	*1,350	257	256
TRLK-11	0.1	4.3	22.0	8.1	8.0	224	225	91	83
TRLK-12	nc	0.8	18.5	nc	nc	nc	763	nc	nc
TRLK-13	nc	0.2	19.5	nc	nc	nc	*1,070	nc	nc
TRLK-14	nc	0.7	20.0	nc	nc	nc	447	nc	nc
TRLK-15	nc	0.3	22.0	nc	nc	nc	544	nc	nc
TRLK-16	nc	2.0	23.0	nc	nc	nc	222	nc	nc

Table 4. Water-quality indicators determined in the field and laboratory for the Cental Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.—Continued

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GAMA Identification No.	Turbidity (NTU) (63676)	Dissolved oxygen (mg/L) (00300)	Water temperature (°C) (00010)	pH (standard units)		Specific conductance (µS/cm@25°C)		Alkalinity (mg/L as $CaCO_3$)	
				Lab (00403)	Field (00400)	Lab (90095)	Field (00095)	Lab (29801)	Field (29802)
Threshold type	TT-US	na	na	SMCL-US	SMCL-US	SMCL-CA	SMCL-CA	na	na
Threshold level	5	na	na	6.5 - 8.5	6.5 - 8.5	900 (1,600)	900 (1,600)	na	na
Flow-path wells									
CE-QPCFP-01	nc	3.6	22.0	nc	nc	nc	174	nc	nc
MERFP-01	nc	<0.2	20.5	7.6	nc	*974	*1,010	270	nc
MERFP-02	nc	0.5	23.5	7.7	nc	462	454	138	nc
MERMW-01	*110	7.4	24.0	7.2	nc	468	442	119	nc
MERMW-02	2.3	5.6	20.0	7.4	nc	509	516	152	nc
MERMW-03	nc	1.8	19.5	7.3	nc	567	559	247	nc
MERMW-04	nc	2.6	19.5	7.6	nc	322	397	141	nc
MERMW-05	0.4	8.0	20.5	7.5	nc	481	472	180	nc
MODFP-01	nc	<0.2	22.5	7.0	nc	**9,470	**9,410	83	nc
MODFP-02	nc	0.3	20.5	7.6	nc	*1,140	*1,140	226	nc
MODFP-03	nc	4.9	20.5	7.7	nc	378	387	65	nc
MODFP-04	nc	5.6	18.5	7.7	nc	504	506	218	nc
MODMW-01	nc	7.2	19.9	7.3	nc	552	520	171	nc
TRLKFP-01	nc	0.3	19.0	7.2	nc	**1,800	**1,810	492	nc
TRLKFP-02	nc	0.3	19.5	7.3	nc	522	523	114	nc
TRLKMW-01	nc	0.2	19.0	8.0	nc	757	757	205	nc
TRLKMW-02	nc	1.4	18.5	7.6	nc	837	765	303	nc
TRLKMW-03	nc	5.7	20.0	7.5	nc	616	626	215	nc
TRLKMW-04	nc	6.0	20.0	7.4	nc	560	568	188	nc
TRLKMW-05	nc	7.2	19.5	7.4	nc	*1,190	*1,190	223	nc

Table 5. Volatile organic compounds (VOCs) and gasoline oxygenates and their degradates detected in samples collected for the Central Eastside (CESJO) Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June, 2006.

[The five-digit code below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. **GAMA identification no:** CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Threshold type:** maximum contaminant level thresholds are listed as MCL-US when the MCL-CA is identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. The MCL-US threshold for trihalomethanes is the sum of chloroform, bromoform, bromodichloromethane, and dibromochloromethane; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; HAL-US, U.S. Environmental Protection Agency lifetime health advisory level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; NL-CA, California Department of Public Health notification level. **Abbreviations:** CESJO, Central Eastside; GAMA, Groundwater Ambient Monitoring and Assessment; E, estimated; LRL, laboratory reporting level; V, value censored due to possible blank contamination and was not included in ground-water quality analyses; THM, trihalomethane; VOC, volatile organic carbon; µg/L, micrograms per liter; na, not available; –, not detected]

	Disinfection by-product (THM)				Refrigerant			Refrigerant/ organic synthesis	Organic synthesis			Fire retardant	Gasoline
GAMA Identification No.	**Chloroform (trichloro-methane) (µg/L) (32106)**	**Bromoform (tribromo-methane) (µg/L) (32104)**	**Bromodi-chloro-methane (µg/L) (32101)**	**Dibromo-chloro-methane (µg/L) (32105)**	**Dichlorodi-fluoro-methane (CFC-12) (µg/L) (34668)**	**1,1,2-Trichloro-trifluoro-ethane (CFC-113) (µg/L) (77652)**	**Trichloro-fluoro-methane (CFC-11) (µg/L) (34488)**	**Chloro-methane (µg/L) (34418)**	**1,1-Di-chloro-ethene (µg/L) (34501)**	**Carbon disulfide (µg/L) (77041)**	**1,2,4-Trimethyl-benzene (µg/L) (77222)**	**Bromo-chloro-methane (µg/L) (77297)**	**Toluene (µg/L) (34010)**
[LRL]	[0.024]	[0.1]	[0.028]	[0.1]	[0.18]	[0.038]	[0.08]	[0.17]	[0.024]	[0.038]	[0.056]	[0.12]	[0.02]
Threshold type	MCL-US	MCL-US	MCL-US	MCL-US	NL-CA	MCL-US	HAL-US	HAL-US	MCL-CA	NL-CA	NL-CA	HAL-US	MCL-CA
Threshold	80	80	80	80	1,000	1,200	2,000	30	6	160	330	90	150
Uplands study area (9 grid wells sampled)													
CE-QPC-01	–	–	–	–	E 0.2	–	E 0.05	–	E 0.09	–	–	–	–
CE-QPC-02	0.46	0.57	0.64	0.8	–	–	–	–	–	E 0.03	–	–	–
Number of wells with detections	1	1	1	1	1	0	1	0	1	1	0	0	0
Detections frequency (percent)	11	11	11	11	11	0	11	0	11	11	0	0	0
Total detections													
Merced study area (23 grid wells sampled)													
MER-02	–	–	–	–	–	–	–	E 0.1	–	–	–	–	–
MER-03	E 0.01	–	–	–	–	–	–	–	–	–	–	–	–
MER-05	–	–	–	–	–	–	–	–	–	–	–	–	–
MER-06	E 0.06	–	–	–	–	–	–	–	–	–	–	–	–
MER-09	V 0.04	–	–	–	–	–	–	–	–	–	–	–	–
MER-10	V 0.04	–	–	–	–	–	–	–	–	–	–	–	–
MER-13	V 0.03	–	–	–	–	–	–	–	–	–	–	–	–
MER-19	–	–	–	–	–	–	–	–	–	–	–	–	–
MER-20	–	–	–	–	–	–	–	–	–	E 0.05	–	–	–
MER-21	–	–	–	–	–	–	–	–	–	E 0.07	–	–	E 0.01
Number of wells with detections	2	0	0	0	0	0	0	1	0	2	0	0	1
Detections frequency (percent)	10	0	0	0	0	0	0	4	0	9	0	0	4
Total detections													

Table 5. Volatile organic compounds (VOCs) and gasoline oxygenates and their degradates detected in samples collected for the Central Eastside (CESJO) Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June, 2006.—Continued

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	Disinfection by-product (THM)				Refrigerant			Refrigerant/ organic synthesis	Organic synthesis			Fire retardant	Gasoline
GAMA Identification No.	Chloroform (trichloro-methane) (µg/L) (32106)	Bromoform (tribromo-methane) (µg/L) (32104)	Bromodi-chloro-methane (µg/L) (32101)	Dibromo-chloro-methane (µg/L) (32105)	Dichlorodi-fluoro-methane (CFC-12) (µg/L) (34668)	1,1,2-Trichloro-trifluoro-ethane (CFC-113) (µg/L) (77652)	Trichloro-fluoro-methane (CFC-11) (µg/L) (34488)	Chloro-methane (µg/L) (34418)	1,1-Di-chloro-ethene (µg/L) (34501)	Carbon disulfide (µg/L) (77041)	1,2,4-Trimethyl-benzene (µg/L) (77222)	Bromo-chloro-methane (µg/L) (77297)	Toluene (µg/L) (34010)
[LRL]	[0.024]	[0.1]	[0.028]	[0.1]	[0.18]	[0.038]	[0.08]	[0.17]	[0.024]	[0.038]	[0.056]	[0.12]	[0.02]
Threshold type	MCL-US	MCL-US	MCL-US	MCL-US	NL-CA	MCL-US	HAL-US	HAL-US	MCL-CA	NL-CA	NL-CA	HAL-US	MCL-CA
Threshold	80	80	80	80	1,000	1,200	2,000	30	6	160	330	90	150
Modesto study area (10 grid wells sampled)													
MOD-01	19.2	0.19	1.7	0.3	–	–	–	–	–	–	E 0.01	E 0.03	E 0.01
MOD-02	0.36	–	–	–	–	–	–	–	–	–	–	–	–
MOD-03	33.6	0.32	2.43	0.6	–	–	–	–	–	–	–	–	–
MOD-04	4.54	0.87	0.67	0.6	–	–	–	–	–	–	–	–	–
MOD-05	E 0.03	–	–	–	–	–	–	–	–	–	–	–	–
MOD-06	0.18	0.15	E 0.02	–	–	–	–	–	–	–	–	–	–
MOD-07	2.27	0.25	0.21	E 0.1	E 0.8	–	–	–	E 0.02	–	–	–	–
MOD-08	–	0.15	E 0.02	E 0.1	–	–	–	–	–	–	–	–	–
MOD-09	E 0.02	–	–	–	–	–	–	–	–	–	–	–	–
Number of wells with detections	8	6	6	5	1	0	0	0	1	0	1	1	1
Detections frequency (percent)	80	60	60	50	10	0	0	0	10	0	10	10	10
Total detections													
Turlock study area (16 grid wells sampled)													
TRLK-01	–	0.25	–	–	–	–	–	–	–	–	–	–	–
TRLK-02	–	0.24	–	–	–	–	–	–	–	–	E 0.04	–	–
TRLK-04	E 0.06	–	–	–	–	0.3	–	–	E 0.03	–	–	–	–
TRLK-05	–	–	–	–	–	–	–	–	–	–	–	–	–
TRLK-06	1.89	0.71	0.33	0.4	–	–	–	–	–	–	–	–	–
TRLK-10	E 0.01	–	–	–	–	–	–	–	–	–	–	–	–
TRLK-11	E 0.02	–	–	–	–	–	–	–	–	–	–	–	–
TRLK-16	–	–	–	–	–	–	–	–	–	–	–	–	2.81
Number of wells with detections	4	3	1	1	0	1	0	0	1	0	1	0	1
Detections frequency (percent)	25	19	6	6	0	6	0	0	6	0	6	0	6
Total detections													

Table 5. Volatile organic compounds (VOCs) and gasoline oxygenates and their degradates detected in samples collected for the Central Eastside (CESJO) Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June, 2006.—Continued

[The five-digit code below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. **GAMA identification no:** CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Threshold type:** maximum contaminant level thresholds are listed as MCL-US when the MCL-CA is identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. The MCL-US threshold for trihalomethanes is the sum of chloroform, bromoform, bromodichloromethane, and dibromochloromethane; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; HAL-US, U.S. Environmental Protection Agency lifetime health advisory level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; NL-CA, California Department of Public Health notification level. **Abbreviations:** CESJO, Central Eastside; GAMA, Groundwater Ambient Monitoring and Assessment; E, estimated; LRL, laboratory reporting level; V, value censored due to possible blank contamination and was not included in ground-water quality analyses; THM, trihalomethane; VOC, volatile organic carbon; µg/L, micrograms per liter; na, not available; –, not detected]

GAMA Identification No.	Disinfection by-product (THM)				Refrigerant			Refrigerant/ organic synthesis	Organic synthesis			Fire retardant	Gasoline
	Chloroform (trichloro-methane) (µg/L) (32106)	Bromoform (tribromo-methane) (µg/L) (32104)	Bromodi-chloro-methane (µg/L) (32101)	Dibromo-chloro-methane (µg/L) (32105)	Dichlorodi-fluoro-methane (CFC-12) (µg/L) (34668)	1,1,2-Trichloro-trifluoro-ethane (CFC-113) (µg/L) (77652)	Trichloro-fluoro-methane (µg/L) (CFC-11) (34488)	Chloro-methane (µg/L) (34418)	1,1-Di-chloro-ethene (µg/L) (34501)	Carbon disulfide (µg/L) (77041)	1,2,4-Trimethyl-benzene (µg/L) (77222)	Bromo-chloro-methane (µg/L) (77297)	Toluene (µg/L) (34010)
[LRL]	[0.024]	[0.1]	[0.028]	[0.1]	[0.18]	[0.038]	[0.08]	[0.17]	[0.024]	[0.038]	[0.056]	[0.12]	[0.02]
Threshold type	MCL-US	MCL-US	MCL-US	MCL-US	NL-CA	MCL-US	HAL-US	HAL-US	MCL-CA	NL-CA	NL-CA	HAL-US	MCL-CA
Threshold	80	80	80	80	1,000	1,200	2,000	30	6	160	330	90	150
CESJO study unit (58 grid wells sampled in four study areas above)													
Number of wells with detections	15	10	8	7	2	1	1	1	3	3	2	1	3
Detections frequency (percent)	27	17	14	12	3	2	2	2	5	5	3	2	5
Total detections													
Flow-Path Wells													
CE-QPC-FP01	–	–	–	–	E 0.06	–	–	–	–	–	–	–	–
MERMW-01	V 0.01	–	–	–	–	–	–	–	–	–	–	–	–
MERMW-02	V 0.03	–	–	–	–	–	–	–	–	–	–	–	–
MODFP-04	–	–	–	–	–	–	–	–	–	–	–	–	–
TRLKMW-03	–	–	–	–	–	–	–	–	–	–	–	–	–
TRLKMW-04	–	–	–	–	–	–	–	–	–	–	–	–	–

Table 5. Volatile organic compounds (VOCs) and gasoline oxygenates and their degradates detected in samples collected for the Central Eastside (CESJO) Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June, 2006.—Continued

[The five-digit code below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. **GAMA identification no:** CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Threshold type:** maximum contaminant level thresholds are listed as MCL-US when the MCL-CA is identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. The MCL-US threshold for trihalomethanes is the sum of chloroform, bromoform, bromodichloromethane, and dibromochloromethane; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; HAL-US, U.S. Environmental Protection Agency lifetime health advisory level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; NL-CA, California Department of Public Health notification level. **Abbreviations:** CESJO, Central Eastside; GAMA, Groundwater Ambient Monitoring and Assessment; E, estimated; LRL, laboratory reporting level; V, value censored due to possible blank contamination and was not included in ground-water quality analyses; THM, trihalomethane; VOC, volatile organic carbon; µg/L, micrograms per liter; na, not available; –, not detected]

GAMA identification No.	Gasoline			Fumigant	Solvent								Detections per well	Any VOC
	m- and *p*-xylene (µg/L) (85795)	Benzene (µg/L) (34030)	Ethyl-benzene (µg/L) (34371)	1,2-Dichloro-propane (µg/L) (34541)	Tetrachloro-ethene (PCE) (µg/L) (34475)	Dichloro-methane (µg/L) (34423)	Carbon tetra-chloride (µg/L) (32102)	Trichloro-ethene (TCE) (µg/L) (39180)	1,2,3-Trichloro-propane (µg/L) (77443)	Dibromo-methane (µg/L) (32017)	*cis*-1,2-Dichloro-ethene (µg/L) (77093)	*n*-Propyl-benzene (µg/L) (77224)		
[LRL]	[0.06]	[0.021]	[0.03]	[0.029]	[0.03]	[0.06]	[0.06]	[0.038]	[0.18]	[0.05]	[0.024]	[0.042]		
Threshold type	MCL-CA	MCL-CA	MCL-CA	MCL-US	MCL-US	MCL-US	MCL-CA	MCL-CA	MCL-CA	na	MCL-CA	NL-CA		
Threshold	1,750	1	300	0.5	5	5	0.5	5	0.005	na	6	260		
Uplands Study Area (9 grid wells sampled)														
CE-QPC-01	–	–	–	–	0.13	–	–	E 0.05	–	–	–	–	5	
CE-QPC-02	–	–	–	–	–	–	–	–	–	–	–	–	5	
Number of wells with detections	0	0	0	0	1	0	0	1	0	0	0	0		2
Detections frequency (percent)	0	0	0	0	11	0	0	11	0	0	0	0		22
Total detections														10
Merced Study Area (23 grid wells sampled)														
MER-02	–	–	–	E 0.04	–	–	–	–	0.85	–	–	–	3	
MER-03	–	–	–	E 0.03	0.17	–	–	E 0.03	0.18	–	E 0.03	–	6	
MER-05	–	–	–	E 0.04	–	–	–	–	–	–	–	–	1	
MER-06	–	–	–	–	E 0.02	–	–	–	–	–	–	–	2	
MER-09	–	–	–	–	E 0.03	–	–	–	–	–	–	–	1	
MER-10	–	–	–	–	E 0.06	–	–	–	–	–	–	–	1	
MER-13	–	–	–	–	–	–	–	–	–	–	–	–	0	
MER-19	–	–	–	–	–	E 0.03	–	–	–	–	–	–	1	
MER-20	–	–	–	–	–	–	–	–	–	–	–	–	1	
MER-21	–	–	–	–	–	–	–	–	–	–	–	–	2	
Number of wells with detections	0	0	0	3	4	1	0	1	2	0	1	0		9
Detections frequency (percent)	0	0	0	13	17	4	0	4	9	0	4	0		39
Total detections														18

Table 5. Volatile organic compounds (VOCs) and gasoline oxygenates and their degradates detected in samples collected for the Central Eastside (CESJO) Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June, 2006.—Continued

[The five-digit code below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. **GAMA identification no:** CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Threshold type:** maximum contaminant level thresholds are listed as MCL-US when the MCL-CA is identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. The MCL-US threshold for trihalomethanes is the sum of chloroform, bromoform, bromodichloromethane, and dibromochloromethane; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; HAL-US, U.S. Environmental Protection Agency lifetime health advisory level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; NL-CA, California Department of Public Health notification level. **Abbreviations:** CESJO, Central Eastside; GAMA, Groundwater Ambient Monitoring and Assessment; E, estimated; LRL, laboratory reporting level; V, value censored due to possible blank contamination and was not included in ground-water quality analyses; THM, trihalomethane; VOC, volatile organic carbon; µg/L, micrograms per liter; na, not available; –, not detected]

GAMA identification No.	Gasoline			Fumigant	Solvent								Detections per well	Any VOC
	m- and *p*-xylene (µg/L) (85795)	Benzene (µg/L) (34030)	Ethyl-benzene (µg/L) (34371)	1,2-Dichloro-propane (µg/L) (34541)	Tetrachloro-ethene (PCE) (µg/L) (34475)	Dichloro-methane (µg/L) (34423)	Carbon tetra-chloride (µg/L) (32102)	Trichloro-ethene (TCE) (µg/L) (39180)	1,2,3-Trichloro-propane (µg/L) (77443)	Dibromo-methane (µg/L) (32017)	*cis*-1,2-Dichloro-ethene (µg/L) (77093)	*n*-Propyl-benzene (µg/L) (77224)		
[LRL]	[0.06]	[0.021]	[0.03]	[0.029]	[0.03]	[0.06]	[0.06]	[0.038]	[0.18]	[0.05]	[0.024]	[0.042]		
Threshold type	MCL-CA	MCL-CA	MCL-CA	MCL-US	MCL-US	MCL-US	MCL-CA	MCL-CA	MCL-CA	na	MCL-CA	NL-CA		
Threshold	1,750	1	300	0.5	5	5	0.5	5	0.005	na	6	260		
Modesto Study Area (10 grid wells sampled)														
MOD-01	–	–	–	–	–	0.2	–	–	–	E 0.05	–	–	9	
MOD-02	–	–	–	–	0.12	–	–	–	–	–	–	–	2	
MOD-03	–	–	–	–	0.41	E 0.1	–	–	–	–	–	–	6	
MOD-04	–	–	–	–	–	E 0.1	–	–	–	–	–	–	5	
MOD-05	–	–	–	–	–	–	E 0.05	–	–	–	–	–	2	
MOD-06	–	–	–	–	E 0.05	–	E 0.01	–	–	–	–	–	5	
MOD-07	–	–	–	–	0.22	E 0.04	0.24	E 0.03	–	–	–	–	10	
MOD-08	–	–	–	–	–	–	–	–	–	–	–	–	3	
MOD-09	–	–	–	–	–	–	–	–	–	–	–	–	1	
Number of wells with detections	0	0	0	0	4	4	3	1	0	1	0	0		9
Detections frequency (percent)	0	0	0	0	40	40	30	10	0	10	0	0		90
Total detections														43
Turlock Study Area (16 grid wells sampled)														
TRLK-01	–	–	–	–	–	–	–	–	–	–	–	–	1	
TRLK-02	–	–	–	–	–	–	–	–	–	–	–	–	2	
TRLK-04	–	–	–	–	0.38	–	–	–	–	–	–	–	4	
TRLK-05	–	–	–	–	–	–	E 0.07	–	–	–	–	–	1	
TRLK-06	–	–	–	–	E 0.09	–	–	–	–	E 0.06	–	–	6	
TRLK-10	–	–	–	–	–	–	–	–	–	–	–	–	1	
TRLK-11	–	–	–	–	–	–	–	–	–	–	–	–	1	
TRLK-16	E 0.07	E 0.09	E 0.08	–	–	–	–	–	–	–	–	E 0.02	5	
Number of wells with detections	1	1	1	0	2	0	1	0	0	1	0	1		8
Detections frequency (percent)	6	6	6	0	13	0	6	0	0	6	0	6		50
Total detections														21

