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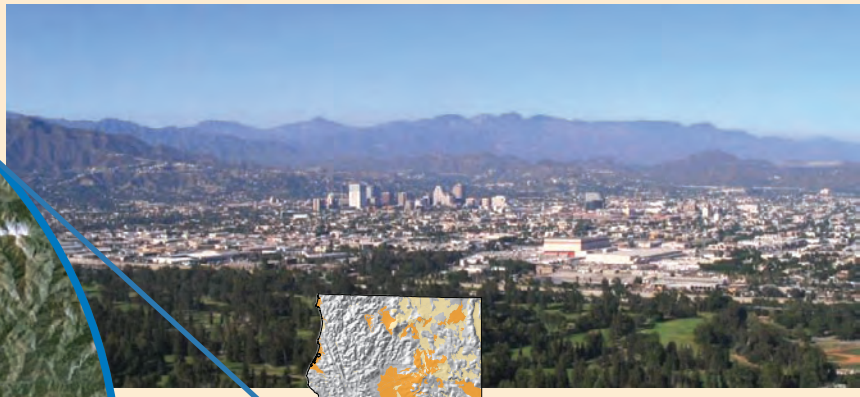
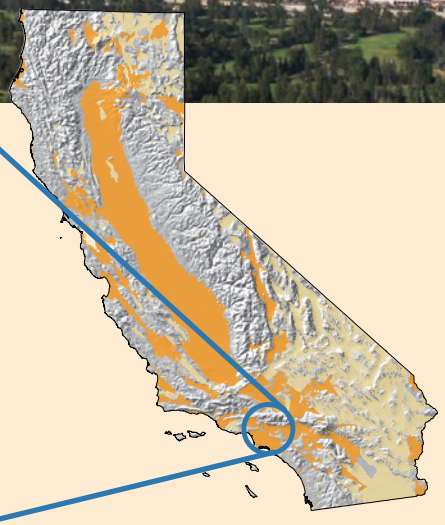
Ground-Water Quality Data in the San Fernando–San Gabriel Study Unit, 2005—Results from the California GAMA Program





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Top photo: Looking northeast from Griffith Park. Downtown Glendale is in the middle ground, and the San Gabriel Mountains are in the background (photo taken July 12, 2006, by Will Bebeck. ***Bottom photo:*** By Andrea Altmann, U.S. Geological Survey.

Ground-Water Quality Data in the San Fernando–San Gabriel Study Unit, 2005—Results from the California GAMA Program

By Michael Land and Kenneth Belitz

Prepared in cooperation with the California State Water Resources Control Board

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Abbreviations and Acronyms

AB	Assembly Bill (through the California State Assembly)
AL-US	Action level (USEPA)
CAS	Chemical Abstract Service (American Chemical Society)
CSU	combined standard uncertainty
E	estimated or having a higher degree of uncertainty
GAMA	Groundwater Ambient Monitoring and Assessment program
GPS	Global Positioning System
HAL-US	Lifetime Health Advisory Level (USEPA)
HPLC	high-performance liquid chromatography
LRL	laboratory reporting level
LSD	land-surface datum
LT-MDL	long-term method detection level
MCL-CA	maximum contaminant level (CDPH)
MCL-US	maximum contaminant level (USEPA)
MDL	method detection limit
MRL	minimum reporting level
MU	method uncertainty
N	Normal (1-gram-equivalent per liter of solution)
na	not available
nc	sample not collected
NL-CA	California notification level (CDPH)
NWIS	National Water Information System (USGS)
QC	quality control
RPD	relative percent difference
RSD	relative standard deviation
RSD5	risk-specific dose at 10-5 (USEPA)
SFSG	San Fernando-San Gabriel study unit
SMCL-CA	secondary maximum contaminant level (CDPH)
SMCL-US	secondary maximum contaminant level (USEPA)
SSMDC	sample-specific minimum detectable concentration
TT-US	Treatment Technique (USEPA)
ULASF	Upper Los Angeles Basins, San Fernando study area
ULASG	Upper Los Angeles Basins, San Gabriel study area
US	United States
V	value censored due to potential blank contamination
VPDB	Vienna Peedee Belemnite
VSMOW	Vienna Standard Mean Ocean Water

Organizations

CDPH	California Department of Public Health
USEPA	U.S. Environmental Protection Agency
LLNL	Lawrence Livermore National Laboratory
MWH	Montgomery Watson Harza
NAWQA	National Water Quality Assessment (USGS)
NWQL	National Water Quality Laboratory (USGS)
SWRCB	State Water Resources Control Board (California)
USGS	U.S. Geological Survey