Table 5. Volatile organic compounds (VOCs) and gasoline oxygenates and their degradates detected in samples collected for the Central Eastside (CESJO) Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June, 2006.—Continued

[The five-digit code below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. **GAMA identification no:** CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Threshold type:** maximum contaminant level thresholds are listed as MCL-US when the MCL-CA is identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. The MCL-US threshold for trihalomethanes is the sum of chloroform, bromoform, bromodichloromethane, and dibromochloromethane; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; HAL-US, U.S. Environmental Protection Agency lifetime health advisory level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; NL-CA, California Department of Public Health notification level. **Abbreviations:** CESJO, Central Eastside; GAMA, Groundwater Ambient Monitoring and Assessment; E, estimated; LRL, laboratory reporting level; V, value censored due to possible blank contamination and was not included in ground-water quality analyses; THM, trihalomethane; VOC, volatile organic carbon; µg/L, micrograms per liter; na, not available; –, not detected]

GAMA identification No.	Gasoline			Fumigant	Solvent								Detections per well	Any VOC
	m- and *p*-xylene (µg/L) (85795)	Benzene (µg/L) (34030)	Ethyl-benzene (µg/L) (34371)	1,2-Dichloro-propane (µg/L) (34541)	Tetrachloro-ethene (PCE) (µg/L) (34475)	Dichloro-methane (µg/L) (34423)	Carbon tetra-chloride (µg/L) (32102)	Trichloro-ethene (TCE) (µg/L) (39180)	1,2,3-Trichloro-propane (µg/L) (77443)	Dibromo-methane (µg/L) (32017)	*cis*-1,2-Dichloro-ethene (µg/L) (77093)	*n*-Propyl-benzene (µg/L) (77224)		
[LRL]	[0.06]	[0.021]	[0.03]	[0.029]	[0.03]	[0.06]	[0.06]	[0.038]	[0.18]	[0.05]	[0.024]	[0.042]		
Threshold type	MCL-CA	MCL-CA	MCL-CA	MCL-US	MCL-US	MCL-US	MCL-CA	MCL-CA	MCL-CA	na	MCL-CA	NL-CA		
Threshold	1,750	1	300	0.5	5	5	0.5	5	0.005	na	6	260		
CESJO Study Unit (58 grid wells sampled in four study areas above)														
Number of wells with detections	1	1	1	3	11	5	4	3	2	2	1	1		28
Detections frequency (percent)	2	2	2	5	19	9	7	5	3	3	2	2		48
Total detections														92
Flow-Path Wells														
CE-QPC-FP01	–	–	–	–	0.02	–	–	–	–	–	–	–	2	
MERMW-01	–	–	–	–	–	–	–	–	–	–	–	–	1	
MERMW-02	–	–	–	–	0.17	–	–	–	0.26	–	–	–	3	
MODFP-04	–	–	–	–	0.01	–	–	–	–	–	–	–	1	
TRLKMW-03	–	–	–	E 0.1	–	–	–	–	–	–	–	–	1	
TRLKMW-04	–	–	–	–	–	–	–	–	0.33	–	–	–	1	

Table 6. Pesticides and pesticide degradates detected in samples collected for the Central-Eastside (CESJO) Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.

[The five-digit code below the constituent name is the U.S. Geological Survey parameater code used to uniquely identify a specific constituent or property. **GAMA identification no:** CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Threshold type:** maximum contaminant level thresholds are listed as MCL-US when the MCL-CA is identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; HAL-US, U.S. Environmental Protection Agency lifetime health advisory level; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; HAL-US, U.S. Environmental Protection Agency lifetime heal advisory level; LRL, laboratory reporting level. **Deisoproylatrazine, Diuron**, and **Norflurazon** constituents analyzed under pesticide schedule 2060. **Detection,** frequency, and totals are not calculated for constituents analyzed under pesticide schedule 2060, samples only collected from 15 of 58 grid wells in study unit. **Any pesticide:** includes pesticide schedules 2003 and 1306, collected from 58 grid wells in study unit. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; E, estimated; *, indicates value above threshold level; µg/L, micrograms per liter; na, not available; nc, not collected; –, not detected]

GAMA Identification No.	Deethy-latrazine (µg/L) (04040)	Simazine (µg/L) (04035)	Atrazine (µg/L) (39632)	Metola-chlor (µg/L) (39415)	1,2-Dibromo 3-chloro-propane (DBCP) (µg/L) (82625)	3,4-Di-chloro-aniline (µg/L) (61625)	Prometon (µg/L) (04037)	Hexa-zione (µg/L) (04025)	Deisopropyl-atrazine (µg/L) (04038)	Diuron (µg/L) (49300)	Norflu-razon (µg/L) (42923)	Detections per well	Any pesticide
[LRL]	[0.014]	[0.005]	[0.007]	[0.006]	[0.03]	[0.004]	[0.01]	[0.026]	[0.08]	[0.015]	[0.02]		
Threshold type	na	MCL-US	MCL-CA	HAL-US	MCL-US	na	HAL-US	HAL-US	na	HAL-US	na		
Threshold	na	4	1	100	0.2	na	100	400	na	10	na		
Uplands study area (9 grid wells sampled)													
CE-QPC-01	E 0.01	–	–	–	–	–	–	–	–	–	–	1	
CE-QPC-02	E 0.007	–	E 0.007	–	–	–	–	–	nc	nc	nc	2	
CE-QPC-09	E 0.007	–	–	–	–	–	–	–	nc	nc	nc	1	
Number of wells with detections	3	0	1	0	0	0	0	0					3
Detections frequency (percent)	33	0	11	0	0	0	0	0					33
Total detections													4
Merced study area (23 grid wells sampled)													
MER-02	E 0.005	E 0.004	E 0.004	E 0.005	0.16	–	–	–	–	–	–	5	
MER-03	–	–	–	–	0.09	–	–	–	–	–	–	1	
MER-04	–	–	–	–	–	–	–	0.014	nc	nc	nc	1	
MER-06	E 0.018	E 0.006	E 0.006	–	–	–	–	–	nc	nc	nc	3	
MER-08	–	–	E 0.005	E 0.005	–	–	–	–	nc	nc	nc	2	
MER-09	E 0.011	E 0.005	0.011	–	–	–	–	–	E0.02	E0.01	–	3	
MER-10	E 0.012	0.009	0.011	–	–	–	–	–	E0.03	E0.01	–	3	
MER-12	E 0.005	E 0.006	–	–	–	–	–	–	nc	nc	nc	2	
MER-13	E 0.006	E 0.007	–	–	–	–	–	–	nc	nc	nc	2	
MER-15	E 0.005	E 0.003	E 0.004	–	–	–	–	–	nc	nc	nc	3	
MER-16	–	E 0.004	–	–	0.11	–	–	–	nc	nc	nc	2	
MER-17	E 0.007	E 0.003	–	–	–	E 0.005	–	–	nc	nc	nc	3	
MER-19	E 0.005	0.009	E 0.005	–	–	E 0.004	–	–	nc	nc	nc	4	
MER-20	–	0.009	–	E 0.007	–	–	–	–	nc	nc	nc	2	
Number of wells with detections	9	11	7	3	3	2	0	1					14
Detections frequency (percent)	39	48	30	13	13	9	0	4					61
Total detections													36

Table 6. Pesticides and pesticide degradates detected in samples collected for the Central-Eastside (CESJO) Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.—Continued

[The five-digit code below the constituent name is the U.S. Geological Survey parameater code used to uniquely identify a specific constituent or property. **GAMA identification no:** CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Threshold type:** maximum contaminant level thresholds are listed as 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; HAL-US, U.S. Environmental Protection Agency lifetime health advisory level; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; NL, California Department of Public Health notification level; HAL-US, U.S. Environmental Protection Agency lifetime heal advisory level; LRL, laboratory reporting level. **Deisoproylatrazine**, **Diuron**, and **Norflurazon** constituents analyzed under pesticide schedule 2060. **Detection: number:** frequency, and totals are not calculated for constituents analyzed under pesticide schedule 2060, samples only collected from 15 of 58 grid wells in study unit. **Any pesticide:** includes pesticide schedules 2003 and 1306, collected from 58 grid wells in study unit. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; E, estimated; *, indicates value above threshold level; µg/L, micrograms per liter; na, not available; nc, not collected; –, not detected]

GAMA Identification No.	Deethy-latrazine (µg/L) (04040)	Simazine (µg/L) (04035)	Atrazine (µg/L) (39632)	Metola-chlor (µg/L) (39415)	1,2-Dibromo 3-chloro-propane (DBCP) (µg/L) (82625)	3,4-Di-chloro-aniline (µg/L) (61625)	Prometon (µg/L) (04037)	Hexa-zione (µg/L) (04025)	Deisopropyl-atrazine (µg/L) (04038)	Diuron (µg/L) (49300)	Norflu-razon (µg/L) (42923)	Detections per well	Any pesticide
[LRL]	[0.014]	[0.005]	[0.007]	[0.006]	[0.03]	[0.004]	[0.01]	[0.026]	[0.08]	[0.015]	[0.02]		
Threshold type	na	MCL-US	MCL-CA	HAL-US	MCL-US	na	HAL-US	HAL-US	na	HAL-US	na		
Threshold	na	4	1	100	0.2	na	100	400	na	10	na		
Modesto study area (10 grid wells sampled)													
MOD-01	E 0.007	0.017	0.012	–	–	–	E 0.01	–	E 0.01	0.03	E 0.01	4	
MOD-02	E 0.013	0.009	0.009	–	–	–	–	–	E 0.01	–	E 0.01	3	
MOD-03	E 0.009	E 0.007	E 0.006	–	–	–	–	–	nc	nc	nc	3	
MOD-04	–	E 0.004	–	–	–	–	–	–	nc	nc	nc	1	
MOD-05	E 0.008	–	–	–	E 0.06	–	–	–	nc	nc	nc	2	
MOD-06	E 0.007	E 0.004	E 0.004	–	–	–	–	–	nc	nc	nc	3	
MOD-07	E 0.011	E 0.004	E 0.006	–	–	–	–	–	nc	nc	nc	3	
MOD-08	E 0.012	–	E 0.007	–	–	–	–	–	nc	nc	nc	2	
MOD-10	E 0.013	–	0.014	–	–	E 0.01	–	–	nc	nc	nc	3	
Number of wells with detections	8	6	7	0	1	1	1	0					9
Detections frequency (percent)	80	60	70	0	10	10	10	0					90
Total detections													24
Turlock study area (16 grid wells sampled)													
TRLK-01	E 0.004	–	–	–	–	–	–	–	–	–	–	1	
TRLK-04	E 0.008	–	–	–	–	–	–	–	nc	nc	nc	1	
TRLK-06	E 0.006	0.011	E 0.005	E 0.005	0.11	–	–	–	nc	nc	nc	5	
TRLK-10	E 0.005	E 0.004	–	–	–	–	–	–	E 0.01	–	–	2	
TRLK-11	E 0.007	–	E 0.004	–	–	–	–	–	–	–	–	2	
TRLK-13	E 0.005	E 0.006	E 0.005	0.035	–	–	E 0.01	–	nc	nc	nc	5	
TRLK-14	E 0.005	–	–	–	–	–	–	–	nc	nc	nc	1	
TRLK-15	–	–	–	E 0.004	–	–	–	–	nc	nc	nc	1	
Number of wells with detections	7	3	3	3	1	0	1	0					8
Detections frequency (percent)	44	19	19	19	6	0	6	0					50
Total detections													18

Table 6. Pesticides and pesticide degradates detected in samples collected for the Central-Eastside (CESJO) Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.—Continued

[The five-digit code below the constituent name is the U.S. Geological Survey parameater code used to uniquely identify a specific constituent or property. **GAMA identification no:** CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Threshold type:** maximum contaminant level thresholds are listed as 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; HAL-US, U.S. Environmental Protection Agency lifetime health advisory level; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; NL, California Department of Public Health notification level; HAL-US, U.S. Environmental Protection Agency lifetime heal advisory level; LRL, laboratory reporting level. **Deisoproylatrazine, Diuron**, and **Norflurazon** constituents analyzed under pesticide schedule 2060. **Detection: number:** frequency, and totals are not calculated for constituents analyzed under pesticide schedule 2060, samples only collected from 15 of 58 grid wells in study unit. **Any pesticide:** includes pesticide schedules 2003 and 1306, collected from 58 grid wells in study unit. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; E, estimated; *, indicates value above threshold level; µg/L, micrograms per liter; na, not available; nc, not collected; –, not detected]

GAMA Identification No.	Deethy-latrazine (µg/L) (04040)	Simazine (µg/L) (04035)	Atrazine (µg/L) (39632)	Metola-chlor (µg/L) (39415)	1,2-Dibromo 3-chloro-propane (DBCP) (µg/L) (82625)	3,4-Di-chloro-aniline (µg/L) (61625)	Prometon (µg/L) (04037)	Hexa-zione (µg/L) (04025)	Deisopropyl-atrazine (µg/L) (04038)	Diuron (µg/L) (49300)	Norflu-razon (µg/L) (42923)	Detections per well	Any pesticide
[LRL]	[0.014]	[0.005]	[0.007]	[0.006]	[0.03]	[0.004]	[0.01]	[0.026]	[0.08]	[0.015]	[0.02]		
Threshold type	na	MCL-US	MCL-CA	HAL-US	MCL-US	na	HAL-US	HAL-US	na	HAL-US	na		
Threshold	na	4	1	100	0.2	na	100	400	na	10	na		
CESJO study area (58 grid wells sampled)													
Number of wells with detections	27	20	18	6	5	3	2	1	5	3	2		34
Detections frequency (percent)	47	34	31	10	9	5	3	2	33	20	13		59
Total detections													82
Flow-Path Wells													
CE-QPC-	–	–	E 0.004	E 0.005	–	E 0.004	–	–	nc	nc	nc	4	
MERFP-01	–	E 0.004	–	–	–	–	–	–	nc	nc	nc	2	
MERMW-01	E 0.005	–	–	–	0.06	–	–	–	nc	nc	nc	3	
MERMW-02	E 0.005	–	–	–	*1.44	–	–	–	nc	nc	nc	3	
MERMW-04	E 0.01	E 0.004	E 0.006	–	–	–	–	–	nc	nc	nc	4	
MERMW-05	E 0.005	0.008	E 0.005	–	–	–	–	–	nc	nc	nc	4	
MODFP-03	–	E 0.004	–	E 0.005	–	–	–	–	nc	nc	nc	3	
MODFP-04	E 0.007	–	–	–	–	–	–	–	nc	nc	nc	2	
MODMW-01	E 0.016	–	E 0.004	–	–	–	–	–	nc	nc	nc	3	
TRLKFP-01	E 0.005	0.009	0.009	0.008	–	–	0.01	0.062	nc	nc	nc	7	
TRLKFP-02	E 0.007	0.029	E 0.005	E 0.006	–	–	–	E 0.009	nc	nc	nc	6	
TRLKMW-02	–	E 0.006	–	–	–	–	–	–	nc	nc	nc	2	
TRLKMW-03	E 0.007	E 0.007	–	–	*0.33	–	–	E 0.013	nc	nc	nc	5	
TRLKMW-04	E 0.008	0.009	–	–	–	–	–	E 0.012	nc	nc	nc	4	
TRLKMW-05	E 0.015	0.112	E 0.007	–	–	–	–	–	nc	nc	nc	4	

Table 7. Constituents of special interest: perchlorate, 1,2,3-trichloropropane (1,2,3-TCP), *N*-nitrosodimethylamine (NDMA) detected in samples collected for the Central Eastside (CESJO) Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.

[The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses done by the Mongomery Watson Harza laboratory (laboratory entity code CA-MWHL). Samples from all 78 wells were analyzed for perchlorate, samples from the 15 slow wells were sampled for N-nitrosodimenthylamine (NDMA) and 1,2,3-trichloropropane (1,2,3-TCP) with a method reporting level (MRL) of 0.005 µg/L (1,2,3-TCP analyzed by U.S. Geological Survey National Water Quality Laboratory on schedule 2020 (table 5) with a laboratory reporting level of 0.18 µg/L); only wells with at least one detection are listed. **GAMA identification No.**: CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; NL-CA, California Department of Public Health notification level; nc, not collected; *, indicates value above threshold level; –, not detected; µg/L, microgram per liter]

GAMA identification No.	Perchlorate (µg/L) (61209)	1,2,3-Trichloropropane (µg/L)	*N*-Nitrosodimethylamine (µg/L) (64176)
[MRL]	[0.5]	[0.005]	[0.002]
Threshold type	NL-CA	NL-CA	NL-CA
Threshold level	6	0.005	0.01
Uplands study area (9 grid wells sampled)			
CE-QPC-01	0.6	nc	nc
Number of wells with detections[1]	.9		
Detections frequency (percent)[1]	.6		
Merced study area (23 grid wells sampled)			
MER-02	0.6	*0.88	–
MER-03	1	*0.16	–
MER-06	11	nc	nc
MER-10	0.6	–	–
Number of wells with detections[1]	4		
Detections frequency (percent)[1]	17		
Modesto study area (10 grid wells sampled)			
MOD-02	0.5	–	–
MOD-04	0.7	nc	nc
MOD-05	0.7	nc	nc
MOD-06	1.5	nc	nc
MOD-07	0.8	nc	nc
MOD-08	0.6	nc	nc
MOD-09	1.1	–	–
Number of wells with detections[1]	7		
Detections frequency (percent)[1]	70		
Turlock study area (16 grid wells sampled)			
TRLK-03	0.56	–	–
TRLK-05	–	*0.009	–
Number of wells with detections[1]	1		
Detections frequency (percent)[1]	6		
CESJO study unit (58 grid wells sampled in four study areas above)			
Number of wells with detections	13	3	0
Detections frequency (percent)	22	20	0
Flow-Path Wells			
MERMW-01	1.3	nc	nc
MERMW-05	1.2	nc	nc
MODFP-02	1.5	nc	nc
MODMW-01	0.7	nc	nc
TRLKFP-02	1.6	nc	nc
TRLKMW-03	0.7	nc	nc
TRLKMW-04	0.65	nc	nc
TRLKMW-05	*8.8	nc	nc

[1]Not calculated for NDMA and 1,2,3-TCP, samples only collected from 15 of 58 grid wells in study unit.

Table 8. Nutrients and dissolved organic carbon detected in samples collected for the Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.

[The five digit number below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. **GAMA identification No**.: CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Threshold type:** maximum contaminant level thresholds are listed as MCL-US when the MCL-CA (California Department of Public Health maximum contaminant level) is identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; HAL-US, U.S. Environmental Protection Agency lifetime heal advisory level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; NL, California Department of Public Health notification level. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; E, estimated; LRL, laboratory reporting level V, value censored due to possible blank contamination and not included in ground-water quality analyses; *, value above regulatory threshold; na, not available; nc, not collected; nd, no data due to sample processing error; mg/L, milligram per liter; –, not detected]

GAMA identification No.	Ammonia, dissolved as nitrogen (mg/L) (00608)	Nitrite, dissolved as nitrogen (mg/L) (00613)	Nitrite plus nitrate, dissolved as nitrogen (mg/L) (00631)	Total nitrogen (nitrate + nitrite + ammonia + organic-nitrogen) dissolved as nitrogen (mg/L) (62854)	Orthophosphate, dissolved as phosphorous (mg/L) (00671)	Dissolved organic carbon (mg/L) (00681)
[LRL]	[0.04]	[0.008]	[0.06]	[0.06]	[0.006]	[0.3]
Threshold type	HAL-US	MCL-US	MCL-US	na	na	na
Threshold level	30	1	10	na	na	na
Grid wells (samples from 20 of 58 wells were analyzed)						
[1]CE-QPC-01	–	–	4.39	4.30	0.022	V 0.3
CE-QPC-07	–	–	3.31	3.40	0.069	–
CE-QPC-09	–	–	2.09	2.21	0.110	V 0.3
MER-02	–	–	5.33	5.47	0.018	V 0.3
MER-03	–	–	3.37	3.38	0.018	V 0.4
MER-09	–	–	5.85	6.10	0.040	V 0.5
MER-10	–	–	2.65	2.79	0.023	V 0.3
MER-11	–	–	0.78	0.83	0.030	V 0.4
MER-12	–	E 0.005	0.76	0.89	0.029	0.6
MER-20	E 0.02	0.013	nd	nd	0.016	2.3
MER-21	–	0.050	0.41	0.54	0.009	4.3
MOD-01	–	–	4.80	4.88	–	0.7
[1]MOD-02	–	–	6.32	6.12	0.021	V 0.5
MOD-09	–	–	2.88	2.88	0.017	V 0.3
TRLK-01	–	–	1.37	1.31	0.009	V 0.5
TRLK-02	–	–	3.04	3.14	0.011	V 0.4
TRLK-03	–	–	1.44	1.54	0.046	V 0.4
TRLK-05	–	–	2.69	2.70	0.009	V 0.3
TRLK-10	–	–	5.56	5.57	0.031	0.6
TRLK-11	–	–	2.10	2.09	0.011	V 0.4
Flow-path wells (samples from 19 of 20 wells were analyzed)						
MERFP-01	0.06	–	–	0.08	0.012	V 0.5
MERFP-02	E 0.02	–	–	–	–	V 0.2
MERMW-01	–	–	*19.0	19.9	0.069	6.8
MERMW-02	–	–	*17.1	17.3	0.023	14.4
[1]MERMW-03	–	–	5.35	4.99	0.037	0.9
[1]MERMW-04	–	–	2.35	2.27	0.027	3.3
MERMW-05	–	–	7.45	7.73	0.024	1.3
MODFP-01	0.09	–	–	0.10	0.157	nc
MODFP-02	–	0.023	4.40	4.43	0.741	nc
MODFP-03	–	–	*13.2	13.8	0.386	nc
MODFP-04	–	–	4.88	4.92	0.020	0.6
MODMW-01	–	–	*12.4	12.5	0.049	0.9
[1]TRLKFP-01	–	0.558	*49.9	48.9	1.53	13.7
TRLKFP-02	E 0.03	–	*21.2	22.4	0.331	3.9
TRLKMW-01	–	E 0.004	5.00	5.38	0.027	nc
TRLKMW-02	–	–	*13.6	14.0	0.027	nc
TRLKMW-03	–	–	*14.8	15.0	0.087	nc
TRLKMW-04	–	–	*14.7	15.3	0.047	nc
TRLKMW-05	–	–	*39.2	40.3	0.018	3.7

[1]Total nitrogen in these samples is less than the sum of the filtered nitrogen analytes, but falls within the U.S. Geological Survey National Water Quality Laboratory acceptance criteria of a 10 percent relative percent difference.

Table 9. Major and minor ions and dissolved solids detected in samples collected for the Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.

[The five-digit code below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. **GAMA identification no:** CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Threshold type:** maximum contaminant level thresholds are listed as MCL-US when the MCL-CA is identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; HAL-US, U.S. Environmental Protection Agency lifetime health advisory level; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; SMCL-CA, California Department of Public Health secondary maximum contaminant level. The SMCL-CA for chloride, sulfate, and total dissolved solids have recommended and upper threshold values. The upper value is shown in parentheses. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; E, estimated; LRL, laboratory reporting level; na, not available; *, value exceeds recommended thresholdnd, **, value exceeds upper threshold; mg/L, milligrams per liter; –, not detected]

GAMA Identification No.	Calcium (mg/L) (00915)	Magnesium (mg/L) (00925)	Potassium (mg/L) (00935)	Sodium (mg/L) (00930)	Bromide (mg/L) (71870)	Chloride (mg/L) (00940)	Fluoride (mg/L) (00950)	Iodide (mg/L) (71865)	Silica (mg/L) (00955)	Sulfate (mg/L) (00945)	Total dissolved solids (residue on evaporation) (mg/L) (70300)
[LRL]	[0.02]	[0.008]	[0.16]	[0.2]	[0.02]	[0.2]	[0.10]	[0.02]	[0.04]	[0.18]	[10]
Threshold type	na	na	na	na	na	SMCL-CA	SMCL-CA	na	na	SMCL-CA	SMCL-CA
Threshold level	na	na	na	na	na	250 (500)	2	na	na	250 (500)	500 (1,000)
Grid wells (samples from 20 of 58 wells were analyzed)											
CE-QPC-01	22.8	9.31	2.66	14.2	0.02	6.65	0.16	–	32.8	7.58	173
CE-QPC-07	15.3	5.99	3.78	23.4	0.06	10.3	0.21	E 0.002	74.3	16.0	219
CE-QPC-09	20.2	9.17	3.13	13.6	0.05	10.1	0.27	E 0.002	65.7	10.5	199
MER-02	17.4	3.89	8.63	31.0	0.06	6.48	0.18	0.003	51.5	21.7	220
MER-03	15.2	3.76	10.2	36.5	0.07	9.98	0.21	0.004	58.4	12.2	231
MER-09	33.4	16.1	3.87	21.2	0.04	8.25	0.17	E 0.002	67.9	10.6	284
MER-10	35.2	15.8	4.40	20.7	0.05	7.88	0.20	0.002	65.7	11.6	268
MER-11	26.3	9.09	3.67	19.2	0.03	5.86	0.18	0.005	44.6	19.0	202
MER-12	79.3	46.3	1.17	66.9	0.12	70.8	0.22	0.064	49.9	70.6	*604
MER-20	42.7	9.58	3.85	40.4	0.17	37.9	0.24	0.076	40.6	79.6	324
MER-21	23.3	5.58	4.02	27.5	0.29	9.00	0.16	0.151	33.5	12.9	181
MOD-01	38.8	8.48	2.87	42.4	0.10	24.3	E 0.08	0.004	40.9	12.3	297
MOD-02	54.9	22.1	4.28	37.8	0.08	14.3	0.17	0.003	64.8	23.8	396
MOD-09	24.8	11.40	2.94	7.71	0.08	15.8	E 0.06	–	48.7	5.0	188
TRLK-01	23.2	5.04	3.15	20.8	0.09	26.0	0.12	E 0.001	62.2	3.73	204
TRLK-02	22.1	6.35	3.01	21.9	0.04	7.08	0.18	–	46.3	6.06	183
TRLK-03	7.51	2.78	1.85	58.2	0.05	12.1	0.28	0.034	49.0	2.24	232
TRLK-05	21.7	4.90	3.45	23.3	0.05	12.5	0.16	0.003	57.7	5.13	205
TRLK-10	54.9	84.8	2.27	93.3	0.61	178	0.13	0.015	28.9	170	*826
TRLK-11	17.5	4.97	4.36	19.6	0.03	6.90	0.16	–	63.1	5.93	192

Table 9. Major and minor ions and dissolved solids detected in samples collected for the Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.—Continued

[The five-digit code below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. **GAMA identification no:** CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Threshold type:** maximum contaminant level thresholds are listed as MCL-US when the MCL-CA is identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; HAL-US, U.S. Environmental Protection Agency lifetime health advisory level; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; SMCL-CA, California Department of Public Health secondary maximum contaminant level. The SMCL-CA for chloride, sulfate, and total dissolved solids have recommended and upper threshold values. The upper value is shown in parentheses. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; E, estimated; LRL, laboratory reporting level; na, not available; *, value exceeds recommended thresholdnd, **, value exceeds upper threshold; mg/L, milligrams per liter; –, not detected]

GAMA Identification No.	Calcium (mg/L) (00915)	Magnesium (mg/L) (00925)	Potassium (mg/L) (00935)	Sodium (mg/L) (00930)	Bromide (mg/L) (71870)	Chloride (mg/L) (00940)	Fluoride (mg/L) (00950)	Iodide (mg/L) (71865)	Silica (mg/L) (00955)	Sulfate (mg/L) (00945)	Total dissolved solids (residue on evaporation) (mg/L) (70300)
[LRL]	[0.02]	[0.008]	[0.16]	[0.2]	[0.02]	[0.2]	[0.10]	[0.02]	[0.04]	[0.18]	[10]
Threshold type	na	na	na	na	na	SMCL-CA	SMCL-CA	na	na	SMCL-CA	SMCL-CA
Threshold level	na	na	na	na	na	250 (500)	2	na	na	250 (500)	500 (1,000)
Flow-path wells (samples from 19 of 20 wells were analyzed)											
MERFP-01	81.2	27.8	1.83	100	0.13	103	0.23	0.134	42.6	108	*628
MERFP-02	43.1	12.1	3.52	34.1	0.10	13.7	0.23	0.048	71.8	74.3	352
MERMW-01	43.0	15.3	2.53	23.7	0.36	7.06	0.15	E0.002	74.5	32.1	363
MERMW-02	43.3	15.1	5.15	34.2	0.33	10.6	0.15	0.002	62.5	30.9	371
MERMW-03	67.0	25.6	3.42	20.0	0.04	12.3	0.20	0.003	64.2	24.8	390
MERMW-04	29.1	11.2	4.33	20.6	0.03	5.40	0.17	E0.002	56.8	9.59	234
MERMW-05	48.4	13.0	3.97	35.7	0.07	16.6	0.22	0.002	71.2	19.2	390
MODFP-01	540	251	16.1	1,010	13.3	**3,130	–	2.41	60.0	–	**5,840
MODFP-02	47.1	13.6	5.47	169	0.72	177	E0.09	0.218	55.1	46.1	*671
MODFP-03	37.4	13.0	1.70	14.9	0.08	24.5	0.13	0.005	52.7	28.1	264
MODFP-04	54.4	17.1	3.48	30.1	0.05	16.4	0.14	0.002	44.0	10.9	327
MODMW-01	55.3	20.0	3.06	28.7	0.05	13.7	E0.09	0.002	59.7	53.0	399
TRLKFP-01	136	42.5	14.4	186	0.38	124	0.40	0.276	53.2	84.9	**1,190
TRLKFP-02	51.1	17.1	5.56	22.1	0.11	19.4	0.20	0.045	59.8	32.4	387
TRLKMW-01	41.4	12.6	2.61	87.2	0.33	98.2	0.13	0.171	42.9	12.4	450
TRLKMW-02	79.8	23.9	1.67	59.0	0.17	28.0	0.17	0.047	46.1	47.8	*538
TRLKMW-03	68.1	20.9	3.52	30.9	0.15	11.9	0.26	0.003	54.2	35.7	418
TRLKMW-04	56.2	19.8	1.38	31.3	0.18	11.9	0.34	0.003	61.2	27.8	397
TRLKMW-05	138	33.3	3.00	65.0	0.51	60.9	0.17	0.007	60.3	161	*842

Table 10. Trace elements detected in samples collected for the Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.

[The five-digit code below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. **GAMA identification no:** CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Threshold type:** maximum contaminant level thresholds are listed as MCL-US when the MCL-CA is identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; AL-US, U.S. Environmental Protection action level; HAL-US, U.S. Environmental Protection Agency lifetime health advisory level; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; NL-CA, California Department of Public Health notication level; SMCL-CA, California Department of Public Health secondary maximum contaminant level. The SMCL-CA for chloride, sulfate, and total dissolved solids have recommended and upper threshold values. The upper value is shown in parentheses. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; E, estimated; LRL, laboratory reporting level; na, not available; V, value censored due to possible blank contamination and not included in ground-water quality analyses;*, value exceds recommended thresholdnd, µg/L, micrograms per liter; –, not detected]

GAMA Identification No.	Aluminum (µg/L) (01106)	Antimony (µg/L) (01095)	Arsenic (µg/L) (01000)	Barium (µg/L) (01005)	Beryllium (µg/L) (01010)	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)	Lithium (µg/L) (01130)
[LRL]	[1.6]	[0.20]	[0.12]	[0.2]	[0.06]	[8]	[0.04]	[0.04]	[0.04]	[0.4]	[6]	[0.08]	[0.6]
Threshold type	MCL-CA	MCL-US	MCL-US	MCL-CA	MCL-US	NL-CA	MCL-US	MCL-CA	na	AL-US	SMCL-CA	AL-US	na
Threshold level	1,000	6	10	1,000	4	1,000	5	50	na	1,300	300	15	na
Grid wells (samples from 20 of 58 wells analyzed)													
CE-QPC-01	E 1.5	–	1.3	43	–	20	E 0.02	0.92	0.069	2.5	8	2.69	1.5
CE-QPC-07	–	–	4.2	83	–	33	–	12.1	0.044	0.9	–	0.77	2.8
CE-QPC-09	–	–	7.0	156	–	20	–	0.93	0.065	1.1	E5	0.63	7.2
MER-02	–	E 0.11	5.3	79	–	36	–	1.1	0.047	E 0.3	–	0.10	3.8
MER-03	–	–	5.1	44	–	60	–	2.6	E 0.039	0.7	–	0.25	2.2
MER-09	–	–	2.7	212	–	18	–	3.2	0.082	1.5	–	0.30	4.5
MER-10	–	–	2.0	192	–	19	–	3.5	0.085	1.9	–	0.18	1.2
MER-11	–	–	*10.4	156	–	13	–	0.15	0.063	E 0.3	17	V 0.05	1.8
MER-12	–	–	3.7	183	–	24	E 0.02	1.7	0.286	1.3	8	7.88	5.1
MER-20	5.6	0.39	2.3	35	–	68	–	0.06	0.335	1.7	122	1.43	5.6
MER-21	E 1.3	0.21	1.5	122	–	21	–	V 0.06	0.236	E 0.4	20	0.48	2.4
MOD-01	4.4	–	4.1	57	–	102	–	2.1	0.122	1.1	–	0.36	4.4
MOD-02	–	–	5.8	138	–	62	–	5.7	0.193	1.4	–	0.92	7.0
MOD-09	2.8	–	1.3	58	–	15	–	2.3	0.047	E 0.3	–	0.23	0.8
TRLK-01	E 0.8	–	7.2	100	–	24	–	7.9	0.063	0.7	–	0.20	1.4
TRLK-02	E 0.9	–	5.7	48	–	24	–	5.3	0.069	0.7	–	0.31	2.8
TRLK-03	5.6	–	*16.8	50	–	238	E 0.02	0.71	E 0.033	4.4	101	*56.8	2.1
TRLK-05	E 1.1	–	8.2	76	–	26	–	6.2	E 0.039	E 0.4	–	0.09	1.8
TRLK-10	E 1.1	–	1.2	80	–	620	–	6.0	0.17	2.4	–	0.26	26.7
TRLK-11	E 0.8	–	6.0	73	–	31	–	4.6	0.045		–	0.24	2.2

Table 10. Trace elements detected in samples collected for the Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.—Continued

[The five-digit code below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. **GAMA identification no:** CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Threshold type:** maximum contaminant level thresholds are listed as MCL-US when the MCL-CA is identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; AL-US, U.S. Environmental Protection action level; HAL-US, U.S. Environmental Protection Agency lifetime health advisory level; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; NL-CA, California Department of Public Health notication level; SMCL-CA, California Department of Public Health secondary maximum contaminant level. The SMCL-CA for chloride, sulfate, and total dissolved solids have recommended and upper threshold values. The upper value is shown in parentheses. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; E, estimated; LRL, laboratory reporting level; na, not available; V, value censored due to possible blank contamination and not included in ground-water quality analyses;*, value exceds recommended thresholdnd, µg/L, micrograms per liter; –, not detected]

GAMA Identification No.	Manganese (µg/L) (01056)	Mercury (µg/L) (71890)	Molybdenum (µg/L) (01060)	Nickel (µg/L) (01065)	Selenium (µg/L) (01145)	Silver (µg/L) (01075)	Strontium (µg/L) (01080)	Thallium (µg/L) (01057)	Tungsten (µg/L) (01155)	Uranium (µg/L) (22703)	Vanadium (µg/L) (01085)	Zinc (µg/L) (01090)
[LRL]	[0.2]	[0.01]	[0.4]	[0.06]	[0.08]	[0.2]	[0.4]	[0.04]	[0.06]	[0.04]	[0.1]	[0.6]
Threshold type	SMCL-CA	MCL-US	HAL-US	MCL-CA	MCL-US	SMCL-CA	HAL-US	MCL-US	na	MCL-US	NL-CA	SMCL-CA
Threshold level	50	2	40	100	50	100	4,000	2	na	30	50	5,000
Grid wells (samples from 20 of 58 wells analyzed)												
CE-QPC-01	0.3	–	0.8	1.18	0.08	–	309	–	–	0.36	7.0	26.1
CE-QPC-07	–	–	2.5	1.03	1.1	–	179	–	0.08	0.10	33.6	12.2
CE-QPC-09	0.2	–	0.6	1.40	E 0.06	–	268	–	E0.04	0.18	12.5	19.5
MER-02	2.2	–	1.7	0.71	0.26	–	229	–	0.42	0.93	17.9	V0.4
MER-03	–	–	3.1	0.65	0.14	–	172	–	0.23	0.88	31.9	2.1
MER-09	–	–	1.0	2.24	0.17	–	341	–	V 0.11	2.22	14.5	2.4
MER-10	–	–	1.3	2.11	0.25	–	411	–	V 0.04	3.38	19.8	2.7
MER-11	25.8	–	4.5	1.35	0.15	–	250	–	V 0.13	0.60	4.3	1.9
MER-12	8.3	–	2.7	5.41	1.2	–	734	–	V 0.10	21.4	24.4	12.9
MER-20	*109	–	5.0	2.66	0.37	–	366	E 0.03	0.55	0.20	1.2	2.3
MER-21	45.5	–	2.9	3.06	1.5	–	238	–	0.29	0.42	5.3	0.7
MOD-01	–	–	2.3	2.91	0.11	–	453	–	0.28	18.1	23.1	1.3
MOD-02	–	–	0.8	4.31	0.19	–	690	–	0.14	17.9	32.5	1.0
MOD-09	–	–	E 0.3	0.71	0.15	–	320	–	0.08	0.48	8.8	3.6
TRLK-01	–	–	1.6	1.42	0.20	–	220	–	0.27	1.17	45.1	0.6
TRLK-02	0.2	–	1.3	1.70	0.27	–	217	–	0.33	4.01	33.8	0.9
TRLK-03	9.4	–	4.4	0.58	0.14	–	137	–	1.4	0.46	12.0	14.7
TRLK-05	–	–	2.3	0.65	0.43	–	236	–	0.37	1.30	*50.1	1.0
TRLK-10	–	–	0.7	2.76	1.6	–	764	–	E 0.05	2.28	4.2	1.8
TRLK-11	–	–	2.0	0.72	0.27	–	205	–	0.26	0.92	43.0	0.7

Table 10. Trace elements detected in samples collected for the Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.—Continued

[The five-digit code below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. **GAMA identification no:** CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Threshold type:** maximum contaminant level thresholds are listed as MCL-US when the MCL-CA is identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; AL-US, U.S. Environmental Protection action level; HAL-US, U.S. Environmental Protection Agency lifetime health advisory level; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; NL-CA, California Department of Public Health notication level; SMCL-CA, California Department of Public Health secondary maximum contaminant level. The SMCL-CA for chloride, sulfate, and total dissolved solids have recommended and upper threshold values. The upper value is shown in parentheses. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; E, estimated; LRL, laboratory reporting level; na, not available; V, value censored due to possible blank contamination and not included in ground-water quality analyses;*, value exceeds recommended thresholdnd, µg/L, micrograms per liter; –, not detected]

GAMA Identification No.	Aluminum (µg/L) (01106)	Antimony (µg/L) (01095)	Arsenic (µg/L) (01000)	Barium (µg/L) (01005)	Beryllium (µg/L) (01010)	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)	Lithium (µg/L) (01130)
[LRL]	[1.6]	[0.20]	[0.12]	[0.2]	[0.06]	[8]	[0.04]	[0.04]	[0.04]	[0.4]	[6]	[0.08]	[0.6]
Threshold type	MCL-CA	MCL-US	MCL-US	MCL-CA	MCL-US	NL-CA	MCL-US	MCL-CA	na	AL-US	SMCL-CA	AL-US	na
Threshold level	1,000	6	10	1,000	4	1,000	5	50	na	1,300	300	15	na
Flow-Path Wells (samples from 19 of 20 wells analyzed)													
MERFP-01	–	–	9.8	99	–	40	E 0.03	V0.04	0.231	0.7	189	V 0.05	5.2
MERFP-02	E0.9	–	0.5	43	–	29	–	0.04	0.117	1.1	20	1.63	18.2
MERMW-01	E1.1	–	1.2	88	–	45	–	1.2	0.135	1.2	–	V 0.04	11.1
MERMW-02	E0.9	–	1.4	170	–	48	–	1.0	0.128	E 0.3	–	V 0.04	5.6
MERMW-03	–	–	1.9	236	–	20	–	1.3	0.263	0.5	–	V 0.05	5.2
MERMW-04	–	–	2.0	137	–	20	–	2.8	0.079	E 0.3	–	V 0.04	2.5
MERMW-05	–	–	5.9	240	–	19	–	5.2	0.101	E 0.3	E 4	–	2.3
MODFP-01	–	–	*17.2	*2,930	–	474	–	0.26	3.12	2.6	*1,870	–	43.7
MODFP-02	1.7	–	9.1	181	–	335	0.06	0.18	0.236	0.6	13	–	9.2
MODFP-03	E1.2	–	8.8	37	–	44	–	0.95	0.148	0.7	E 5	V 0.04	5.7
MODFP-04	–	–	2.5	94	–	27	–	2.8	0.135	1.3	E 3	0.17	2.4
MODMW-01	–	–	2.6	137	–	35	E 0.03	1.9	0.167	0.5	–	–	7.5
TRLKFP-01	–	0.28	*16.2	206	–	193	0.08	–	2.41	12.5	–	0.16	19.3
TRLKFP-02	–	–	3.2	125	–	55	E 0.02	0.38	1.200	3.3	–	0.10	7.6
TRLKMW-01	E1	–	2.8	94	–	56	–	V0.09	0.148	0.5	–	–	16.6
TRLKMW-02	E1	–	1.0	107	–	112	–	0.74	0.303	1.4	–	V 0.04	6.9
TRLKMW-03	–	–	2.6	216	–	38	–	2.0	0.229	0.6	–	E 0.06	4.2
TRLKMW-04	–	–	3.4	140	–	48	–	2.0	0.190	1.0	–	–	9.0
TRLKMW-05	–	–	2.2	111	–	63	E 0.02	1.3	0.417	1.4	–	V 0.05	5.7