Selected chemical names

$CaCO_3$	calcium carbonate
CFC	chlorofluorocarbon
CO_3^{-2}	carbonate
DOC	dissolved organic carbon
HCl	hydrochloric acid

HCO_3^-	bicarbonate
MTBE	methyl *tert*-butyl ether
NDMA	N-nitrosodimethylamine
PCE	tetrachloroethene
TCP	trichloropropane
TDS	total dissolved solids
THM	trihalomethane
VOC	volatile organic compound

Units of Measure

cm^3 STP/g	cubic centimeters of gas at standard temperature and pressure (0 degrees Celsius and 1 atmosphere of pressure) per gram of water
ft	foot (feet)
in	inch
km	kilometer
L	liter
mg	milligram
mg/L	milligrams per liter (parts per million)
mi	mile
mL	milliliter
pCi/L	picocurie per liter
pmc	percent modern carbon
$\delta^i E$	delta notation, the ratio of a heavier isotope of an element (iE) to the more common lighter isotope of that element, relative to a standard reference material, expressed in per mil (parts per thousand)
µg/L	micrograms per liter (parts per billion)
µL	microliter
µm	micrometer

Notes

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

$$°F=(1.8\times°C)+32$$

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

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

Concentrations of chemical constituents in water are given either in milligrams per liter (mg/L) or micrograms per liter (µg/L). Milligrams per liter is equivalent to parts per million (ppm) and micrograms per liter is equivalent to parts per billion (ppb).

Ground-Water Quality Data in the San Fernando–San Gabriel Study Unit, 2005—Results from the California GAMA Program

By Michael Land and Kenneth Belitz

Abstract

Ground-water quality in the approximately 460 square mile San Fernando-San Gabriel study unit (SFSG) was investigated between May and July 2005 as part of the Priority Basin Assessment Project of the Groundwater Ambient Monitoring and Assessment (GAMA) Program. The GAMA Priority Basin Assessment Project was developed in response to the Groundwater Quality Monitoring Act of 2001 and is being conducted by the U.S. Geological Survey (USGS) in cooperation with the California State Water Resources Control Board (SWRCB).

The San Fernando-San Gabriel study was designed to provide a spatially unbiased assessment of raw ground-water quality within SFSG, as well as a statistically consistent basis for comparing water quality throughout California. Samples were collected from 52 wells in Los Angeles County. Thirty-five of the wells were selected using a spatially distributed, randomized grid-based method to provide statistical representation of the study area (grid wells), and seventeen wells were selected to aid in the evaluation of specific water-quality issues or changes in water chemistry along a historic ground-water flow path (understanding wells).

The ground-water samples were analyzed for a large number of synthetic organic constituents [volatile organic compounds (VOCs), pesticides and pesticide degradates], constituents of special interest [perchlorate, *N*-nitrosodimethylamine (NDMA), 1,2,3-trichloropropane (1,2,3-TCP), and 1,4-dioxane], naturally occurring inorganic constituents (nutrients, major and minor ions, and trace elements), radioactive constituents, and microbial indicators. Naturally occurring isotopes (tritium, and carbon-14, and stable isotopes of hydrogen, oxygen, and carbon), and dissolved noble 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 at approximately one-fifth (11 of 52) 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 data had very little bias or variability and resulted in censoring of less than 0.7 percent (32 of 4,484 measurements) of the data collected for 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, or blended with other waters to maintain acceptable water quality. Regulatory thresholds apply to treated water that is served to the consumer, not to raw ground water. However, to provide some context for the results, concentrations of constituents measured in the raw ground water were compared with health-based thresholds established by the U.S. Environmental Protection Agency (USEPA) and California Department of Public Health (CDPH) and thresholds established for aesthetic concerns (secondary maximum contaminant levels, SMCL-CA) by CDPH.

VOCs were detected in more than 90 percent (33 of 35) of grid wells. For all wells sampled for SFSG, nearly all VOC detections were below health-based thresholds, and most were less than one-tenth of the threshold values. Samples from seven wells had at least one detection of PCE, TCE, tetrachloromethane, NDMA, or 1,2,3-TCP at or above a health-based threshold. Pesticides were detected in about 90 percent (31 of 35) grid wells and all detections in samples from SFSG wells were below health-based thresholds.

Major ions, trace elements, and nutrients in samples from 17 SFSG wells were all below health-based thresholds, with the exception of one detection of nitrate that was above the USEPA maximum contaminant level (MCL-US). With the exception of 14 samples having radon-222 above the proposed MCL-US, radioactive constituents were below health-based thresholds for 16 of the SFSG wells sampled. Total dissolved solids in 6 of the 24 SFSG wells that were sampled had concentrations between the lower and upper non-enforceable thresholds (500 and 1,000 mg/L) set for aesthetic concerns.

Introduction

Ground water comprises nearly one-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 to establish a program for monitoring trends in ground-water quality, the California 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: Priority Basin Assessment, conducted by the USGS (http://ca.water.usgs.gov/gama/); Voluntary Domestic Well Assessment, conducted by the SWRCB; and Special Studies, conducted by LLNL.

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

The GAMA Priority Basin Assessment Project is unique in California because the data collected during the study include analyses for an extensive number of chemical constituents at very low concentrations, analyses that are not available normally. A broader understanding of ground-water composition will be especially useful for providing an early indication of changes in water quality and for identifying the natural and human factors affecting water quality. Additionally, the GAMA Priority Basin Assessment Project will analyze a broader suite of constituents than is required by the California Department of Public Health (CDPH; formerly California Department of Health Services (CDHS)—replaced on July 1, 2007). 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 ten provinces were included in the project design. Eighty percent of California's approximately 16,000 public-supply wells are located in ground-water basins within these hydrologic provinces. These ground-water basins, defined by the California Department of Water Resources (CDWR), 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, based on 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 defined. 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 water-quality data collected in each study unit (Wright and others, 2005; Bennett and others, 2006; Kulongoski and others, 2006; Kulongoski and Belitz, 2007; Dawson and others, 2008). Subsequent reports will present the *status*, *trends*, and *understanding* assessments of water-quality in the study units.

The San Fernando-San Gabriel GAMA study unit, hereafter referred to as SFSG, contains three major ground-water basins, including several smaller, adjacent subbasins. SFSG was considered a high priority for sampling to provide adequate representation of the Transverse Ranges and selected Peninsular Ranges hydrogeologic province (Belitz and others, 2003).

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

Figure 1. The hydrogeologic provinces of California and the location of the San Fernando-San Gabriel 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 describe the study design and study methods; (2) to present the results of quality-control tests; and (3) to present the analytical results for ground-water samples collected in SFSG. Ground-water samples were analyzed for organic, inorganic, and microbial constituents, field parameters, and chemical tracers. The chemical and microbial data presented in this report were evaluated by comparison to state and federal drinking water regulatory and other health-based standards that are applied to treated drinking water. Regulatory thresholds considered for this report are those established by the U.S. Environmental Protection Agency (USEPA) and the California Department of Public Health (CDPH). 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. Discussion of the factors that influence the distribution and occurrence of the constituents detected in ground-water samples will be the subject of subsequent publications.

Acknowledgments

The authors thank the following cooperators for their support: the California State Water Resources Control Board (SWRCB), California Department of Public Health, California Department of Water Resources, and Lawrence Livermore National Laboratory. We especially thank the well owners and water purveyors for their generosity in allowing the USGS to collect samples from their wells. Funding for this work was provided by State bonds authorized by Proposition 50 and administered by the SWRCB.

Hydrogeologic Setting

The San Fernando-San Gabriel (SFSG) study unit lies within the Transverse Range and Selected Peninsular Ranges hydrogeologic province (fig. 1) described by Belitz and others (2003), and includes three ground-water basins: San Fernando Valley, Raymond, and San Gabriel Valley (California Department of Water Resources, 2003). Combined, these basins define the extent of SFSG, and cover an area of approximately 500 mi^2 in Los Angeles County, California. (fig. 2).

In this report, the western part of the SFSG *study unit* includes the San Fernando Valley ground-water basin and is referred to as the San Fernando *study area*; the eastern part of SFSG includes the Raymond and San Gabriel Valley ground-water basins, and collectively is referred to as the San Gabriel *study area*. The San Fernando study area (ULASF) includes part of the Bull Canyon, Sylmar, Tujunga, Verdugo, and Eagle Rock watersheds. The San Gabriel study area (ULASG) includes part of the Monk Hill, Pasadena, Lower Canyon, Upper San Gabriel River, Foothill, Live Oak, Pomona, and San Jose watersheds.

SFSG has approximately 3,000 ft of topographic relief. The major ground-water basins in SFSG are sloping gently with a median altitude ranging from approximately 600 to 1,000 ft. The climate in SFSG is characterized by hot, dry summers and cool, moist winters, with most precipitation falling between the months of December and March (California Department of Water Resources, 2003).

The SFSG study unit is bounded to the north by the Santa Susana and the San Gabriel Mountains; to the east by the San Jose and the Chino Faults; to the south by the Santa Monica Mountains and the Elysian, Repetto, Merced and Puente Hills; and to the west by the Simi Hills. The primary water-bearing materials are composed of unconsolidated to semi-consolidated gravel, sand, and clay of Pleistocene to Recent age (California Department of Water Resources, 2005a,b,c). These sediments were deposited by alluvial fans from the surrounding hills and mountains. Deeper water-bearing units in SFSG consist of marine deposits of late Pleistocene age.