Table 10. Trace elements detected in samples collected for the Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.—Continued

[The five-digit code below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. **GAMA identification no:** CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Threshold type:** maximum contaminant level thresholds are listed as MCL-US when the MCL-CA is identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; AL-US, U.S. Environmental Protection action level; HAL-US, U.S. Environmental Protection Agency lifetime health advisory level; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; NL-CA, California Department of Public Health notication level; SMCL-CA, California Department of Public Health secondary maximum contaminant level. The SMCL-CA for chloride, sulfate, and total dissolved solids have recommended and upper threshold values. The upper value is shown in parentheses. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; E, estimated; LRL, laboratory reporting level; na, not available; V, value censored due to possible blank contamination and not included in ground-water quality analyses;*, value exceds recommended thresholdnd, µg/L, micrograms per liter; –, not detected]

GAMA Identification No.	Manganese (µg/L) (01056)	Mercury (µg/L) (71890)	Molybdenum (µg/L) (01060)	Nickel (µg/L) (01065)	Selenium (µg/L) (01145)	Silver (µg/L) (01075)	Strontium (µg/L) (01080)	Thallium (µg/L) (01057)	Tungsten (µg/L) (01155)	Uranium (µg/L) (22703)	Vanadium (µg/L) (01085)	Zinc (µg/L) (01090)
[LRL]	[0.2]	[0.01]	[0.4]	[0.06]	[0.08]	[0.2]	[0.4]	[0.04]	[0.06]	[0.04]	[0.1]	[0.6]
Threshold type	SMCL-CA	MCL-US	HAL-US	MCL-CA	MCL-US	SMCL-CA	HAL-US	MCL-US	na	MCL-US	NL-CA	SMCL-CA
Threshold level	50	2	40	100	50	100	4,000	2	na	30	50	5,000
Flow-path wells (samples from 19 of 20 wells analyzed)												
MERFP-01	*443	–	6.7	5.43	–	–	586	–	0.68	9.96	3.3	1.8
MERFP-02	*84.4	–	7.3	2.25	–	–	373	–	0.14	–	–	15.1
MERMW-01	1.2	–	0.4	2.73	E 0.07	–	521	–	V 0.17	6.89	14.4	4.0
MERMW-02	–	–	0.8	2.18	E 0.05	–	516	–	V 0.15	13.1	16.3	V 0.4
MERMW-03	0.6	–	0.4	2.89	E 0.06	–	784	–	V 0.15	8.97	19.6	0.7
MERMW-04	–	–	1.3	1.18	0.18	–	360	–	0.24	2.04	20.1	–
MERMW-05	2.9	–	2.6	2.23	0.50	–	453	–	V 0.12	2.17	35.5	–
MODFP-01	*3,940	–	6.6	47.5	1.0	–	*5,700	–	0.44	E 0.09	1.4	3.8
MODFP-02	216	–	16.7	4.02	–	–	564	–	0.71	4.53	13.1	V 0.5
MODFP-03	E 0.1	–	1.4	3.07	E 0.05	–	482	–	0.87	1.40	39.1	V0.4
MODFP-04	0.5	–	0.5	1.90	–	–	724	–	V 0.04	6.86	17.4	2.8
MODMW-01	E 0.1	–	E0.3	2.56	–	–	843	–	V 0.05	4.01	18.2	V 0.5
TRLKFP-01	*1,130	–	13.7	9.97	0.72	–	2,230	–	3.0	*91.9	41.9	1.4
TRLKFP-02	22	–	1.8	3.19	0.09	–	541	–	0.14	9.76	13.3	E 0.6
TRLKMW-01	9.4	–	3.4	2.85	E 0.06	–	413	–	0.36	24.2	11.5	V 0.3
TRLKMW-02	10.3	–	3.4	5.98	–	–	834	–	V 0.20	*59.2	11.5	1.1
TRLKMW-03	E 0.2	–	0.7	5.72	–	–	731	–	V 0.15	22.2	23.4	1.2
TRLKMW-04	E 0.1	–	0.9	4.92	–	–	612	–	V 0.22	8.39	26.7	1.3
TRLKMW-05	E 0.1	–	1.9	7.62	0.16	–	1,220	–	V 0.19	*56.9	20.8	0.8

Table 11. Species of inorganic arsenic, iron, and chromium in samples collected for the Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.

[The five digit number below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Analyses made by the U.S. Geological Survey Trace Metals Laboratory (laboratory entity code USGSTMCO). **GAMA identification No.**: CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Threshold type:** maximum contaminant level thresholds are listed as MCL-US when the MCL-CA is identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; MDL, method detection level; V, value censored due to possible blank contamination and not included in ground-water quality analyses; *, value exceds recommended thresholdnd, no data;–, not detected; µg/L, microgram per liter]

GAMA Identification No.	Arsenic (µg/L) (99033)	Arsenic (III) (µg/L) (99034)	Chromium (µg/L) (01030)	Chromium (VI) (µg/L) (01032)	Iron (µg/L) (01046)	Iron (II) (µg/L) (01047)
[MDL]	0.5	1	1	1	2	2
Threshold type	10	na	50	na	300	na
Threshold level	MCL-US	na	MCL-CA	na	SMCL-CA	na
Grid wells (samples from 20 of 58 wells were analyzed)						
CE-QPC-01	1.1	–	–	–	V 6	–
CE-QPC-07	3.8	–	10	9	–	–
CE-QPC-09	6.4	–	–	–	2	–
MER-02	4.9	–	–	1	–	–
MER-03	5.7	–	3	3	–	–
MER-09	2.3	–	4	4	–	–
MER-10	1.7	–	3	3	–	–
MER-11	8.8	–	–	–	15	7
MER-12	3.3	–	2	2	5	4
MER-20	1.7	–	–	–	108	12
MER-21	1.5	–	–	–	12	3
MOD-01	4.3	–	2	2	–	–
MOD-02	5.5	–	5	5	–	–
MOD-09	0.86	–	2	2	–	–
TRLK-01	6.5	–	9	9	–	–
TRLK-02	6.2	–	6	7	–	–
TRLK-03	*16	–	1	–	V 13	–
TRLK-05	7.5	–	6	6	–	–
TRLK-10	1.2	–	5	5	–	–
TRLK-11	7.1	–	4	4	–	–
Flow-Path Wells (samples from 19 of 20 wells were analyzed)						
MERFP-01	8.2	4.5	–	–	161	106
MERFP-02	0.6	–	–	–	15	–
MERMW-01	1.1	–	1	–	–	–
MERMW-02	1.1	–	1	–	–	–
MERMW-03	2.1	–	1	1	–	–
MERMW-04	2.0	–	3	4	–	–
MERMW-05	6.2	–	5	5	5	3
MODFP-01	*12	12	–	–	*1,830	1,860
MODFP-02	8.5	–	–	–	V 3	–
MODFP-03	8.5	–	1	–	–	–
MODFP-04	3.0	–	3	2	V 3	–
MODMW-01	3.5	–	1	2	–	–
TRLKFP-01	*13	–	–	–	–	–
TRLKFP-02	2.2	–	–	–	–	–
TRLKMW-01	2.5	–	–	–	–	–
TRLKMW-02	0.66	–	–	–	–	–
TRLKMW-03	2.4	–	2	2	–	–
TRLKMW-04	2.7	–	2	2	–	–
TRLKMW-05	2.1	–	3	–	–	–

Table 12. Radioactive constituents detected in samples collected for the Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.

[All values are in picocuries per liter. The five-digit code below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. **GAMA identification no:** CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Threshold type:** maximum contaminant level thresholds are listed as MCL-US when the MCL-CA is identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; SSMDC, sample-specific minimum detectable concentration; E, estimated; na, not available; *, above lower theshold; <, less than]

GAMA Identification No.	Gross-alpha radioactivity								Gross-beta radioactivity							
	72-hour count (62636)				30-hour count (62639)				72-hour count (62642)				30-day count (62645)			
	Result	Critical value	1-sigma combined standard uncertainty	SSMDC	Result	Critical value	1-sigma combined standard uncertainty	SSMDC	Result	Critical value	1-sigma combined standard uncertainty	SSMDC	Result	Critical value	1-sigma combined standard uncertainty	SSMDC
Threshold type	MCL-US	na	na	na	MCL-US	na	na	na	MCL-CA	na	na	na	MCL-CA	na	na	na
Threshold	15	na	na	na	15	na	na	na	50	na	na	na	50	na	na	na
Grid wells (samples from 15 of 58 wells analyzed)																
CE-QPC-01	<2.4	1.0	0.70	2.4	<0.93	0.41	0.26	0.93	E3.5	1.2	0.92	2.5	E2.7	1.0	0.70	2.1
MER-02	E2.6	0.92	1.0	2.3	<1.3	0.61	0.39	1.3	10.3	1.1	1.4	2.2	10.0	0.56	1.1	1.1
MER-03	<2.1	0.82	0.65	2.1	<2.9	1.2	0.70	2.9	11.9	1.1	1.6	2.2	11.4	1.2	1.5	2.5
MER-09	E3.1	1.3	1.1	3.1	E3.4	1.1	1.1	2.7	E4.8	1.2	0.98	2.5	5.4	1.1	0.96	2.3
MER-10	E6.8	1.1	1.6	2.7	E2.3	1.5	1.2	3.6	6.6	1.1	1.1	2.3	E7.0	1.8	1.4	3.8
MER-11	<2.7	1.1	0.80	2.7	<1.4	0.62	0.41	1.4	E3.7	1.2	0.93	2.5	3.9	0.56	0.56	1.1
MOD-01	8.2	1.0	1.3	2.2	9.1	0.86	1.4	1.9	4.6	1.1	0.84	2.3	8.8	0.76	1.1	1.6
MOD-02	13.6	1.2	1.9	2.6	10.1	1.2	1.5	2.7	E4.0	1.0	0.81	2.1	10.1	0.92	1.2	1.9
MOD-09	<2.7	1.1	0.70	2.7	<1.2	0.57	0.38	1.2	E3.2	1.2	0.86	2.4	2.7	0.54	0.45	1.1
TRLK-01	E1.9	0.92	0.87	2.3	<1.5	0.70	0.49	1.5	E4.9	1.3	1.0	2.7	3.8	0.57	0.54	1.2
TRLK-02	<3.9	1.7	1.1	3.9	E2.0	0.50	0.47	1.1	E4.0	1.5	1.1	3.1	4.9	0.56	0.64	1.2
TRLK-03	<3.0	1.2	0.91	3.0	<3.3	1.4	0.76	3.3	E2.0	1.2	0.82	2.6	<3.3	1.6	1.0	3.3
TRLK-05	E2.3	0.60	0.78	1.7	<1.4	0.63	0.43	1.4	4.7	1.1	0.93	2.3	4.1	0.57	0.57	1.2
TRLK-10	<5.0	2.3	1.4	5.0	<5.5	2.5	1.5	5.5	E4.0	1.5	0.98	3.0	3.7	0.90	0.71	1.9
TRLK-11	<2.5	1.0	0.76	2.5	E0.50	0.44	0.34	1.1	E4.5	1.2	0.96	2.5	6.9	1.2	1.1	2.4

Table 12. Radioactive constituents detected in samples collected for the Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.—Continued

[All values are in picocuries per liter. The five-digit code below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. **GAMA identification no:** CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Threshold type:** maximum contaminant level thresholds are listed as MCL-US when the MCL-CA is identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; SSMDC, sample-specific minimum detectable concentration; E, estimated; na, not available; *, above lower theshold; <, less than]

GAMA Identification No.	Radium-226 (09511)				Radium-228 (81366)				Radon-222 (82303)	Radon-222 2-sigma combined uncertainty (76002)
	Result	Critical value	1-sigma combined standard uncertainty	SSMDC	Result	Critical value	1-sigma combined standard uncertainty	SSMDC	Result	Result
Threshold type	MCL-US	na	na	na	MCL-US	na	na	na	Proposed MCL-US	na
Threshold	[1]5	na	na	na	[1]5	na	na	na	300, 4,000	na
Grid wells (samples from 15 of 58 wells analyzed)										
CE-QPC-01	<0.032	0.013	0.009	0.032	E0.43	0.21	0.13	0.45	*316	20
MER-02	0.134	0.013	0.018	0.031	0.63	0.17	0.082	0.38	*444	22
MER-03	E0.040	0.016	0.012	0.035	E0.32	0.19	0.085	0.41	*413	22
MER-09	0.275	0.013	0.023	0.031	E0.34	0.23	0.10	0.50	*668	25
MER-10	0.276	0.017	0.022	0.037	E0.47	0.23	0.10	0.50	*608	24
MER-11	0.105	0.013	0.017	0.032	<0.58	0.28	0.13	0.58	*1,583	36
MOD-01	0.087	0.012	0.015	0.029	<0.45	0.21	0.085	0.45	*938	29
MOD-02	0.076	0.014	0.014	0.032	E0.26	0.23	0.095	0.48	*628	24
MOD-09	E0.0154	0.010	0.008	0.025	<0.51	0.24	0.10	0.51	*307	20
TRLK-01	E0.041	0.013	0.012	0.030	E0.42	0.21	0.11	0.44	*439	22
TRLK-02	E0.0168	0.011	0.009	0.026	0.43	0.19	0.086	0.41	193	18
TRLK-03	E0.0251	0.013	0.010	0.029	E0.39	0.20	0.086	0.43	*666	25
TRLK-05	0.074	0.011	0.013	0.026	<0.56	0.26	0.14	0.56	*850	28
TRLK-10	0.099	0.013	0.015	0.030	E0.49	0.25	0.12	0.54	*312	20
TRLK-11	0.058	0.012	0.011	0.026	<0.49	0.23	0.09	0.49	*715	26

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

Table 13. Uranium isotope values in samples collected for the Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.

[All values are in picocureis per liter. The five-digit code below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. **GAMA identification no:** CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Threshold type:** maximum contaminant level thresholds are listed as MCL-US when the MCL-CA is identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; SSMDC, sample-specific minimum detectable concentration; E, estimated; na, not available; *, value exceds recommended threshold; na, not available; nc, not collected; <, less than]

GAMA Identification No.	Uranium-234 (22610)				Uranium-235 (22620)				Uranium-238 (22603)			
	Result	Critical value	1-sigma combined standard uncertainty	SSMDC	Result	Critical value	1-sigma combined standard uncertainty	SSMDC	Result	Critical value	1-sigma combined standard uncertainty	SSMDC
Threshold type	MCL-US	na	na	na	MCL-US	na	na	na	MCL-CA	na	na	na
Threshold	[1]20	na	na	na	[1]20	na	na	na	[1]20	na	na	na
Grid wells (samples from 20 of 58 wells analyzed)												
CE-QPC-01	0.22	0.005	0.023	0.015	<0.018	0.006	0.005	0.018	0.083	0.005	0.014	0.015
CE-QPC-07	0.13	0.014	0.026	0.040	<0.039	0.012	0.006	0.039	0.044	0.014	0.018	0.040
CE-QPC-09	0.10	0.006	0.018	0.019	<0.023	0.007	0.006	0.023	0.059	0.006	0.013	0.019
MER-02	0.42	0.010	0.038	0.028	E0.025	0.008	0.011	0.027	0.26	0.007	0.031	0.022
MER-03	0.34	0.005	0.030	0.017	E0.009	0.007	0.009	0.021	0.25	0.005	0.024	0.017
MER-09	1.34	0.014	0.073	0.035	E0.053	0.012	0.014	0.033	0.70	0.012	0.051	0.031
MER-10	1.71	0.012	0.086	0.033	E0.044	0.009	0.015	0.027	1.11	0.010	0.066	0.028
MER-11	0.38	0.014	0.037	0.036	E0.022	0.012	0.011	0.034	0.24	0.010	0.028	0.028
MER-12	10.3	0.025	0.350	0.060	0.28	0.010	0.036	0.032	6.7	0.021	0.250	0.051
MER-20	0.15	0.010	0.024	0.028	E0.011	0.008	0.007	0.027	0.057	0.010	0.015	0.028
MER-21	0.24	0.008	0.029	0.026	E0.013	0.010	0.009	0.032	0.18	0.008	0.025	0.026
MOD-01	7.1	0.020	0.240	0.048	0.28	0.008	0.030	0.024	6.3	0.020	0.220	0.046
MOD-02	8.1	0.018	0.260	0.042	0.26	0.009	0.029	0.026	5.57	0.018	0.190	0.042
MOD-09	0.39	0.011	0.037	0.030	E0.012	0.009	0.008	0.029	0.10	0.008	0.020	0.024
TRLK-01	0.54	0.011	0.047	0.032	E0.025	0.010	0.013	0.031	0.39	0.008	0.040	0.025
TRLK-02	1.69	0.011	0.073	0.027	0.100	0.006	0.018	0.018	1.25	0.011	0.063	0.027
TRLK-03	0.22	0.004	0.020	0.013	<0.016	0.005	0.002	0.016	0.133	0.004	0.016	0.013
TRLK-05	0.65	0.012	0.050	0.033	E0.037	0.009	0.011	0.027	0.39	0.010	0.035	0.029
TRLK-10	1.14	0.016	0.071	0.040	E0.053	0.010	0.017	0.030	0.70	0.008	0.051	0.025
TRLK-11	0.47	0.010	0.043	0.029	E0.019	0.009	0.008	0.028	0.26	0.010	0.029	0.029

Table 13. Uranium isotope values in samples collected for the Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.—Continued

[All values are in picocureis per liter. The five-digit code below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. **GAMA identification no:** CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Threshold type:** maximum contaminant level thresholds are listed as MCL-US when the MCL-CA is identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; SSMDC, sample-specific minimum detectable concentration; E, estimated; na, not available; *, value exceeds recommended threshold; na, not available; nc, not collected; <, less than]

GAMA Identification No.	Uranium-234 (22610)				Uranium-235 (22620)				Uranium-238 (22603)			
	Result	Critical value	1-sigma combined standard uncertainty	SSMDC	Result	Critical value	1-sigma combined standard uncertainty	SSMDC	Result	Critical value	1-sigma combined standard uncertainty	SSMDC
Threshold type	MCL-US	na	na	na	MCL-US	na	na	na	MCL-CA	na	na	na
Threshold	[1]20	na	na	na	[1]20	na	na	na	[1]20	na	na	na
Flow-path wells (samples from 18 of 20 wells were analyzed)												
MERFP-01	5.22	0.020	0.190	0.048	0.19	0.008	0.028	0.026	3.47	0.018	0.140	0.043
MERMW-01	2.13	0.015	0.100	0.038	E0.088	0.009	0.019	0.028	1.84	0.017	0.092	0.042
MERMW-02	5.5	0.023	0.200	0.052	0.29	0.008	0.034	0.024	3.92	0.019	0.150	0.045
MERMW-03	3.51	0.019	0.140	0.044	0.24	0.008	0.030	0.024	2.44	0.016	0.100	0.040
MERMW-04	0.97	0.006	0.056	0.020	E0.042	0.008	0.013	0.024	0.61	0.006	0.044	0.020
MERMW-05	0.90	0.010	0.059	0.029	E0.034	0.009	0.011	0.028	0.71	0.007	0.050	0.023
MODFP-01	0.092	0.009	0.017	0.025	<0.024	0.008	0.007	0.024	0.038	0.006	0.011	0.020
MODFP-02	2.64	0.011	0.110	0.029	0.092	0.008	0.017	0.024	1.45	0.013	0.074	0.033
MODFP-03	0.55	0.008	0.040	0.023	E0.033	0.007	0.012	0.022	0.51	0.006	0.037	0.018
MODFP-04	3.61	0.019	0.160	0.049	E0.12	0.011	0.025	0.036	2.06	0.019	0.110	0.049
MODMW-01	1.38	0.013	0.087	0.037	E0.06	0.011	0.020	0.035	0.86	0.009	0.064	0.029
TRLKFP-01	*30.4	0.062	0.940	0.130	1.96	0.011	0.110	0.034	*28.6	0.058	0.900	0.130
TRLKFP-02	3.06	0.021	0.130	0.049	0.20	0.008	0.029	0.026	2.72	0.017	0.120	0.042
TRLKMW-01	9.7	0.025	0.310	0.057	0.50	0.007	0.040	0.022	8.4	0.024	0.270	0.055
TRLKMW-02	19.3	0.035	0.570	0.075	1.03	0.006	0.061	0.020	18.7	0.033	0.550	0.071
TRLKMW-03	9.5	0.024	0.310	0.056	0.39	0.008	0.038	0.025	6.3	0.023	0.220	0.054
TRLKMW-04	3.73	0.016	0.150	0.040	0.16	0.008	0.025	0.025	2.70	0.016	0.120	0.040
TRLKMW-05	17.2	0.037	0.520	0.081	1.05	0.007	0.061	0.023	15.3	0.035	0.470	0.076

[1] The MCL-US threshold is for total uranium rather than individual isotopes of uranium.