Several creeks and washes drain the SFSG study unit. In the western part of SFSG, water from surface channels drains to the Los Angeles River, where it passes through the Los Angeles River Narrows and into the coastal plain before ultimately reaching San Pedro Bay. In the eastern part of SFSG, water from tributary creeks and washes drains to the San Gabriel River or the Rio Hondo then passes through the Whittier Narrows before ultimately reaching San Pedro Bay.

Recharge in SFSG is from a variety of sources. Natural recharge mainly is from direct infiltration of precipitation and percolation of streamflow from the surrounding highland areas. Precipitation in SFSG may vary from as little as 15 in./yr in the valley areas to as much as 31 in./yr in the upland areas; the average value over the three ground-water basins ranges from 17–21 in./yr (California Department of Water Resources, 2005a,b,c). Runoff—consisting of natural streamflow, imported water, reclaimed wastewater, industrial discharge, and(or) precipitation falling on impervious material—is often diverted to spreading basins or impounded at dams to enhance recharge. A lesser amount of recharge occurs as: (1) Subsurface flow from adjacent basins or from fractures in the surrounding mountains (California Department of Water Resources, 2005a,b,c) and (2) return flow from irrigation and from other distributed sources (such as leakage from pipes).

Imported water for direct use and for artificial recharge is delivered to SFSG from several distant sources. Beginning in 1913, Los Angeles Water & Power began to deliver water from Owens Valley by means of the Los Angeles Aqueduct. In 1941, the Metropolitan Water District of Southern California began to deliver water from the Colorado River by means of the Colorado River Aqueduct. In 1972, the Department of Water Resources began to deliver water from the Bay/Delta area by means of the West- and East-Branch State Water Project.