Table 14. Results for analyses of stable isotope ratios and carbon-14 and tritium activities in samples collected for the Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.

[The five-digit code below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Samples from all 78 wells were analyzed for stable isotopes of water; samples from 39 of the slow and intermediate wells were analyzed for tritium, carbon-14, and stable isotope ratios of carbon, nitrate, and sulfate. 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. **GAMA identification no:** CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Threshold type:** MCL-CA, California Department of Public Health maximum contaminant level. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; na, not availabble; nc, sample not collected; nm, not measureable; pCi/L, picocuries per liter; –, not detected]

GAMA Identification No.	$\delta^{2}H$ of water (per mil) (82082)	$\delta^{18}O$ of water (per mil) (82085)	$\delta^{3}C$ of dissolved inorganic carbon (per mil) (82081)	Carbon-14 (percent modern) (49933)	Carbon-14 counting error, water, filtered, percent modern (49934)	$\delta^{15}N$ of nitrate (per mil) (82690)	$\delta^{18}O$ of nitrate (per mil) (63041)	$\delta^{15}S$ of sulfate (per mil) (49932)	$\delta^{18}O$ of sulfate (per mil)	Tritium (pCi/L) (07000)	Tritium 2-sigma combined standard uncertainty (pCi/L) (75985)
Threshold type	na	na	na	na	na	na	na	na	na	MCL-CA	na
Threshold	na	na	na	na	na	na	na	na	na	20,000	na
Grid wells											
CE-QPC-01	-83.80	-11.62	-16.60	110.0	0.560	6.60	3.43	4.46	1.66	34.6	1.9
CE-QPC-02	-68.80	-9.27	nc	nc	nc	nc	nc	nc	nc	nc	nc
CE-QPC-03	-85.50	-11.71	nc	nc	nc	nc	nc	nc	nc	nc	nc
CE-QPC-04	-84.70	-11.56	nc	nc	nc	nc	nc	nc	nc	nc	nc
CE-QPC-05	-69.20	-9.36	nc	nc	nc	nc	nc	nc	nc	nc	nc
CE-QPC-06	-55.40	-7.38	nc	nc	nc	nc	nc	nc	nc	nc	nc
CE-QPC-07	-58.30	-7.65	-16.40	48.73	0.240	4.61	3.71	2.31	6.34	0.0	1.0
CE-QPC-08	-71.40	-9.56	nc	nc	nc	nc	nc	nc	nc	nc	nc
CE-QPC-09	-48.50	-6.46	-17.50	110.3	0.470	4.31	3.86	5.50	5.24	10.6	1.0
MER-01	-71.10	-9.55	nc	nc	nc	nc	nc	nc	nc	nc	nc
MER-02	-78.10	-10.82	-17.80	82.14	0.430	5.00	2.12	5.34	4.82	16.6	1.3
MER-03	-67.00	-9.02	-16.70	34.42	0.260	5.71	3.48	5.79	6.85	5.1	0.6
MER-04	-78.50	-10.52	nc	nc	nc	nc	nc	nc	nc	nc	nc
MER-05	-66.70	-9.09	nc	nc	nc	nc	nc	nc	nc	nc	nc
MER-06	-58.30	-7.69	nc	nc	nc	nc	nc	nc	nc	nc	nc
MER-07	-62.00	-8.36	nc	nc	nc	nc	nc	nc	nc	nc	nc
MER-08	-64.50	-8.72	nc	nc	nc	nc	nc	nc	nc	nc	nc
MER-09	-69.50	-9.42	-14.80	105.2	0.410	4.73	3.71	3.42	3.93	16.6	1.3
MER-10	-70.10	-9.56	-15.20	96.62	0.390	6.62	4.19	4.38	4.63	15.0	1.3
MER-11	-65.70	-8.98	-14.10	94.88	0.400	5.76	6.15	1.16	2.46	15.4	1.0
MER-12	-59.30	-7.86	-11.00	100.8	0.400	9.20	7.58	3.40	6.05	5.1	1.0
MER-13	-59.90	-7.99	nc	nc	nc	nc	nc	nc	nc	nc	nc
MER-14	-64.40	-8.59	nc	nc	nc	nc	nc	nc	nc	nc	nc
MER-15	-86.30	-11.81	nc	nc	nc	nc	nc	nc	nc	nc	nc

Table 14. Results for analyses of stable isotope ratios and carbon-14 and tritium activities in samples collected for the Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.—Continued

[The five-digit code below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Samples from all 78 wells were analyzed for stable isotopes of water; samples from 39 of the slow and intermediate wells were analyzed for tritium, carbon-14, and stable isotope ratios of carbon, nitrate, and sulfate. 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. **GAMA identification no:** CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Threshold type:** MCL-CA, California Department of Public Health maximum contaminant level. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; na, not availabble; nc, sample not collected; nm, not measureable; pCi/L, picocuries per liter; –, not detected]

GAMA Identification No.	$\delta^{2}H$ of water (per mil) (82082)	$\delta^{18}O$ of water (per mil) (82085)	$\delta^{3}C$ of dissolved inorganic carbon (per mil) (82081)	Carbon-14 (percent modern) (49933)	Carbon-14 counting error, water, filtered, percent modern (49934)	$\delta^{15}N$ of nitrate (per mil) (82690)	$\delta^{18}O$ of nitrate (per mil) (63041)	$\delta^{15}S$ of sulfate (per mil) (49932)	$\delta^{18}O$ of sulfate (per mil)	Tritium (pCi/L) (07000)	Tritium 2-sigma combined standard uncertainty (pCi/L) (75985)
Threshold type	na	na	na	na	na	na	na	na	na	MCL-CA	na
Threshold	na	na	na	na	na	na	na	na	na	20,000	na
Grid wells—Continued											
MER-16	-79.00	-10.73	nc	nc	nc	nc	nc	nc	nc	nc	nc
MER-17	-52.40	-6.98	nc	nc	nc	nc	nc	nc	nc	nc	nc
MER-18	-56.70	-7.64	nc	nc	nc	nc	nc	nc	nc	nc	nc
MER-19	-71.40	-9.45	nc	nc	nc	nc	nc	nc	nc	nc	nc
MER-20	-58.80	-7.32	-16.20	26.95	0.190	33.28	22.32	-3.33	8.53	1.6	1.0
MER-21	-57.90	-7.78	-14.90	51.23	0.250	7.77	4.70	1.87	5.41	0.0	0.6
MER-22	-54.90	-7.08	nc	nc	nc	nc	nc	nc	nc	nc	nc
MER-23	-76.94	-10.42	nc	nc	nc	nc	nc	nc	nc	nc	nc
MOD-01	-79.60	-10.79	-15.00	91.40	0.380	7.60	3.75	5.68	3.67	17.9	1.3
MOD-02	-64.08	-8.84	-16.30	96.96	0.410	6.20	1.72	7.67	3.56	12.8	1.3
MOD-03	-79.10	-10.97	nc	nc	nc	nc	nc	nc	nc	nc	nc
MOD-04	-80.30	-11.17	nc	nc	nc	nc	nc	nc	nc	nc	nc
MOD-05	-75.30	-10.31	nc	nc	nc	nc	nc	nc	nc	nc	nc
MOD-06	-73.40	-9.97	nc	nc	nc	nc	nc	nc	nc	nc	nc
MOD-07	-80.00	-10.95	nc	nc	nc	nc	nc	nc	nc	nc	nc
MOD-08	-71.20	-9.50	nc	nc	nc	nc	nc	nc	nc	nc	nc
MOD-09	-82.10	-11.53	-15.40	93.35	0.480	7.15	4.57	3.25	0.68	3.2	1.0
MOD-10	-65.80	-8.62	nc	nc	nc	nc	nc	nc	nc	nc	nc
TRLK-01	-86.70	-11.75	-17.40	13.97	0.180	5.25	1.52	-0.27	2.53	0.0	0.6
TRLK-02	-82.80	-11.25	-14.90	55.39	0.260	6.81	3.75	2.31	2.00	5.4	0.6
TRLK-03	-75.10	-10.00	-19.30	18.96	0.210	4.89	3.55	4.52	3.68	0.0	0.6
TRLK-04	-77.20	-10.50	nc	nc	nc	nc	nc	nc	nc	nc	nc
TRLK-05	-80.10	-10.89	-15.70	26.67	0.240	6.72	4.66	2.14	2.42	1.3	0.6
TRLK-06	-80.80	-10.92	nc	nc	nc	nc	nc	nc	nc	nc	nc

Table 14. Results for analyses of stable isotope ratios and carbon-14 and tritium activities in samples collected for the Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.—Continued

[The five-digit code below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Samples from all 78 wells were analyzed for stable isotopes of water; samples from 39 of the slow and intermediate wells were analyzed for tritium, carbon-14, and stable isotope ratios of carbon, nitrate, and sulfate. 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. **GAMA identification no:** CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Threshold type:** MCL-CA, California Department of Public Health maximum contaminant level. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; na, not availabble; nc, sample not collected; nm, not measureable; pCi/L, picocuries per liter; –, not detected]

GAMA Identification No.	$\delta^{2}H$ of water (per mil) (82082)	$\delta^{18}O$ of water (per mil) (82085)	$\delta^{3}C$ of dissolved inorganic carbon (per mil) (82081)	Carbon-14 (percent modern) (49933)	Carbon-14 counting error, water, filtered, percent modern (49934)	$\delta^{15}N$ of nitrate (per mil) (82690)	$\delta^{18}O$ of nitrate (per mil) (63041)	$\delta^{15}S$ of sulfate (per mil) (49932)	$\delta^{18}O$ of sulfate (per mil)	Tritium (pCi/L) (07000)	Tritium 2-sigma combined standard uncertainty (pCi/L) (75985)
Threshold type	na	na	na	na	na	na	na	na	na	MCL-CA	na
Threshold	na	na	na	na	na	na	na	na	na	20,000	na
Grid wells—Continued											
TRLK-07	-83.90	-11.50	nc	nc	nc	nc	nc	nc	nc	nc	nc
TRLK-08	-88.70	-12.26	nc	nc	nc	nc	nc	nc	nc	nc	nc
TRLK-09	-84.90	-11.62	nc	nc	nc	nc	nc	nc	nc	nc	nc
TRLK-10	-66.00	-8.79	-12.70	90.80	0.480	4.39	1.12	-7.06	6.15	8.0	1.0
TRLK-11	-82.50	-11.24	-15.20	39.35	0.290	6.56	2.01	2.58	2.38	1.6	0.6
TRLK-12	-77.70	-10.10	nc	nc	nc	nc	nc	nc	nc	nc	nc
TRLK-13	-80.00	-10.83	nc	nc	nc	nc	nc	nc	nc	nc	nc
TRLK-14	-77.60	-10.37	nc	nc	nc	nc	nc	nc	nc	nc	nc
TRLK-15	-78.40	-10.50	nc	nc	nc	nc	nc	nc	nc	nc	nc
TRLK-16	-54.90	-7.43	nc	nc	nc	nc	nc	nc	nc	nc	nc

Table 14. Results for analyses of stable isotope ratios and carbon-14 and tritium activities in samples collected for the Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.—Continued

[The five-digit code below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Samples from all 78 wells were analyzed for stable isotopes of water; samples from 39 of the slow and intermediate wells were analyzed for tritium, carbon-14, and stable isotope ratios of carbon, nitrate, and sulfate. 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. **GAMA identification no:** CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Threshold type:** MCL-CA, California Department of Public Health maximum contaminant level. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; na, not availabble; nc, sample not collected; nm, not measureable; pCi/L, picocuries per liter; –, not detected]

GAMA Identification No.	$\delta^{2}H$ of water (per mil) (82082)	$\delta^{18}O$ of water (per mil) (82085)	$\delta^{3}C$ of dissolved inorganic carbon (per mil) (82081)	Carbon-14 (percent modern) (49933)	Carbon-14 counting error, water, filtered, percent modern (49934)	$\delta^{15}N$ of nitrate (per mil) (82690)	$\delta^{18}O$ of nitrate (per mil) (63041)	$\delta^{15}S$ of sulfate (per mil) (49932)	$\delta^{18}O$ of sulfate (per mil)	Tritium (pCi/L) (07000)	Tritium 2-sigma combined standard uncertainty (pCi/L) (75985)
Threshold type	na	na	na	na	na	na	na	na	na	MCL-CA	na
Threshold	na	na	na	na	na	na	na	na	na	20,000	na
Flow-path wells											
CE-QPC-FP01	-75.80	-10.52	nc	nc	nc	nc	nc	nc	nc	nc	nc
MERFP-01	-64.90	-8.46	-12.30	80.24	0.330	nm	nm	3.79	9.07	2.9	1.0
MERFP-02	-59.00	-7.33	-13.10	3.170	0.120	nm	nm	-5.26	10.54	-0.3	1.0
MERMW-01	-76.80	-10.53	-18.90	116.5	0.580	3.56	3.79	4.20	5.42	15.0	1.3
MERMW-02	-82.30	-11.25	-17.80	128.7	0.600	7.55	0.06	5.86	5.09	25.6	1.6
MERMW-03	-77.00	-10.34	-13.70	111.4	0.540	9.79	5.66	5.79	3.27	31.0	1.9
MERMW-04	-70.80	-9.50	-14.40	91.96	0.470	6.73	2.99	2.88	3.51	13.8	1.3
MERMW-05	-55.00	-7.60	-14.10	94.52	0.380	3.20	5.29	4.90	2.61	6.7	1.0
MODFP-01	-69.90	-9.08	-44.50	0.890	0.110	nm	nm	nc	nc	-0.6	0.6
MODFP-02	-73.20	-9.90	-19.10	72.69	0.340	9.32	11.23	5.05	2.93	9.3	1.0
MODFP-03	-81.10	-10.95	-16.10	88.58	0.440	7.43	0.52	11.41	1.19	10.2	1.0
MODFP-04	-70.40	-9.59	-15.50	119.3	0.590	nc	nc	4.65	1.96	34.9	1.9
MODMW-01	-76.40	-10.41	-15.80	122.1	0.570	9.05	2.25	6.49	0.03	29.8	1.9
TRLKFP-01	-74.60	-9.96	-8.48	107.5	0.420	15.71	4.73	2.96	1.99	14.7	1.3
TRLKFP-02	-81.70	-10.92	-15.70	105.8	0.410	11.26	8.88	3.10	3.23	12.2	1.0
TRLKMW-01	-80.10	-10.74	-15.80	67.16	0.330	11.45	10.28	5.77	1.95	2.9	0.6
TRLKMW-02	-80.90	-10.83	-14.10	114.5	0.460	8.57	10.29	5.68	0.92	30.1	1.9
TRLKMW-03	-78.30	-10.76	-16.90	103.0	0.460	5.70	2.93	7.21	4.54	19.5	1.3
TRLKMW-04	-78.60	-10.60	-16.60	99.67	0.440	7.24	2.01	6.49	4.58	17.9	1.3
TRLKMW-05	-68.30	-9.06	-13.10	113.7	0.550	3.61	2.74	8.19	5.67	24.3	1.6

Table 15. Results of analyses for noble gases and dissolved gases in samples collected for the Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.

[The five-digit code below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. **GAMA identification no:** CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Threshold type:** MCL-CA, California Department of Public Health maximum contaminant level. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; na, not available; nc, sample not collected; nr, data not received at time of publication; pCi/L, picocuries per liter; cm^3 STP g^{-1} H_2O, cubic centimeters at standard temperature and pressure per gram of water]

GAMA Identification No.	Collection date	Tritium (pCi/L) (07000)	Tritium measurement uncertainty (+/-) (pCi/L) (07001)	Dissolved gas analysis date	Helium-3/ Helium-4 (atom ratio) (61040)	Noble gases measured with nobel gas mass spectometry					Dissolved gases measured with membrane inlet mass spectrometry		
						Helium-4 (85561)	Neon (61046)	Argon (85563)	Krypton (85565)	Xenon (85567)	Nitrogen	Argon	Methane
						(cm^3 STP g^{-1} H_2O)							
					(× 10^{-6})	(× 10^{-7})	(× 10^{-7})	(× 10^{-4})	(× 10^{-8})	(× 10^{-8})	(× 10^{-2})	(× 10^{-4})	(× 10^{-9})
Threshold type	na	MCL-CA	na	na	na	na	na	na	na	na	na	na	na
Threshold	na	20,000	na	na	na	na	na	na	na	na	na	na	na
Grid wells													
CE-QPC-01	03-20-06	40.1	1.5	04-05-06	3.74	0.60	2.53	3.64	7.77	1.04	1.67	4.08	8.89
CE-QPC-02	03-22-06	8.9	0.4	04-11-06	1.13	2.68	1.91	3.27	7.27	1.01	nc	nc	nc
CE-QPC-03	03-28-06	27.1	1.2	06-08-06	3.30	0.56	2.32	3.62	8.12	1.10	nc	nc	nc
CE-QPC-04	04-06-06	nr	nr	08-15-06	1.34	0.58	2.20	3.30	7.24	0.96	nc	nc	nc
CE-QPC-05	04-19-06	2.7	0.5	08-28-06	2.65	0.81	2.87	3.75	7.74	1.02	nc	nc	nc
CE-QPC-06	04-19-06	nr	0.4	08-29-06	1.08	0.64	1.99	3.12	6.80	0.93	nc	nc	nc
CE-QPC-07	04-20-06	0.3	0.5	07-25-06	0.75	1.26	2.04	3.22	7.11	0.90	1.66	4.08	16.86
CE-QPC-08	05-02-06	nr	0.7	07-25-06	2.07	0.75	2.92	3.77	8.09	1.04	nc	nc	nc
CE-QPC-09	05-03-06	11.3	0.6	08-16-06	1.30	0.71	2.09	3.44	7.85	1.03	1.49	3.83	13.65
MER-01	03-27-06	2.4	0.3	06-21-06	0.30	42.42	2.26	3.55	7.79	1.08	nc	nc	nc
MER-02	03-29-06	17.6	0.8	06-08-06	1.13	2.76	2.28	3.37	7.28	0.94	1.78	3.79	12.78
MER-03	03-30-06	5.8	0.4	06-09-06	0.62	10.82	2.18	3.43	7.51	1.03	1.75	4.23	12.67
MER-04	03-30-06	11.7	0.6	06-08-06	1.51	0.53	2.20	3.30	7.21	0.92	nc	nc	nc
MER-05	04-03-06	1.8	0.2	07-25-06	0.61	4.77	2.15	3.50	7.80	1.05	nc	nc	nc
MER-06	04-06-06	nm	nm	07-27-06	0.64	17.36	2.20	3.38	7.17	0.98	nc	nc	nc
MER-07	04-06-06	nr	nr	07-27-06	1.45	0.93	2.37	0.05	7.53	1.02	nc	nc	nc
MER-08	04-06-06	nr	nr	nr	nm	nm	nm	nm	nm	nm	nc	nc	nc
MER-09	04-10-06	15.8	0.7	08-15-06	1.83	0.93	2.62	3.70	7.76	1.04	1.80	4.11	16.94
MER-10	04-11-06	13.4	0.9	08-15-06	1.84	0.98	2.38	3.61	7.66	1.06	1.80	4.43	13.86
MER-11	04-12-06	15.8	0.7	08-15-06	1.45	1.42	3.22	4.28	8.86	1.17	2.09	4.51	11.26
MER-12	04-13-06	6.5	1.7	08-15-06	1.02	1.70	3.64	4.82	9.99	1.34	2.23	5.05	43.55
MER-13	04-13-06	1.1	0.6	08-16-06	1.23	1.06	3.13	4.11	8.41	1.08	nc	nc	nc
MER-14	04-17-06	3.1	0.4	08-28-06	0.57	24.30	2.16	3.38	7.67	1.02	nc	nc	nc

Table 15. Results of analyses for noble gases and dissolved gases in samples collected for the Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.—Continued

[The five-digit code below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. **GAMA identification no:** CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Threshold type:** MCL-CA, California Department of Public Health maximum contaminant level. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; na, not available; nc, sample not collected; nr, data not received at time of publication; pCi/L, picocuries per liter; cm^3 STP g^{-1} H_2O, cubic centimeters at standard temperature and pressure per gram of water]

GAMA Identification No.	Collection date	Tritium (pCi/L) (07000)	Tritium measurement uncertainty (+/-) (pCi/L) (07001)	Dissolved gas analysis date	Helium-3/ Helium-4 (atom ratio) (61040)	Noble gases measured with nobel gas mass spectometry					Dissolved gases measured with membrane inlet mass spectrometry		
						Helium-4 (85561)	Neon (61046)	Argon (85563)	Krypton (85565)	Xenon (85567)	Nitrogen	Argon	Methane
						(cm^3 STP g^{-1} H_2O)							
					($\times 10^{-6}$)	($\times 10^{-7}$)	($\times 10^{-7}$)	($\times 10^{-4}$)	($\times 10^{-8}$)	($\times 10^{-8}$)	($\times 10^{-2}$)	($\times 10^{-4}$)	($\times 10^{-9}$)
Threshold type	na	MCL-CA	na	na	na	na	na	na	na	na	na	na	na
Threshold	na	20,000	na	na	na	na	na	na	na	na	na	na	na
Grid wells—Continued													
MER-15	04-18-06	27.0	1.1	08-28-06	2.65	0.50	2.10	3.31	7.19	0.99	nc	nc	nc
MER-16	04-18-06	14.9	0.7	08-28-06	0.89	5.98	2.27	3.40	7.39	0.96	nc	nc	nc
MER-17	04-18-06	16.0	0.9	08-28-06	1.40	0.66	2.72	3.76	7.60	1.01	nc	nc	nc
MER-18	04-19-06	1.6	0.3	08-29-06	1.07	0.84	2.72	3.50	7.42	0.97	nc	nc	nc
MER-19	04-20-06	36.5	1.5	08-29-06	1.96	0.59	2.23	3.38	7.39	1.00	nc	nc	nc
MER-20	05-01-06	0.5	0.5	08-31-06	0.47	13.00	10.50	nr	15.20	1.63	4.29	8.69	106.77
MER-21	04-05-06	nc	nc	07-26-06	1.01	0.69	2.04	3.16	7.01	0.93	1.68	3.79	14.43
MER-22	05-02-06	1.8	0.3	08-31-06	0.31	22.2	2.08	2.97	6.66	0.88	nc	nc	nc
MER-23	06-11-06	0.4	0.2	nr	nr	nr	nr	nr	nr	nr	nc	nc	nc
MOD-01	03-13-06	20.2	0.9	06-20-06	0.96	2.43	2.25	3.52	7.76	1.04	1.69	3.86	15.38
MOD-02	03-14-06	15.9	0.7	06-20-06	1.47	1.38	2.29	3.49	7.47	1.00	1.70	3.78	14.95
MOD-03	03-20-06	13.1	0.6	04-06-06	1.26	0.52	2.13	3.62	8.40	1.21	nc	nc	nc
MOD-04	03-20-06	5.0	0.3	04-11-06	1.59	0.70	2.32	3.60	8.13	1.10	nc	nc	nc
MOD-05	03-20-06	15.4	0.7	04-11-06	1.59	1.17	2.23	3.53	8.04	1.08	nc	nc	nc
MOD-06	03-21-06	7.7	0.4	04-11-06	0.96	3.21	2.48	3.59	7.74	1.04	nc	nc	nc
MOD-07	03-21-06	14.7	1.0	04-11-06	0.81	12.43	2.17	3.45	7.77	1.05	nc	nc	nc
MOD-08	03-21-06	17.0	0.7	04-14-06	1.64	1.88	2.40	3.50	7.69	1.05	nc	nc	nc
MOD-09	03-23-06	9.4	0.5	04-13-06	1.67	0.57	2.57	3.79	7.87	1.14	1.74	4.14	14.32
MOD-10	05-03-06	4.8	0.4	07-26-06	1.91	1.08	2.93	4.00	8.33	1.03	nc	nc	nc
TRLK-01	03-15-06	3.2	0.3	05-19-06	0.69	11.97	2.20	3.50	7.78	1.04	1.72	3.71	8.96
TRLK-02	03-16-06	7.5	0.4	06-21-06	0.93	2.31	2.14	3.40	7.44	1.01	1.60	3.72	15.57
TRLK-03	03-21-06	1.2	0.2	04-05-06	0.78	4.40	3.90	5.29	10.90	1.39	nr	nr	nr
TRLK-04	03-22-06	25.6	1.1	04-12-06	1.46	1.61	2.21	3.39	7.45	1.02	nc	nc	nc

Table 15. Results of analyses for noble gases and dissolved gases in samples collected for the Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.—Continued

[The five-digit code below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. **GAMA identification no:** CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Threshold type:** MCL-CA, California Department of Public Health maximum contaminant level. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; na, not available; nc, sample not collected; nr, data not received at time of publication; pCi/L, picocuries per liter; cm^3 STP g^{-1} H_2O, cubic centimeters at standard temperature and pressure per gram of water]

GAMA Identification No.	Collection date	Tritium (pCi/L) (07000)	Tritium measurement uncertainty (+/-) (pCi/L) (07001)	Dissolved gas analysis date	Helium-3/ Helium-4 (atom ratio) (61040)	Noble gases measured with nobel gas mass spectometry					Dissolved gases measured with membrane inlet mass spectrometry		
						Helium-4 (85561)	Neon (61046)	Argon (85563)	Krypton (85565)	Xenon (85567)	Nitrogen	Argon	Methane
						(cm^3 STP g^{-1} H_2O)							
					($\times 10^{-6}$)	($\times 10^{-7}$)	($\times 10^{-7}$)	($\times 10^{-4}$)	($\times 10^{-8}$)	($\times 10^{-8}$)	($\times 10^{-2}$)	($\times 10^{-4}$)	($\times 10^{-9}$)
Threshold type	na	MCL-CA	na	na	na	na	na	na	na	na	na	na	na
Threshold	na	20,000	na	na	na	na	na	na	na	na	na	na	na
Grid wells—Continued													
TRLK-05	03-22-06	1.8	1.2	04-13-06	0.75	4.98	2.26	3.44	7.68	1.02	1.68	3.75	15.52
TRLK-06	03-22-06	29.4	1.1	04-12-06	1.53	1.85	2.96	3.60	7.59	0.99	nc	nc	nc
TRLK-07	03-23-06	17.3	1.3	04-12-06	1.88	0.53	2.35	3.70	8.28	1.09	nc	nc	nc
TRLK-08	03-23-06	14.4	1.0	04-14-06	1.68	0.61	2.57	3.63	7.84	1.01	nc	nc	nc
TRLK-09	03-23-06	12.9	0.7	04-14-06	1.69	0.57	2.40	3.54	7.66	1.03	nc	nc	nc
TRLK-10	03-27-06	10.6	0.5	05-19-06	1.17	1.05	2.37	3.66	8.02	1.08	1.77	4.05	15.68
TRLK-11	03-28-06	2.5	0.3	05-20-06	0.91	1.83	2.25	3.42	7.74	1.02	1.56	3.66	6.84
TRLK-12	04-03-06	19.5	1.9	06-09-06	3.87	0.60	2.27	3.59	7.91	1.02	nc	nc	nc
TRLK-13	04-03-06	40.6	1.8	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
TRLK-14	04-04-06	5.2	2.2	07-26-06	0.61	24.99	2.54	5.08	7.64	1.08	nc	nc	nc
TRLK-15	04-04-06	1.6	0.2	08-31-06	0.65	57.80	3.51	4.45	8.67	1.13	nc	nc	nc
TRLK-16	05-02-06	3.5	0.3	08-30-06	1.39	0.44	1.91	2.95	6.53	0.88	nc	nc	nc

Table 15. Results of analyses for noble gases and dissolved gases in samples collected for the Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.—Continued

[The five-digit code below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. **GAMA identification no:** CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Threshold type:** MCL-CA, California Department of Public Health maximum contaminant level. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; na, not available; nc, sample not collected; nr, data not received at time of publication; pCi/L, picocuries per liter; cm^3 STP g^{-1} H_2O, cubic centimeters at standard temperature and pressure per gram of water]

GAMA Identification No.	Collection date	Tritium (pCi/L) (07000)	Tritium measurement uncertainty (+/-) (pCi/L) (07001)	Dissolved gas analysis date	Helium-3/ Helium-4 (atom ratio) (61040)	Noble gases measured with nobel gas mass spectometry					Dissolved gases measured with membrane inlet mass spectrometry		
						Helium-4 (85561)	Neon (61046)	Argon (85563)	Krypton (85565)	Xenon (85567)	Nitrogen	Argon	Methane
						(cm^3 STP g^{-1} H_2O)							
					($\times 10^{-6}$)	($\times 10^{-7}$)	($\times 10^{-7}$)	($\times 10^{-4}$)	($\times 10^{-8}$)	($\times 10^{-8}$)	($\times 10^{-2}$)	($\times 10^{-4}$)	($\times 10^{-9}$)
Threshold type	na	MCL-CA	na	na	na	na	na	na	na	na	na	na	na
Threshold	na	20,000	na	na	na	na	na	na	na	na	na	na	na
Flow-path wells													
CE-QPC-FP01	05-03-06	5.5	0.4	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
MERFP-01	04-13-06	4.9	0.3	08-15-06	0.89	1.93	3.19	4.45	9.48	1.25	2.23	4.74	19.60
MERFP-02	05-01-06	0.9	0.2	09-14-06	0.86	0.78	2.03	3.22	6.93	0.94	2.29	3.50	17.17
MERMW-01	03-27-06	18.0	0.8	05-19-06	1.58	0.40	1.80	3.14	7.12	0.94	1.54	3.97	15.29
MERMW-02	03-27-06	29.4	1.3	05-19-06	3.41	0.53	2.33	3.47	7.56	1.00	1.65	3.94	16.21
MERMW-03	03-28-06	33.8	1.4	05-19-06	4.77	0.52	2.22	3.54	7.72	0.99	1.75	4.24	12.20
MERMW-04	03-28-06	16.5	0.9	06-08-06	2.02	0.71	2.30	3.52	7.71	0.99	1.73	4.00	10.00
MERMW-05	04-05-06	nr	nr	07-26-06	1.39	0.56	2.41	3.34	6.89	0.88	1.77	3.94	17.22
MODFP-01	03-13-06	1.1	0.7	06-20-06	0.46	79.37	1.98	3.38	7.62	1.16	1.88	2.97	16.90
MODFP-02	03-13-06	11.5	0.6	05-18-06	0.61	12.44	2.19	3.58	7.84	1.05	1.92	3.86	16.84
MODFP-03	03-14-06	12.2	0.9	05-18-06	1.27	0.54	2.04	3.13	6.95	0.90	1.36	3.34	10.69
MODFP-04	03-30-06	32.8	1.9	06-09-06	4.22	0.61	2.64	3.63	7.94	1.04	1.84	4.55	18.38
MODMW-01	03-30-06	28.1	1.1	06-08-06	1.93	0.56	2.48	3.74	7.85	1.01	1.75	4.08	16.25
TRLKFP-01	04-05-06	16.5	0.7	07-26-06	1.46	0.48	2.03	3.25	7.24	0.98	2.45	4.74	33.48
TRLKFP-02	04-05-06	nr	nr	07-26-06	1.50	0.76	2.57	3.56	7.70	1.00	1.96	4.35	17.28
TRLKMW-01	03-15-06	4.3	0.6	06-20-06	0.70	4.62	2.52	3.69	7.86	1.06	1.87	3.97	10.89
TRLKMW-02	03-15-06	28.5	1.1	05-18-06	3.17	0.56	2.39	3.65	7.83	1.06	1.78	3.98	11.54
TRLKMW-03	03-16-06	24.1	1.0	05-19-06	2.76	0.60	2.65	3.80	8.02	1.05	1.81	4.00	18.22
TRLKMW-04	03-16-06	21.6	0.9	05-19-06	2.24	0.57	2.62	3.74	7.92	1.04	1.86	4.09	21.67
TRLKMW-05	03-29-06	24.0	1.0	06-08-06	1.73	0.53	2.23	3.39	7.34	0.95	1.64	3.94	17.53

Table 16. Microbial indicators detected in samples collected for the Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.

[The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. **GAMA identification No**.: CE-QPC, Uplands study area well; MER, Merced study area well; MOD, Modesto study area well; TRLK, Turlock study area well; FP, flow-path well; MW, monitoring well. **Threshold type:** MCL-US, U.S. Environmental Protection Agency maximum contaminant level; TT-US, Environmental Protection Agency treatment technique. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; *E. coli*, *Escheia coli*; mL, milliliter; nr, data not received, sample accidently discarded at lab; –, not detected]

GAMA Identification No.	*E. coli* colonies/ 100 mL (90901)	Total coliforms colonies/ 100 mL (90900)	Male-specific (F+) coliphage (99335)	Somatic coliphage (99332)
Threshold type	TT-US	MCL-US	TT-US	TT-US
Threshold	No fecal coliforms are allowed	5 percent of samples per month	99.9 percent killed/inactive	99.9 percent killed/inactive
Grid wells (samples from 15 of 58 wells were analyzed)				
CE-QPC-01	–	–	–	–
MER-02	–	–	–	–
MER-03	–	–	–	–
MER-09	–	2	–	–
MER-10	–	–	–	–
MER-11	–	–	nr	nr
MOD-01	–	8	–	–
MOD-02	–	–	–	–
MOD-09	–	–	–	–
TRLK-01	–	–	–	–
TRLK-02	–	–	–	–
TRLK-03	–	–	–	–
TRLK-05	–	–	–	–
TRLK-10	–	–	–	–
TRLK-11	–	–	–	–

Appendix

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

Sample Collection and Analysis

Sample Collection

Ground-water samples were collected using standard and modified USGS National Field Manual protocols (Koterba and others, 1995; U.S. Geological Survey, variously dated), and protocols described by Weiss, 1968; Shelton and others, 2001; Ball and McClesky, 2003; and Wright and others, 2005. These sampling protocols ensure that a representative sample of ground water was collected at each site and that the samples were collected and handled in a way that minimized the potential for airborne contamination of samples or cross contamination between samples collected at wells.

Prior to sampling, each well was pumped continuously in order 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. 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 foot length of the Teflon™ tubing (Lane and others, 2003). For monitoring wells, submersible sampling pumps were used to collect water from the wells, following USGS protocols (U.S. Geological Survey, variously dated). 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 multi-probe meter that simultaneously measured dissolved oxygen, temperature, pH, and specific conductance. Field measurements were made in accordance with protocols in the USGS National Field Manual (Wilde and Radtke, 2005; Wilde, 2006; Lewis, 2006; Radtke and others, 2005; Wilde and others, 2006). All sensors on the multi-probe meter were calibrated daily. Measured 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-GAMA, a software package designed by the USGS with support from the GAMA program. Analytical service requests and chain of custody documentation were also managed by PCFF-GAMA. 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 and others, 1999; Wilde and others, 2004). Prior to sample collection, polyethylene sample bottles were pre-rinsed using native water three times before sample 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 the USGS National Water Quality Laboratory (NWQL).

Temperature-sensitive samples were stored on ice prior to daily shipping to the various laboratories. The non-temperature-sensitive samples for tritium, noble gases, chromium speciation and the isotopic composition of oxygen and hydrogen of water, and sulfur and oxygen of sulfate, and uranium were shipped monthly, while volatile organic compounds, pesticides, compounds of special interest, dissolved organic carbon, nutrients, major, minor, and trace elements, nitrogen and oxygen isotopes of nitrate, dissolved gases, 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 (2005) and the USGS National Field Manual (Wilde and others, 1999; Wilde and others, 2004) and in the references for analytical methods listed in table A1; only brief descriptions are given here. Volatile organic compounds (VOCs) and gasoline oxygenates and degradates, 1,2-dibromo-3-chloropropane (DBCP) and 1,2-dibromoethane (EDB), 1,2,3-trichloropropane (1,2,3-TCP), and dissolved gas 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 DBCP and EDB, 1,2,3-TCP, or dissolved gas 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 hydrogen and oxygen in 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 and *N*-nitrosodimethylamine (NDMA) samples were collected in 1-L baked amber glass bottles. Pesticide samples were filtered with glass-fiber filters, whereas the NDMA samples were filtered at the Montgomery Watson-Harza (MWH) 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 and others, 2004). Filtration was done using a Whatman capsule filter. The 250-mL filtered sample then was preserved with 7.5 N nitric acid. Mercury samples were collected by filtering ground water into a 250-mL glass bottle and preserving with 6 N hydrochloric acid. 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 hydrochloric acid. Nutrient samples were filtered into 125-mL brown 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 a 500-mL polyethylene bottle. Samples for analysis of sulfur and oxygen isotopic composition of sulfate were collected by filtering ground water into two 1-L polyethylene bottles. Samples for analysis of nitrogen and oxygen isotopic composition of nitrate were collected by filtering ground water into a 1-L polyethylene bottle.

Dissolved organic carbon (DOC), chromium, radon-222, dissolved gases, and microbial constituents were collected from the hose bib at 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 and others, 2004). Using a 50-mL syringe and 0.45-µm disk filter, each ground-water sample then was filtered into a 125-mL baked glass bottle and preserved with 4.5 N sulfuric acid. Samples for DOC in monitoring wells were collected using disposable Teflon bailers following NAWQA protocols (U.S. Geological Survey, variously dated). Submersible sampling pumps and tubing used to collect samples from monitoring wells could not be used for DOC sample collection because the equipment was cleaned with methanol after sampling each well and residual methanol from cleaning has been shown to bias DOC samples. 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 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, 2003).

For the collection of radon-222, a stainless-steel and Teflon valve assembly was attached to the sampling port at the well head (Wilde and others, 2004). The valve was partially closed to create back pressure, and a 10-mL sample was taken through a Teflon septum on the valve 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 in order 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 following protocols described in Myers (2004) and Bushon (2003). 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. Two sterilized 250-mL bottles were then filled with ground water for coliform analyses (total and Escherichia coliform determinations), and one sterilized 3-liter carboy was filled for coliphage analyses (F specific and somatic coliphage determinations).

Sample Analysis

Ten laboratories performed chemical and microbial analyses for this study (see table A1). Most of the analyses were performed at the NWQL or by laboratories contracted by the NWQL. The NWQL maintains a rigorous quality-assurance program (Maloney, 2005). Laboratory quality-control 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/Performance/publiclabcertcoverpage.html). In addition, the Branch of Quality Systems within the USGS Office of Water Quality maintains independent oversight of quality assurance at the NWQL and laboratories contracted by the NWQL. The Branch of Quality Systems also runs a National Field Quality Assurance program that includes annual testing of all USGS field personnel for proficiency in making field water-quality measurements (http://nfqa.cr.usgs.gov/). Results for

analyses made at the NWQL or by laboratories contracted by the NWQL are uploaded directly into NWIS by the NWQL. Laboratory quality-control data are also stored in NWIS.

Turbidity, alkalinity, and total coliforms and *Escherichia coliform* (*E. coli*) were measured in the mobile laboratory at the well site. Alkalinity and the concentrations of bicarbonate (HCO_3^-) and carbonate (CO_3^{2-}) were measured on filtered samples by Gran's titration method (Rounds, 2006). Turbidity was measured in the field with a calibrated turbidity meter. 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 22–24 hour incubation time.

Data Reporting

Laboratory Reporting Conventions

The USGS NWQL uses the laboratory reporting level (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 MDL there is less than 1 percent chance of a false positive) (U.S. Environmental Protection Agency, 2002a). The USGS NWQL updates LRL values regularly, and the values listed in this report were in effect during the period that analyses were made for ground-water samples from the CESJO study (March to June, 2006).

Detections between the LRL and the LT-MDL are reported as estimated concentrations (designated with an "E" before the values in the tables and text). For information-rich methods, detections below the LRL 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, pesticides). 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 quality-control criteria, and for samples that were diluted prior to analysis (Childress and others, 1999).

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

Detections that could have resulted from sample contamination are reported with a "V" before the values in the tables). The potential for sample contamination was assessed using results from field, source-solution, and laboratory blanks.

The reporting levels for radiochemical constituents (gross-alpha radioactivity, gross-beta radioactivity, radium-226, radium-228, uranium-234, uranium-235, and uranium-238) are based on a sample-specific critical value, a combined standard uncertainty (CSU), and a sample-specific minimum detectable concentration (SSMDC)(U.S. Environmental Protection Agency, 2004; Bennett and others, 2006). 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. If the raw analytical result was less than the critical value (case 1), the analyte was considered "not detected", and the concentration was reported on table 12 as less than the SSMDC. If the analytical result was greater than the critical value, the ratio of the CSU to the analytical result is calculated as a percent (percent relative CSU). For those samples with percent relative CSU greater than 20 percent, concentrations are reported as "estimated" values (designated by an "E" preceding the value on table 12) (case 2). For those samples that have a relative CSU less than 20 percent, concentrations are reported on table 12 with no qualifiers (case 3).

Scenario	Critical Value (pCi/L)	SSMDC (pCi/L)	Combined standard uncertainty (pCi/L)	Relative CSU (percent)	Raw result (pCi/L)	Reported result (pCi/L)
Case 1 – Result less than critical value	1.4	3.2	±1.2	133	0.9	<3.2
Case 2 – Relative combined standard uncertainty greater than 20 percent	0.5	1.4	±0.6	32	2.0	E2.0
Case 3 – Relative combined standard uncertainty less than 20 percent	0.4	1.1	±0.5	14	3.2	3.2

Stable isotopic compositions of oxygen and hydrogen of water, nitrogen and oxygen of dissolved nitrate, sulfur and oxygen of dissolved sulfate and carbon of dissolved inorganic carbon are reported as relative isotope ratios in units of per mil using the standard delta notation (Coplen and others, 2002):

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

where

^{i}E is the heavier isotope (oxygen-18, nitrogen-15, sulfur-34, carbon-13, or hydrogen-2),

R_{sample} is the ratio of the abundance of the heavier isotope to the lighter isotope (oxygen-16, nitrogen-14, sulfur-32, carbon-12, or hydrogen-1) in the sample, and

$R_{reference}$ is the ratio of the abundance of the heavier isotope to the lighter isotope (oxygen-16, nitrogen-14, sulfur-32, carbon-12, or hydrogen-1) 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) (Coplen, 1994). The reference material for carbon is Vienna Peedee Belemnite (VPDB), which is assigned a $\delta^{13}C$ value of 0 per mil (Coplen, 1994). The reference material for sulfur is Vienna Canon Diablo Troilite (VCDT), which is assigned a $\delta^{34}S$ value of 0 per mil (Coplen and Krouse, 1998). The reference material for nitrogen is nitrogen gas in atmospheric air, which is assigned a $\delta^{15}N$ value of 0 per mil (Kendall, 1998; Singleton and others, 2005). Positive values indicate enrichment of the heavier isotope and negative values indicate depletion of the heavier isotope, compared to the ratios observed in the standard reference material.