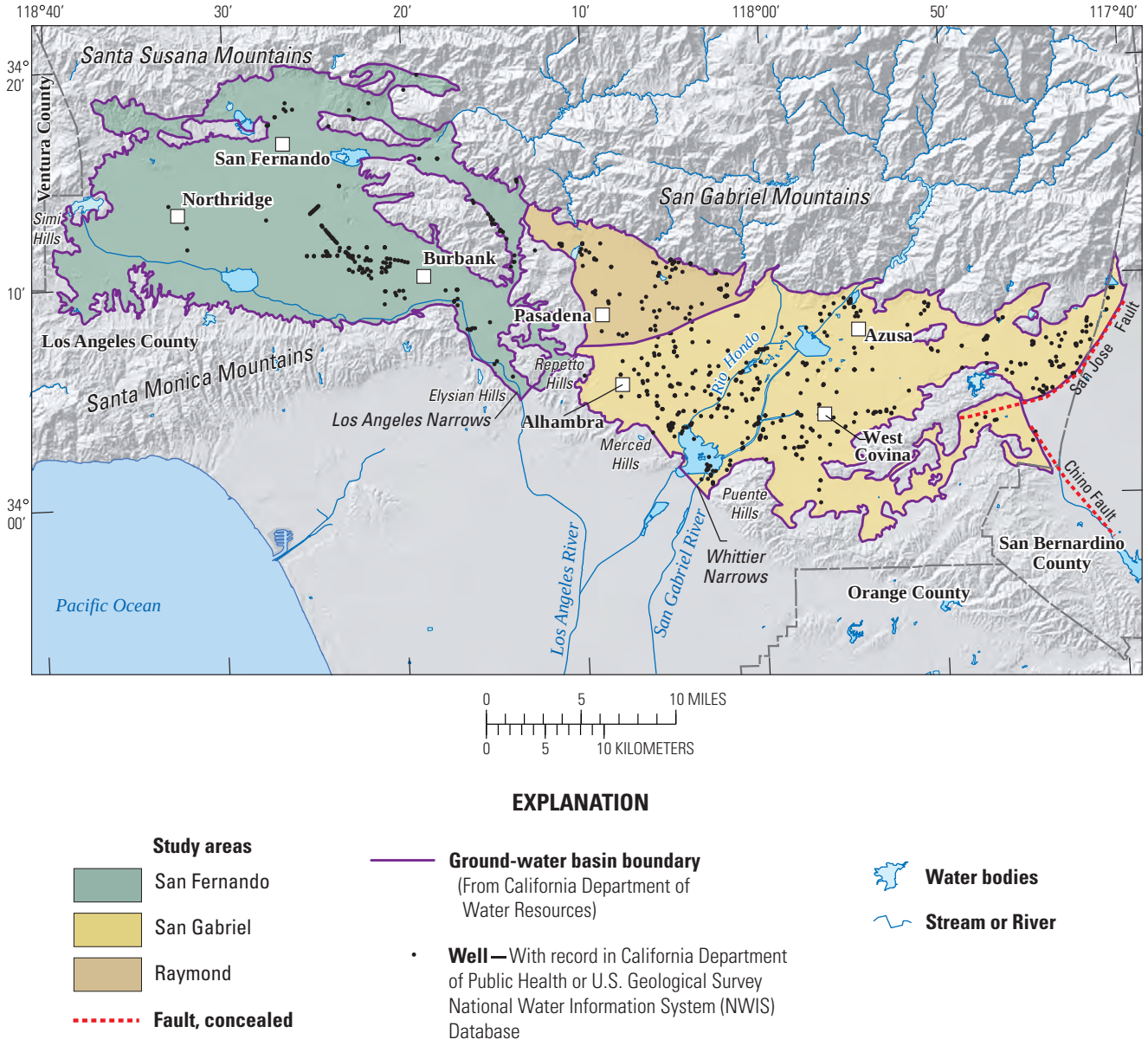

Figure 2. The San Fernando-San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit showing the California Department of Water Resources defined ground-water basins within the study unit and major hydrologic features.

The combined safe yield for all basins in the SFSG study unit is approximately 314,000 acre-ft/yr. (California Department of Water Resources, 2003). Except for a small area of limited pumping in the San Gabriel Valley, ground-water extractions are controlled in all of SFSG. The court-ordered adjudication of the San Fernando Valley, the Raymond, and the San Gabriel Valley ground-water basins is administered by separate Watermaster appointments.

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. The Appendix to this report contains detailed descriptions of the sample collection protocols and analytical methods, the quality-assurance methods, and the results of analyses of quality-control samples.

Study Design

The wells selected for sampling in this study reflect the combination of two well selection strategies. Thirty-five wells were selected to provide a statistically unbiased, spatially distributed assessment of the quality of ground-water resources used for public drinking water supply. Seventeen additional wells were selected to provide greater sampling density in several areas to aid in the evaluation of specific ground-water quality issues or to better understand changes in water chemistry along historic ground-water flow paths in the study unit.

The spatially distributed wells in each study area were selected using a randomized grid-based method (Scott, 1990). Wells listed in statewide databases maintained by the USGS and the CDPH were considered in this selection process.

For the ULASG assessment, the San Gabriel study area was divided into 25 10 mi^2 grid cells, across the mapped unconsolidated deposits of the basin floor (fig. 3A). The objective was to select one public-supply well per grid cell. If a grid cell contained more than one well, each well was randomly assigned a rank. The highest ranking well that met basic sampling criteria (for example, sampling point located prior to water 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 an active or accessible well, an attempt was made to select from an adjacent cell. 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 spatially distributed, randomized grid-cell network are hereafter referred to as "grid wells." Twenty-three of the 25 grid cells were sampled in ULASG; the other two grid cells did not contain accessible wells. Grid wells sampled in ULASG were numbered in the order of sample collection using the prefix "ULASG."

For the ULASF assessment, the western portion of the San Fernando Valley had few (if any) production wells. To minimize the potential for unsampled cells, the sampling grid was refined by drawing a 1.86-mi (3-km) radius buffer around each well within the ULASF study area. The area encompassed by the circles then was divided to create 10 mi^2 grid cells, 15 in all (fig. 3B). Twelve of the 15 grid cells were sampled; the other three grid cells did not contain suitable wells. Grid wells sampled in ULASF were numbered in the order of sample collection using the prefix "ULASF."

Seventeen additional wells were sampled for the purpose of obtaining a better understanding of the source and movement of ground water along historic ground-water flow paths in each study area. Wells sampled as part of these studies were not included in the statistical characterization of water quality in SFSG because inclusion of these wells would have caused overrepresentation of certain cells. These additional, non-randomized wells were numbered in the order of sample collection using either the prefix "ULASFU" or "ULASGU" depending on the study area ("U" indicating "understanding").

Table 1 (all tables shown in back of report) provides the GAMA alphanumeric identification number for each well, along with the date sampled, sampling schedule, well type, and well-construction information. Ground-water samples were collected from 47 public-supply wells, 3 industrial wells, and 2 irrigation wells between May and July 2005. A total of 18 wells were sampled in the ULASF study area and 34 wells were sampled in the ULASG study area.