Constituents on Multiple Analytical Schedules

Seventeen constituents targeted in this study were determined by more than one analytical schedule or more than one laboratory (table A2). Results from certain analytical schedules are preferred over others because the methodology is more accurate or precise and generally yields greater sensitivity for a given compound. The preferred method for constituents analyzed at USGS laboratories was selected based on the procedure recommended by the NWQL (http://wwwnwql.cr.usgs.gov/USGS/Preferred_method_selection_procedure.html). Similarly, for constituents analyzed by more than one laboratory, the method with the lower reporting level is the preferred method for this report. If a VOC, gasoline oxygenate, or pesticide constituent appears on multiple NWQL analytical schedules, then only the measurement determined by the preferred method is reported. For arsenic, chromium, and iron concentrations, the standard method used by the NWQL is preferred over the research method used by the USGS Trace Metal Laboratory, although both are reported. Similarly, tritium results from both the USGS Stable Isotope and Tritium Laboratory and LLNL are reported even though the LLNL method is the preferred method.

Argon gas concentrations were analyzed using noble gas mass spectrometry (Clarke and others, 1976; Moran and others, 2002) and as part of a dissolved gas analysis (nitrogen, argon, and methane) using Membrane Inlet Mass Spectrometry (MIMS) (Singleton and Hudson, 2005; Singleton and others, 2007) (table A1). The noble gas mass spectrometry measurement of argon is typically more accurate for argon concentrations than the MIMS analysis and is the preferred method (Michael J. Singleton, Lawrence Livermore National Laboratory, written commun., September 6, 2006). However, since nitrogen gas concentrations are measured with MIMS, argon concentrations measured with MIMS are used, for the sake of consistency of analytical and sample collection conditions, for interpretations of excess nitrogen gas that may indicate whether reactions affecting nitrate concentrations and producing nitrogen gas, such as denitrification, may be occurring in the aquifer. Consequently, both argon concentrations determined using noble gas spectrometry and MIMS are reported in table 15. Interpreted quantities of excess nitrogen gas data are not presented in this report.

Quality-Assurance Methods

The quality-assurance methods used for this study follow protocols described in the USGS National Field Manual (U.S. Geological Survey, variously dated), protocols used by the USGS NAWQA program (Koterba and others, 1995), and the NWQL quality-assurance plan (Maloney, 2005). Quality-control (QC) samples were collected concurrently with approximately 17 percent of samples in the CESJO study to assess the bias and variability of water-quality data potentially introduced during sample collection, processing, storage, transportation, and laboratory analysis, as well as intrinsic variability within the ground water itself. Four types of QC samples were collected and analyzed: blanks, field replicates, laboratory surrogates, and laboratory matrix spikes.

Blanks

Blank samples (blanks) were collected using water (nitrogen-purged blank water) certified by the NWQL to contain less than the LRL or MRL of the organic and inorganic analytes investigated in the study. 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 of interest. Field and source-solution blanks were collected at 8 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, perchlorate, NDMA, 1,2,3-TCP, nutrients, dissolved organic carbon, major and minor ions, trace elements, iron, arsenic, and chromium speciation, and radioactive constituents.

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. For field blanks, blank water was either pumped or poured through the sampling equipment (fittings and tubing) used to collect ground water, then processed and transported using the same protocols for the ground-water samples.

If a constituent was detected in a field blank, the associated source-solution blank results were examined for similar constituent detections. If the field blank and the source-solution blank contained the same constituent(s), then the source-solution water was interpreted as the origin of the contamination in the blanks, and any field-blank detections originating from the same blank water were disregarded as having any affect on the environmental samples. If a field blank detection could not be attributed to the source solution, then the ground-water samples collected prior to, and following the blank were evaluated. If the ground-water samples prior to, or following the contaminated field blank had no detections, then carry-over contamination was ruled out. If the concentration of an analyte detected in a field blank was greater than the concentration measured in a ground-water sample collected prior to or following the blank sample, then the ground-water value was censored (table A3). Censored values are indicated by a ‘V’ preceding the value in the tables, and are excluded from the summary statistics. If a compound was detected in multiple field blanks, and the detections could not be attributed to the source-solution water, then any ground-water sample that had a detection of the compound in question was evaluated for possible bias due to contamination.

Field blanks were not collected for noble gases, dissolved gases, carbon-14, stable isotopes, tritium, and uranium isotopes, as described below. Noble gases, dissolved gases, carbon-14 (in atmospheric carbon dioxide), and tritium are present in the atmosphere and would dissolve into any solution used in collecting a blank, making it impractical to collect a field blank for these analytes. An indirect indicator of the quality of sampling data is that for tritium, activities are expected to be less than 3 pCi/L in water recharged prior to the 1950s. The presence of tritium below the MRL of 1 pCi/L in 6 of 39 samples (table 14) collected implies that the sampling methods did not bias the sampling results for tritium. Stable-isotopic ratios of oxygen, hydrogen, carbon, sulfur, and nitrogen are an intrinsic property of any of these elements and the concept of a blank does not apply to these ratios, which always have values as long as the element is present and cannot be measured if the element is absent. Field blanks for uranium isotopes were not collected. However, field blanks analyzed for inorganic constituents indicated that dissolved uranium was not detected above the reporting level of 0.04 micrograms per liter. The sum of concentrations of individual uranium isotopes (uranium-234, -235, and -238) (converted to micrograms per liter) were highly correlated

with concentrations of dissolved uranium, implying that if dissolved uranium was below detection in field blanks, a similar result would be expected for individual uranium isotopes.

Replicates

Sequential replicate samples were collected to assess variability that may result from the processing and analyses of inorganic and organic constituents. Relative standard deviation (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 non-detection and the other value was reported as an estimate 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 non-detection and the other value was greater than the LRL or MRL, then the non-detection 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 5 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 known compounds added in 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 low recovery could falsely indicate a concentration below the MCL. 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 oxygenates and their degradates; Connor and others, 1998; Rose and Sandstrom, 2003; Zaugg and others, 2002), 60 to 120 percent for NWQL schedules 2003 and 2060 (and pesticides; Sandstrom and others, 2001; Furlong and others, 2001). Based on these ranges, we defined 70 to 130 percent as the acceptable range for matrix-spike recoveries for organic compounds in this study.

Matrix spikes were done for VOCs, gasoline oxygenates and their degradates, pesticide compounds, NDMA, and 1,2,3-TCP because the analytical methods for these constituents are chromatographic methods which may be susceptible to matrix interferences. Replicate samples for matrix spike additions were collected at 5 percent of the wells sampled, although not all analyte classes were tested at every well (table A5).

Surrogates

Surrogate compounds are added to environmental samples in the laboratory prior to analysis in order to evaluate the recovery of similar constituents. Surrogate compounds were added to all of the ground-water and quality-control 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-d8 used for 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-d8 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-d8 surrogate does not interfere with the analysis of toluene (Grob, 1995). Only 0.015 percent of hydrogen atoms are deuterium (Firestone and others, 1996), thus deuterated compounds like toluene-d8 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 due 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 (table A6) (Connor and others, 1998; Sandstrom and others, 2001).

Quality-Control Sample Results

Detections in Field and Source-Solution Blanks

Table A3 presents a summary of detections in field blanks. Eight VOCs were detected in one to two of the six field blanks analyzed for VOCs. For all of these VOCs except chloroform, environmental samples collected prior to and following these field blanks were free from these constituents, hence no ground-water sample detections were censored as a result of these blank detections. Considerable flushing of the sampling equipment occurs during purging of each well, which greatly reduces the potential for carry-over of contaminants from tainted blank water or from previous wells into ground-water samples. For chloroform, concentrations in five environmental samples collected with the same sampling equipment had concentrations less than or equal to the concentration in the field blank. Consequently, concentrations of chloroform in these five environmental samples were censored and these data were not used for summary statistical calculations (table 5). Censored values are preceded by a V in table 5.

The pesticide simazine was detected in one of six field blanks, with a maximum concentration of E 0.004 µg/L. Ground-water samples collected with the same sampling equipment during the week of the blank detection either had no detection of simazine or had a concentration more than twice as large as that detected in the field blank. As a result, no environmental concentrations of simazine were censored.

There were detections of DOC in three out of three blanks, with a maximum concentration of 2.6 mg/L. As a result, sixteen ground-water detections for DOC out of 32 samples analyzed were censored (table 8). Low concentrations of DOC were detected in field blanks collected in previous GAMA study units (Kulongoski and Belitz, 2007; Bennett and others, 2006).

Two major ions were detected in field blanks, calcium and magnesium. Environmental samples had detections of calcium and magnesium greater than 300-times larger than values in blanks; hence, no ground-water detections were censored.

Six trace elements analyzed at NWQL were detected in field blanks: chromium, copper, lead, thallium, tungsten, and zinc. As a result of the blank detections, 32 detections in ground-water samples were censored following the procedures described earlier (see Blanks), including 3 chromium, 6 zinc, 9 lead, and 14 tungsten values (table 10).

In samples analyzed at the USGS Trace Metal Laboratory (TML), iron (total) was detected in two field blanks. Four detections of iron (total) in ground-water samples analyzed by the TML were censored (table 11). However, measurements of iron (total) from the NWQL were preferred over measurements at the TML (table A2), so this censoring did not affect interpretations of environmental concentrations.

Radium-226 and radium-228 were detected in one of two field blanks, with maximum concentrations of 0.014 pCi/L and 0.28 pCi/L, respectively. Environmental samples collected prior to and following these field blanks had concentrations greater than these blank detections; hence, no ground-water sample detections were censored as a result of these blank detections. No other radioactive constituents were detected in the two field blanks collected.

No compounds were detected in field blanks for the following analyte groups: perchlorate (six field blanks, 1,2,3-TCP and NDMA (two field blanks), and nutrients (four field blanks).

Variability in Replicate Samples

Table A4 summarizes the results of replicate analyses for constituents detected in ground-water samples collected in the CESJO study. Replicate analyses that were non-detections are not reported in table A4. Concentrations or activities in the environmental and replicate samples are reported for all replicate analyses with RSD values greater than 20 percent. The majority of replicate sample pairs collected during the Central Eastside study had RSDs of less than 20 percent. Nine replicate sample pairs representing 8 minor and trace elements, one replicate sample pair for 72-hour beta radioactivity, 2 replicate sample pairs for uranium-235, and 1 replicate pair for uranium-238 had RSDs greater than 20 percent. The magnitudes of the concentrations of the replicate sample pairs with RSD values greater than 20 percent were within a factor of 10 of the LRLs for fluoride, chromium (NWQL and TML), 72-hour gross beta radioactivity, uranium-235, and uranium-238, and one of the replicate pairs for zinc. At these low concentrations, small deviations in measured values result in large RSDs. Copper, iron, lead, nickel and zinc each had one replicate pair where the RSDs were greater than 20 percent and concentrations exceeded the LRL by a factor of more than 10. The relatively high variabilities and high concentrations for these five constituents all occurred in the same replicate pair sample. The cause of these results within a single sample pair is unknown. However, these five metals (also chromium) are commonly used in metal pipe fittings and can be introduced to samples from abrasion, corrosion, or rust of the fittings used in the hook-up to the well or in the well itself. Vibration or water movement can mobilize corroded material in a manner that introduces variability in the concentrations. Bias from this process would be in the positive direction, so the lower of the 2 replicate values is likely to be the more accurate value. No data were censored as a result of variability in replicate analyses.

Matrix-Spike Recoveries

Table A5 presents a summary of matrix-spike recoveries for the CESJO study. 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. Four environmental samples were spiked with VOCs, two with gasoline oxygenates, two with NDMA, and one with 1,2,3-TCP to calculate matrix-spike recoveries (table A5A). All but five of the 88 VOCs and gasoline oxygenates and their degradates, compounds, plus the 2 constituents of special interest (NDMA and 1,2,3-TCP), had matrix-spike recoveries within the acceptable range of 70 to 130 percent. Three VOCs (chloromethane, methyl bromide, and vinyl bromide) had at least one matrix-spike recovery greater than 130 percent. Of these compounds, only chloromethane was detected in ground-water samples (in 1 of 78 samples). Methyl iodide and dichlorodifluoromethane (CFC-12) were the only VOCs that had matrix-spike recoveries below 70 percent. Methyl iodide had one spike recovery below 70 percent and was not detected in ground-water samples. CFC-12 had three spike recoveries below 70 percent (58 to 66 percent) and was detected in three ground-water samples. Low matrix-spike recoveries may indicate that a compound might not have been detected in some samples if it was present at very low concentrations.

Four ground-water samples analyzed for schedule 2003 (table 3D) were spiked with pesticide and pesticide degradate compounds in order to calculate matrix spike recoveries. Thirty-five of the sixty-one compounds on schedule 2003 had matrix-spike recoveries within the acceptable range of 70 through 130 percent (table A5B). Three schedule 2003 compounds had at least 1 matrix-spike recovery greater than 130 percent; these compounds were not detected in ground-water samples. Twenty-four schedule 2003 compounds had at least one matrix spike recovery (minimum recovery) below 70 percent. Of these 24 compounds, one (deethylatrazine) was detected in ground-water samples. Low recoveries may indicate that the compound might not have been detected in some samples if it was present at very low concentrations.

Two environmental samples analyzed for polar pesticides and their degradates using NWQL schedule 2060 (table 3E) were spiked in order to calculate matrix-spike recoveries. Thirty-eight of the fifty-four compounds on schedule 2060 had matrix-spike recoveries within the acceptable range of 70 through 130 percent (table A5B). Eleven schedule 2060 compounds had at least 1 spike recovery greater than 130 percent; however, none of these compounds was detected in ground-water samples. Five schedule 2060 compounds had at least one spike recovery below 70 percent. Of these five compounds, one (deisopropylatrazine) was detected in ground-water samples. Low recoveries may indicate that the compound might not have been detected in some samples if it was present at very low concentrations.

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(s) on which it was applied, the number of analyses for blanks and environmental samples, the median recovery for each surrogate, 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 environmental samples affect surrogate recoveries. No systematic differences between surrogate recoveries in blanks and environmental samples were observed. Greater than 95 percent of the blanks and environmental samples had surrogate recoveries between the acceptable limit of 70 and 130 percent.

One environmental sample with a detection of a VOC had a recovery of the surrogate 1,2-dichloroethane-d4 greater than 130 percent. The VOC detected in this sample (carbon disulfide) elutes near 1,2-dichloroethane-d4 in the chromatographic sequence. A high recovery for a surrogate suggests that measured concentrations of analytes eluting near the surrogate may be biased towards higher concentrations. This detection of carbon sulfide already had an ‘E” code, thus no additional flagging was needed.

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

[**Abbreviations:** USGS, U.S. Geological Survey; MI agar, supplemented nutrient agar in which coliforms (total and *Escherichia*) produce distinctly different fluorescence under ultraviolet lighting; UV, ultraviolet; VOCs, volatile organic compounds; δ, delta notation expressed as per mil]

Analyte	Analytical method	Laboratory and analytical schedule	Citation(s)
		Water-quality indicators	
Field parameters		USGS field measurement	U.S. Geological Survey, variously dated
		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 and pesticide degradates	Solid-phase extraction and chromatography-mass spectrometry	NWQL, schedules 2003, 2060	Zaugg and others, 1995; Lindley and others, 1996; Furlong and others, 2001; Sandstrom and others, 2001; Madsen and others, 2003
		Constituents of special interest	
Perchlorate	Chromatography and mass spectrometry	Montgomery Watson Harza Laboratory	Hautman and others, 1999
N-nitrosodimethylamine (NDMA)	Chromatography and mass spectrometry	Montgomery Watson Harza Laboratory	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	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	Ultraviolet-promoted persulfate oxidation and infrared spectrometry	NWQL, schedule 2612	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	Fishman and Friedman, 1989; Fishman, 1993; Faires, 1993; McLain, 1993; American Public Health Association, 1998; Garbarino, 1999; Garbarino and Damrau, 2001; Garbarino and others, 2006
Chromium, arsenic, and iron speciation	Various techniques of ultraviolet visible spectrophotometry and atomic absorbance spectroscopy	USGS National Research Program Trace Metal Laboratory, Boulder, Colorado	Stookey, 1970; To and others, 1998; Ball and McCleskey, 2003; McCleskey and others, 2003

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

[**Abbreviations:** USGS, U.S. Geological Survey; MI agar, supplemented nutrient agar in which coliforms (total and *Escherichia*) produce distinctly different fluorescence under ultraviolet lighting; UV, ultraviolet; VOCs, volatile organic compounds; δ, delta notation expressed as per mil]

Analyte	Analytical method	Laboratory and analytical schedule	Citation(s)
		Stable isotopes	
Stable isotopes of water: $\delta^{2}H$ and $\delta^{18}O$	Gaseous hydrogen and carbon dioxide-water equilibration and stable-isotope mass spectrometry	USGS Stable Isotope Laboratory, Reston, Virginia	Epstein and Mayeda, 1953; Coplen and others, 1991 ; Coplen, 1994
Carbon isotopes: $\delta^{13}C$ of dissolved inorganic carbon	Accelerator mass spectrometry	University of Waterloo, Environmental Isotope Laboratory; University of Arizona Accelerator Mass Spectrometry Laboratory	Donahue and others, 1990; Jull and others, 2004
Nitrogen and oxygen isotopes of nitrate: $\delta^{15}N$-NO3 and $\delta^{18}O$-NO_3	Denitrifier method and mass spectrometry	Lawrence Livermore National Laboratory	Singleton and others, 2005
Sulfur and oxygen isotopes of sulfate: $\delta^{34}S$-SO_4 and $\delta 1^{8}O$-SO_4	Barium sulfate precipitation with continuous flow isotope ratio mass spectrometry	USGS Stable Isotope Laboratory, Reston, Virginia	Carmody and others, 1997; Böhlke and others, 2003
		Radioactivity and gases	
Tritium	Electrolytic enrichment-liquid scintillation	USGS Stable Isotope and Tritium Laboratory, Menlo Park, California	Thatcher and others, 1977
Tritium and noble gases	Helium-3 in-growth and mass spectrometry	Lawrence Livermore National Laboratory	Clarke and others, 1976; Moran and others, 2002; Eaton and others, 2004
Dissolved gases: nitrogen, argon, and methane	Membrane Inlet Mass Spectrometry	Lawrence Livermore National Laboratory	Singleton and Hudson, 2005; Singleton and others, 2007
Radon-222	Liquid scintillation counting	NWQL, schedule 1369	American Society for Testing and Materials, 1998
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)
Uranium isotopes: $\delta^{234}U$, $\delta^{235}U$, and $\delta^{238}U$	Alpha-particle spectrometry	Eberline Analytical Services, NWQL method 1130	American Society for Testing and Materials, D 3972
		Microbial constituents	
Total and Escherichia coliform	Membrane filter technique with "MI agar", colony counting	USGS field measurement	U.S. Environmental Protection Agency, 2002b
Male-specific (F^{+}) and somatic coliphage	Single-agar layer and two-step enrichment methods	USGS Ohio Water Microbiology Laboratory	U.S. Environmental Protection Agency, 2001

Table A2. Preferred analytical schedules for constituents appearing on multiple schedules for the Cental Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 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. **Abbreviations:** LLNL, Lawrence Livermore National Laboratory; MWH, Montgomery Watson-Harza Laboratory; SITL, U.S. Geological Survey Stable Isotope and Tritium Laboratory; TML, U.S. Geological Survey Trace Metal Laboratory; VOC, volatile organic compound; MIMS, Membrane Inlet Mass Spectrometry]

Constituent	Primary constituent classification	Analytical schedules/ methods	Preferred analytical schedule
Results from preferred method reported			
1,2-Dibromo-3-chloropropane (DBCP)	Fumigant	1306, 2020	1306
1,2-Dibromoethane (EDB)	Fumigant	1306, 2020	1306
Acetone	VOC	2020, 4024	2020
Argon	Noble gas	LLNL Noble gas mass spectrometry,dissolved gas (MIMS)	Noble gas
Atrazine	Pesticide	2003, 2060	2003
Carbaryl	Pesticide	2003, 2060	2003
Deethylatrazine (2-Chloro-4-isopropylamino-6-amino-*s*-triazine)	Pesticide degradate	2003, 2060	2003
Diisopropyl ether	Gasoline oxygenate	2020, 4024	2020
Ethyl *tert*-butyl ether (ETBE)	Gasoline oxygenate	2020, 4024	2020
Metalaxyl	Pesticide	2003, 2060	2060
Methyl *tert*-butyl ether (MTBE)	Gasoline oxygenate	2020, 4024	2020
Methyl *tert*-pentyl ether	Gasoline oxygenate	2020, 4024	2020
Results from both methods reported			
Argon	Noble gas	LLNL Noble gas mass spectrometry,dissolved gas (MIMS)	Noble gas
1,2,3-Trichloropropane (1,2,3-TCP)	VOC	2020, MHW	MWH
Total arsenic	Trace element	1948, TML	1948
Total chromium	Trace element	1948, TML	1948
Total iron	Trace element	1948, TML	1948
Tritium	Isotope	Ingrowth, counting	Ingrowth

Table A3. Constituents detected in field blanks collected for the Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.

[Censored data are reported but not used in summary statistics. **Abbreviations:** E, estimated value; pCi/L, picocuries per liter; µg/L, micrograms per liter; mg/L, milligrams per liter; –, not detected]

Constituent	Number of field blank detections/analyses	Maximum concentration detected in field blank samples	Minimum concentration detected in ground-water samples	Number of ground-water samples censored
Volatile organic compounds and gasoline oxygenates and their degradates (µg/L)				
Acetone	1/6	29	–	0
2-Butanone (methyl ethyl ketone)	2/6	124	–	0
Chloroform (trichloromethane)	1/6	E 0.05	E 0.01	5
Ethylbenzene	1/6	E 0.02	E 0.08	0
Tetrahydrofuran	1/6	3	–	0
Toluene	1/6	E 0.01	E 0.01	0
m- and *p*-Xylene	1/6	E 0.07	E 0.07	0
o-Xylene	1/6	E 0.04	–	0
Pesticides and (or) pesticide degradates (µg/L)				
Simazine	1/6	E 0.004	E 0.003	0
Nutrients and dissolved organic carbon (mg/L)				
Dissolved organic carbon (DOC)	3/3	2.6	E 0.3	16
Major and minor ions (mg/L)				
Calcium	2/4	0.02	7.5	0
Magnesium	1/4	.009	2.8	0
Trace elements (µg/L)				
Chromium	2/4	0.09	0.04	3
Copper	1/4	E 0.2	E 0.3	0
Iron (TML)[1]	2/4	11	2	4
Lead	2/4	E 0.05	E 0.04	9
Thallium	1/4	E 0.02	E 0.03	0
Tungsten	1/4	0.22	0.04	14
Zinc	1/4	E 0.5	E 0.3	6
Radioactivity (pCi/L)				
Radium-226	1/2	0.014	0.015	0
Radium-228	1/2	0.28	0.26	0

[1]Iron analyses made by U.S. Geological Survey Trace Metal Laboratory.

Table A4. Quality-control summary for replicate analyses of constituents detected in samples collected for the Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California, March to June 2006.

[**Abbreviations:** E, estimated value; *E. coli*, *Escherichia coli;* RSD, relative standard deviation in percent; TU, tritium unit; VOCs, volatile organic compounds; <, less than; mg/L, milligram per liter; µg/L, microgram per liter; pCi/L, picocurie per liter; na, not available]

Constituent	Number of relative standard deviations greater than 20 percent/ number of replicate pairs	Maximum relative standard deviation (percent)	Measured values for pairs with RSD greater than zero (environmental, replicate)
Volatile organic compounds, gasoline oxygenates, and additives from schedules 2020 and 4204			
All VOCs from schedule 2020 and 4024	0/4	<20	na
Pesticides and pesticide degradates from schedules 2003 and 2060			
All additional pesticides and pesticide degradates from schedule 2003	0/3	<20	na
All additional pesticides and pesticide degradates from schedule 2060	0/2	<20	na
Constituents of special interest[1]			
Perchlorate	0/4	<20	na
1,2,3-Trichloropropane, and N-Nitrosodimethylamine	0/2	<20	na
Major ions, minor ions, trace elements, nutrients, arsenic, chromium, and iron speciation			
Fluoride (mg/L)	1/4	47	(0.2, 0.1)
Chromium (µg/L)	1/4	79	(0.06, 0.21)
Copper (µg/L)	1/4	34	(4.4, 2.7)
Iron (µg/L)	1/4	57	(101, 43)
Lead (µg/L)	1/4	101	(56.8, 21.3)
Nickel (µg/L)	1/4	21	(0.58, 0.43)
Zinc (µg/L)	2/4	45	(14.7, 7.6); (0.7, 1.2)
Chromium [5] (total) (µg/L)	1/3	35	(3, 5)
Arsenic (total), arsenic(III), iron(total), iron(III), chromium(VI) (µg/L)	0/3	<20	na
Nutrients from schedule 2755	0/3	<20	na
All additional major ions, minor ions, trace elements from schedule 1948, and dissolved organic carbon from lab code 2613	0/4	<20	na
Isotopes, radioactivity, and noble gases			
[2]Radium-226 (pCi/L)	0/2	<20	na
[2]Radium-228 (pCi/L)	0/2	<20	na
[3]Tritium (TU) and noble gases	0/6	<20	na
[4]Tritium (TU)	0/3	<20	na
[2]Gross alpha radioactivity, 72-hour count (pCi/L)	0/2	<20	na
[2]Gross beta radioactivity, 72-hour count (pCi/L)	1/2	28	(6.6, E 5.0)
[2]Gross alpha radioactivity, 30-day count (pCi/L)	0/2	<20	na
[2]Gross beta radioactivity, 30-day count (pCi/L)	0/2	<20	na
[2]Uranium-234 (pCi/L)	0/4	<20	na
[2]Uranium-235 (pCi/L)	2/4	74	(0.013, 0.004); (0.147,0.235)
[2]Uranium-238 (pCi/L)	1/4	39	(0.177, 0.100)
Oxygen, hydrogen, and carbon isotopes	0/3	<20	na
Radon; sulfur and oxygen isotopes of sulfate	0/2	<20	na
Microbial indicators			
F-specific and somatic coliphage	0/1	<20	na
E. coli and total coliforms	0/15	< 20	na

[1]Analyses performed at Montgomery Watson Harza Laboratories, Monrovia, California.
[2]Analyses performed at Eberline Analyltical Services, Richmond, California.
[3]Analyses performed at Lawrence Livermore National Laboratory, Livermore, California.
[4]Analyses performed at U.S. Geological Survey, Menlo Park, California.
[5]Analyses performed at U.S. Geological Survey Trace Metal Laboratory, Boulder, Colorado.

Table A5A. Quality-control summary of matrix-spike recoveries of volatile organic compounds, gasoline oxygenates and their degradates, *N*-nitrosodimethylamine, and 1,2,3-trichloropropane in samples collected for the Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California March to June 2006.

[Acceptable recovery range is between 70 and 130 percent, bold values indicate those outside of acceptable recovery range]

Constituent (common name)	Number of spiked samples	Recovery (percent)		
		Minimum	Maximum	Median
Acetone[3]	4	100	120	110
Acrylonitrile	4	97	117	102
Benzene[1]	4	102	116	105
Bromobenzene	4	92	103	96
Bromochloromethane[1]	4	102	117	110
Bromodichloromethane[1]	4	96	113	100
Bromoform (tribromomethane)[1]	4	94	111	103
2-Butanone (MEK, Methyl ethyl ketone)	4	93	114	101
n-Butylbenzene	4	77	88	82
sec-Butylbenzene	4	89	104	95
tert-Butylbenzene	4	105	116	110
Carbon disulfide[1]	4	75	88	78
Carbon tetrachloride (Tetrachloromethane)[1]	4	96	116	104
Chlorobenzene	4	94	104	96
Chloroethane	4	80	120	88
Chloroform (Trichloromethane)[1]	4	100	118	110
Chloromethane[1]	4	81	**139**	97
3-Chloropropene	4	94	119	104
2-Chlorotoluene	4	98	110	103
4-Chlorotoluene	4	95	105	99
Dibromochloromethane[1]	4	95	109	101
1,2-Dibromo-3-chloropropane (DBCP)[1]	4	98	122	117
1,2-Dibromoethane (EDB)	4	98	109	100
Dibromomethane[1]	4	94	106	101
1,2-Dichlorobenzene	4	96	111	107
1,3-Dichlorobenzene	4	94	104	100
1,4-Dichlorobenzene	4	91	104	96
trans-1,4-Dichloro-2-butene	4	79	91	88
Dichlorodifluoromethane (CFC-12)[1]	4	**58**	101	**63**
1,1-Dichloroethane	4	103	114	106
1,2-Dichloroethane	4	98	115	110
1,1-Dichloroethylene (DCE)[1]	4	77	110	85
cis-1,2-Dichloroethene[1]	4	100	114	102
trans-1,2-Dichloroethene	4	96	110	102
Dichloromethane (Methylene chloride)[1]	4	101	114	110
1,2-Dichloropropane[1]	4	96	110	97
1,3-Dichloropropane	4	98	111	103
2,2-Dichloropropane	4	78	93	80
1,1-Dichloropropene	4	86	111	96
cis-1,3-Dichloropropene	4	75	97	85
trans-1,3-Dichloropropene	4	90	104	94
Diethyl ether	4	94	114	100
Diisopropyl ether (DIPE)	4	81	105	90
Ethylbenzene[1]	4	89	106	99
tert-Butyl ethyl ether (ETBE)	4	83	103	89
Ethyl methacrylate	4	83	106	86
1-Ethyl-2-methylbenzene (*o*-Ethyl toluene)	4	89	104	95
Hexachlorobutadiene	4	76	89	80
Hexachloroethane	4	95	112	106
2-Hexanone (*n*-Butyl methyl ketone)	4	91	110	94
Isopropylbenzene (Cumene)	4	94	110	103

Table A5A. Quality-control summary of matrix-spike recoveries of volatile organic compounds, gasoline oxygenates and their degradates, *N*-nitrosodimethylamine, and 1,2,3-trichloropropane in samples collected for the Central Eastside Groundwater Ambient Monitoring and Assessment (GAMA) study, California March to June 2006.—Continued

[Acceptable recovery range is between 70 and 130 percent, bold values indicate those outside of acceptable recovery range]

Constituent (common name)	Number of spiked samples	Recovery (percent)		
		Minimum	Maximum	Median
4-Isopropyl-1-methylbenzene	4	90	97	94
Methyl acrylate	4	95	113	98
Methyl acrylonitrile	4	97	117	108
Methyl bromide (Bromomethane)	4	90	**150**	116
Methyl *tert*-butyl ether (MTBE)[3]	4	89	110	94
Methyl iodide (Iodomethane)	4	**59**	125	102
Methyl isobutyl ketone (MIBK)	4	83	104	87
Methyl methacrylate	4	72	96	78
Methyl *tert*-pentyl ether (*tert*-Amyl methyl ether, TAME)	4	85	106	93
Naphthalene	4	96	122	104
n-Propylbenzene[1]	4	89	101	94
Styrene	4	87	110	97
1,1,1,2-Tetrachloroethane	4	94	105	101
1,1,2,2-Tetrachloroethane	4	98	112	109
Tetrachloroethylene (PCE)[1]	4	92	102	97
Tetrahydrofuran	4	102	127	112
1,2,3,4-Tetramethylbenzene	4	97	115	101
1,2,3,5-Tetramethylbenzene	4	106	127	111
Toluene[1]	4	91	106	95
1,2,3-Trichlorobenzene	4	98	114	107
1,2,4-Trichlorobenzene	4	88	106	90
1,1,1-Trichloroethane (TCA)	4	100	114	104
1,1,2-Trichloroethane	4	96	114	104
Trichloroethylene (TCE)[1]	4	90	100	92
Trichlorofluoromethane (CFC-11)[1]	4	89	116	95
1,2,3-Trichloropropane (1,2,3-TCP)	4	101	116	108
1,1,2-Trichloro-1,2,2-trifluoroethane (CFC-113)[1]	4	79	106	85
1,2,3-Trimethylbenzene	4	97	110	102
1,2,4-Trimethylbenzene[1]	4	102	110	107
1,3,5-Trimethylbenzene	4	96	106	99
Vinyl bromide (Bromoethene)	4	90	**133**	114
Vinyl chloride (Chloroethene)	4	77	117	87
m- and *p*-Xylene[1]	4	96	113	104
o-Xylene	4	89	108	96
tert-Amyl alcohol	2	87	90	89
tert-Butyl alcohol (TBA)	2	85	92	89
Methyl acetate	2	105	124	114
N-Nitrosodimethylamine (NDMA)[2]	2	97	98	98
1,2,3-Tricholorpropane (1,2,3-TCP)[1,2]	1	na	na	124

[1]Constituents detected in ground-water samples.

[2]Constituents analyzed by Montgomery Watson-Harza Laboratory on the Constituents of Special Interest Schedule.

[3]Constituents on schedules 2020 and 4024; only values from schedule 2020 are reported as the preferred analytical schedule.

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

[Acceptable recovery range is between 70 and 130 percent, bold values indicate those outside of acceptable recovery range]

Constituent (common name)	Number of spiked samples	Recovery (percent)		
		Minimum	Maximum	Median
Schedule 2003				
Acetochlor	4	94	110	103
Alachlor	4	96	107	102
Atrazine[1]	4	97	108	105
Azinphos-methyl	4	**55**	86	**65**
Azinphos-methyl-oxon	4	**20**	**38**	**33**
Benfluralin	4	62	79	72
Carbaryl	4	91	110	101
2-Chloro-2,6-diethylacetanilide	4	98	110	103
4-Chloro-2-methylphenol	4	**64**	74	**66**
Chlorpyrifos	4	88	98	91
Chlorpyrifos oxygen analog	4	**10**	**38**	**19**
Cyfluthrin	4	**40**	**63**	**56**
Cypermethrin	4	**39**	**63**	**48**
Dacthal (DCPA)	4	99	111	104
Deethylatrazine (2-chloro-4-isopropylamino-6-amino-s-triazine)[1]	4	**46**	**50**	**49**
Desulfinylfipronil	4	73	101	85
Desulfinylfipronil amide	4	71	102	83
Diazinon	4	90	98	93
Diazinon oxon	4	76	105	78
3,4-Dichloroaniline[1]	4	70	85	79
Dichlorvos	4	**19**	**29**	**24**
Dicrotophos	4	**29**	**30**	**29**
Dieldrin	4	91	**182**	96
2,6-Diethylaniline	4	94	103	99
Dimethoate	4	**29**	**34**	**32**
Ethion	4	**67**	100	76
Ethion monoxon	4	77	115	82
2-Ethyl-6-methylaniline	4	88	102	97
Fenamiphos	4	**67**	105	73
Fenamiphos sulfone	4	**52**	89	**58**
Fenamiphos sulfoxide	4	**19**	**39**	**38**
Fipronil	4	74	109	92
Fipronil sulfide	4	**63**	95	83
Fipronil sulfone	4	70	115	93
Fonofos	4	93	99	96
Hexazinone[1]	4	74	88	78
Iprodione	4	**19**	**25**	**22**
Isofenphos	4	88	113	101
Malaoxon	4	70	95	72
Malathion	4	91	110	99
Metalaxyl	4	86	102	95
Methidathion	4	90	116	102
Metolachlor1	4	105	117	109
Metribuzin	4	78	93	86
Myclobutanil	4	78	110	91
1-Naphthol	4	**10**	**29**	**15**
Paraoxon-methyl	4	**38**	**57**	**44**
Parathion-methyl	4	75	94	80
Pendimethalin	4	85	110	96

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

[Acceptable recovery range is between 70 and 130 percent, bold values indicate those outside of acceptable recovery range]

Constituent (common name)	Number of spiked samples	Recovery (percent)		
		Minimum	Maximum	Median
Schedule 2003—Continued				
cis-Permethrin	4	**43**	**58**	**49**
Phorate	4	**53**	88	**64**
Phorate oxon	4	**67**	**134**	82
Prometon[1]	4	86	98	96
Prometryn	4	91	109	99
Pronamide (Propyzamide)	4	93	105	97
Simazine[1]	4	98	109	104
Tebuthiuron	4	118	**172**	**148**
Terbufos	4	77	115	97
Terbufos oxon sulfone	4	**67**	96	78
Terbuthylazine	4	96	108	105
Trifluralin	4	**68**	87	80
Schedule 2060				
Acifluorfen	2	**145**	**153**	**149**
Aldicarb	2	**63**	78	70
Aldicarb sulfone	2	85	109	97
Aldicarb sulfoxide	2	103	116	109
Bendiocarb	2	81	109	95
Benomyl	2	96	107	101
Bensulfuron-methyl	2	100	129	114
Bentazon	2	81	98	89
Bromacil	2	85	113	99
Bromoxynil	2	**66**	82	74
Caffeine	2	99	114	106
Carbaryl	2	92	105	99
Carbofuran	2	92	109	100
Chloramben methyl ester	2	85	90	87
Chlorimuron-ethyl	2	96	127	111
3-(4-Chlorophenyl)-1-methyl urea	2	89	94	91
Clopyralid	2	**37**	78	**57**
Cycloate	2	92	102	97
2,4-DB (4-(2,4-dichlorophenoxy)butanoic acid)	2	100	129	114
Dacthal monoacid	2	125	**137**	**131**
Deisopropyl atrazine (2-chloro-6-ethylamino-4-amino-s-triazine)1	2	**51**	74	**62**
Dicamba	2	100	113	106
Dichlorprop	2	121	**203**	**162**
Dinoseb	2	107	109	108
Diphenamid	2	100	109	104
Diuron[1]	2	100	113	106
Fenuron	2	96	109	103
Flumetsulam	2	125	**168**	**147**
Fluometuron	2	96	105	101
Hydroxyatrazine (2-Hydroxy-4-isopropylamino-6-ethylamino-s-triazine)	2	118	**139**	128
3-Hydroxycarbofuran	2	94	114	104
Imazaquin	2	129	**199**	**164**
Imazethapyr	2	125	**160**	**143**

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

[Acceptable recovery range is between 70 and 130 percent, bold values indicate those outside of acceptable recovery range]

Constituent (common name)	Number of spiked samples	Recovery (percent)		
		Minimum	Maximum	Median
Schedule 2060—Continued				
Imidacloprid	2	111	**135**	123
Linuron	2	89	102	95
MCPA (2-Methyl-4-chlorophenoxyacetic acid)	2	109	118	114
MCPB (4-(2-Methyl-4-chlorophenoxy) butyric acid)	2	103	**133**	118
Metalaxyl	2	96	105	101
Methiocarb	2	93	108	100
Methomyl	2	110	123	117
Metsulfuron methyl	2	**55**	90	73
Neburon	2	92	113	103
Nicosulfuron	2	**140**	**242**	**191**
Norflurazon[1]	2	100	121	110
Oryzalin	2	85	105	95
Oxamyl	2	107	125	116
Picloram	2	77	94	86
Propham	2	96	109	102
Propiconazole	2	92	102	97
Propoxur	2	87	116	102
Siduron	2	103	117	110
Sulfometuron-methyl	2	101	122	112
Terbacil	2	92	121	107
Triclopyr	2	125	**141**	**133**

[1]Constituents detected in ground-water samples.

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

[**Analytical schedule(s)**: MWH, constituent analyzed at Montogmery Watson Harza Laboratory (MWH), Monrovia, California. **Abbreviations:** NDMA, *N*-Nitrosodimethylamine; VOCs, volatile organic compounds]

Surrogate	Analytical schedule(s))	Constitutent or constituent class analyzed	Number of blanks analysed	Median surrogate recovery in blanks (percent)	Number of surrogate recoveries		Number of environmental samples analysed	Median surrogate recovery in environmental samples (percent)	Median surrogate recoveries	
					Below 70 percent in blanks	Above 130 percent in blanks			Below 70 percent in environmental samples	Above 130 percent in environmental samples
1-Bromo-4-fluorobenzene	2020, 4024	VOCs, gasoline oxygenates	10	103	0	0	78	91	1	0
1,2-Dichloroethane-d4	2020, 4024	VOCs, gasoline oxygenates	10	109	0	0	78	110	0	8
Toluene-d8	2020, 4024	VOCs, gasoline oxygenates	10	99	0	0	78	98	0	0
Isobutyl alcohol-d6	4024	Gasoline oxygenates	4	93	0	0	15	90	0	0
α-HCH-d6	2003	Pesticides or degradates	6	87	0	0	78	92	0	0
Diazinon-d10	2003	Pesticides or degradates	6	87	2	0	78	93	3	1
Barban	2060	Pesticides or degradates	2	101	0	0	15	96	0	0
Caffeine-^{13}C	2060	Pesticides or degradates	2	115	0	1	15	112	0	1
2,4,5-T (2,4,5-trichlorophenoxyacetic acid)	2060	Pesticides or degradates	2	109	0	0	15	124	0	5
Toluene-d8	MWH1	1,2,3-Trichloropropane	4	95	0	0	15	93	0	1
NDMA-d6	MWH1	NDMA	4	81	0	0	15	100	0	0

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Publishing Service Center, Tacoma, Washington
Bobbie Jo Richey
Carol Sanchez
Larry G. Schneider
Sharon Wahlstrom
For more information concerning the research in this report, contact the
California Water Science Center Director,
U.S. Geological Survey, 6000 J Street
Sacramento, California 95819
http://ca.water.usgs.gov