Well locations and identifications were verified using GPS, 1:24,000 scale USGS topographic maps, comparison with existing well information in USGS and CDPH databases, and information provided by well owners. Logs for wells were obtained when available. Well information was recorded by hand in the field, verified, and then uploaded into the USGS National Water Information System (NWIS). In order to maintain confidentiality of well owners and well locations, well information and chemical data currently are inaccessible from the USGS NWIS public website.

The wells in SFSG study unit were sampled using a tiered analytical approach. All wells were sampled for a standard set of constituents, including VOCs, pesticides and pesticide degradates, stable isotopes of water, and tritium to provide an initial assessment of ground-water quality in the area. This standard set of constituents was termed the "fast" schedule (table 2). Wells on the "intermediate" schedule were sampled for all the constituents on the fast schedule plus perchlorate, NDMA, 1,2,3-TCP, 1,4-dioxane, nutrients, dissolved organic carbon, major and minor ions, trace elements, speciation of arsenic and chromium and iron, and the noble gases. Wells on the "slow" schedule were sampled for all the constituents on the intermediate schedule, plus gasoline oxygenates and degradates, polar pesticides and degradates, 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 or four fast wells could be sampled in one day. For the SFSG study unit, 28 of the ground-water wells were sampled on the fast schedule, 7 wells were sampled on the intermediate schedule, and 17 wells 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. The methods used for sample collection are described in the Appendix section "Sample Collection and Analysis."

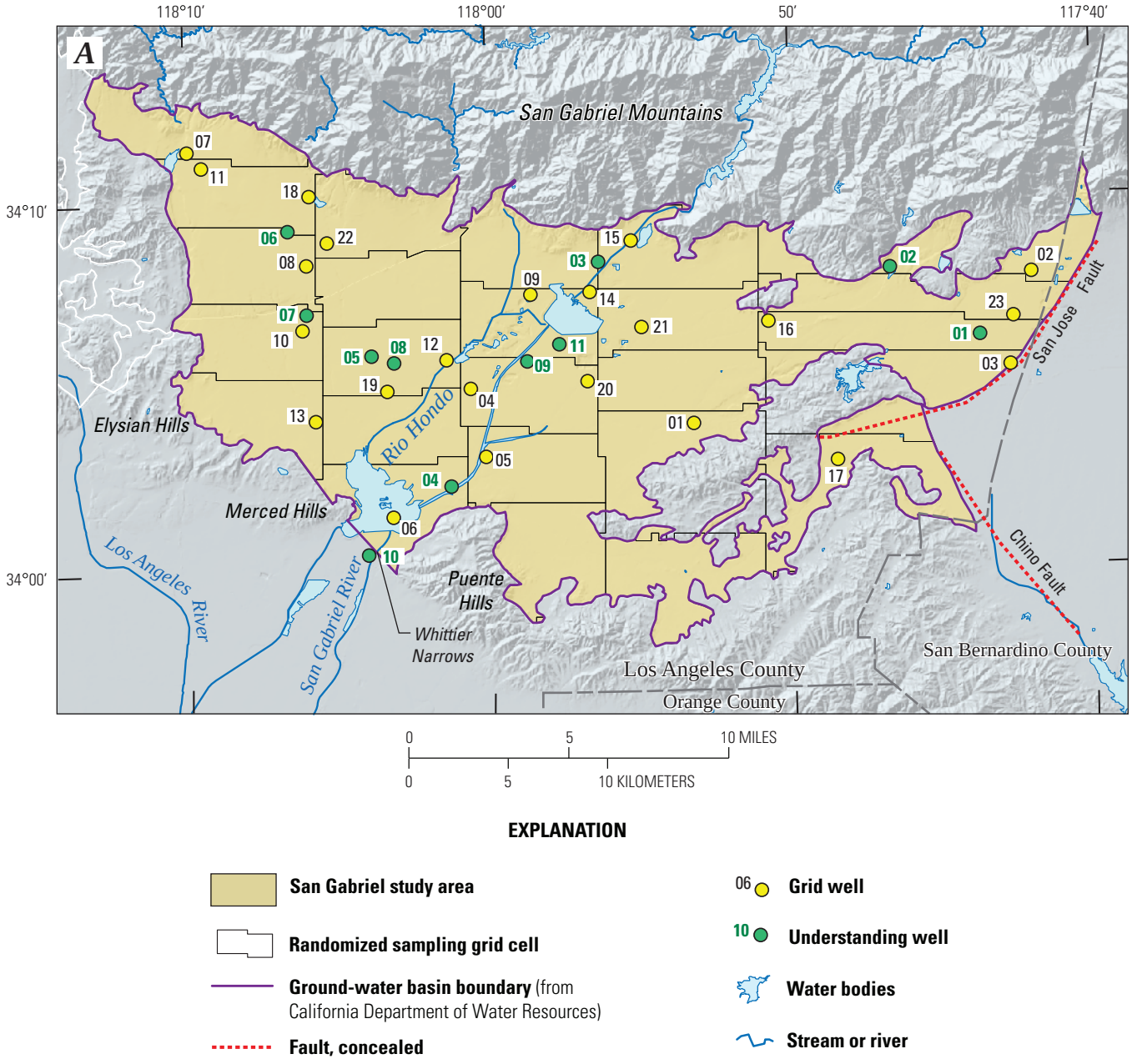

Figure 3. The (*A*) eastern and (*B*) western study areas of the San Fernando-San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit showing the distribution of study area grid cells and the location of sampled grid-cell and understanding wells.

Tables 3A–K 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), 122 pesticides and pesticide degradates (table 3C, D), 4 constituents of special interest (table 3E), 5 nutrients and dissolved organic carbon (table 3F), 10 major and minor ions and total dissolved solids, and 25 trace elements (table 3G), arsenic, iron, and chromium redox species (table 3H), 12 isotopic and radioactive constituents (table 3I), 6 dissolved noble gases and tritium/helium age dates (table 3J), and 4 microbial constituents (table 3K). The methods used for sample analysis are described in the Appendix section "Sample Collection and Analysis."

Data Reporting

The methods and conventions used for reporting the data are described in the Appendix section "Data Reporting." Ten constituents analyzed in this study were measured by more than one method at the USGS National Water Quality Laboratory (NWQL), but only the results from the

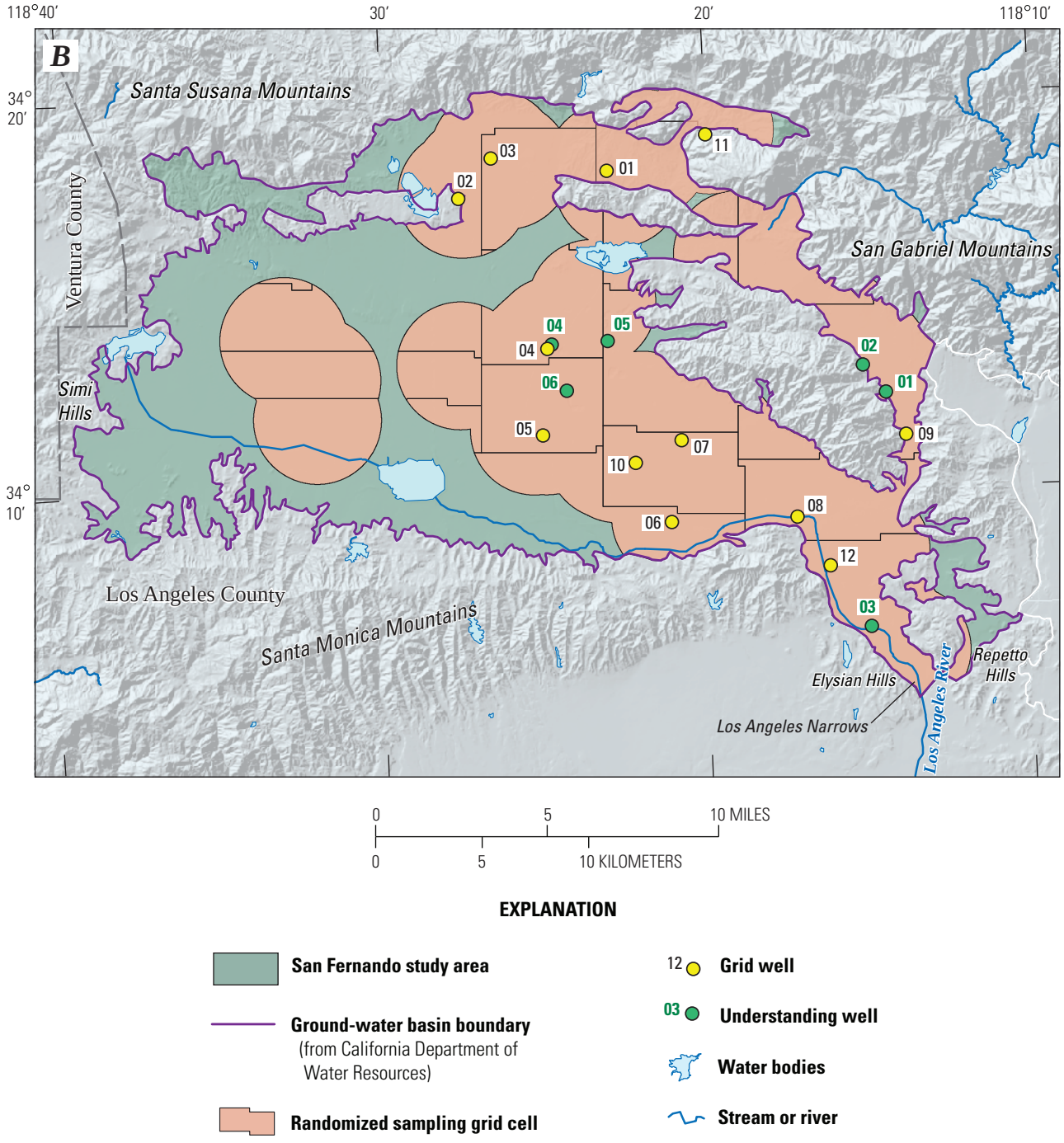

Figure 3. Continued.

preferred method are reported. Arsenic, iron, chromium, and 1,2,3-trichloropropane concentrations and tritium activities were measured by more than one laboratory, and both sets of results are reported.

Quality-Assurance

The quality-assurance methods used for this study follow the protocols used by the USGS NAWQA program (Koterba and others, 1995) and described in the USGS National Field Manual (U.S. Geological Survey, variously dated). The quality assurance plan followed by the NWQL, the primary laboratory used to analyze samples for this study, is described in Maloney (2005) and Pirkey and Glodt (1998). Quality-control (QC) samples collected in the SFSG 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 chemistry data that may have resulted

from sample collection, processing, storage, transportation, and laboratory analysis. A more detailed description of these methods is presented in the Appendix section "Quality Assurance."

Water-Quality Results

Results from analyses of raw (untreated) ground-water samples from SFSG are presented in tables 4–17. Ground-water samples collected in SFSG were analyzed for 290 constituents, and 162 of those constituents were not detected in any of the samples (tables 3A–K). The results tables present only the constituents that were detected, and list only samples that had at least one constituent detected. For constituent classes that were analyzed at all of the grid wells, the tables include the number of wells at which each analyte was detected, the frequency at which it was detected (in relation to the number of grid wells), and the total number of constituents detected at each well. Results from the flow-path 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, while tables 5–17 present the results of ground-water analyses organized by compound classes:

- Organic constituents
  - VOCs and gasoline oxygenates and degradates (table 5)
  - Pesticides and pesticide degradates (table 6)
- Constituents of special interest (table 7)
- Inorganic constituents
  - Nutrients and dissolved organic carbon (table 8)
  - Major and minor ions and total dissolved solids (table 9)
  - Trace elements (table 10)
  - Arsenic and iron species (table 11)
  - Chromium species (table 12)
- Inorganic tracer constituents
  - Stable isotopes of water and tritium (table 13)
  - Carbon isotopes (table 14)
  - Noble gases and tritium (table 15)
- Radioactive constituents (table 16)
- Microbial indicators (table 17)

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 blanks resulted in the censoring of less than 0.7 percent of the data for the ground-water samples. Replicate analyses indicated that variability between measurements was acceptably low. Matrix-spike recoveries for a number of organic constituents were lower than the acceptable limits, which indicate that these constituents might not have been detected in some samples if they were present at very low concentrations. For the analyses that used surrogates, nearly all surrogate recoveries were within acceptable limits. A more detailed description of these results is included in the Appendix section "Quality-Control Sample Results."

Comparison Thresholds

Concentrations of constituents detected in ground-water samples were compared with CDPH (formerly California Department of Health Services [CDHS]–replaced on July 1, 2007) and USEPA drinking-water health-based thresholds and with thresholds established for aesthetic purposes (U.S. Environmental Protection Agency, 2006; California Department of Public Health, 2007a). The chemical and microbial data presented in this report are meant to characterize the quality of the untreated ground-water resources within SFSG 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. CDPH has established MCLs for additional constituents not regulated by the USEPA, as well as lowered the threshold concentration for a number of constituents with MCLs established by the USEPA. In this report, a threshold set by the USEPA and adopted by CDPH is labeled "MCL-US", and one set by CDPH that is more stringent than the MCL-US is labeled "MCL-CA." CDPH is notified when constituents are detected at concentrations above the MCL-US or MCL-CA thresholds in samples collected for the GAMA Priority Basin Assessment Project.

- **AL – Action Level.** Legally enforceable standards that apply to public water systems and that are designed to protect public health by limiting the levels of copper and lead in drinking water. Detections of copper or lead above the action-level thresholds trigger requirements for mandatory water treatment to reduce the corrosiveness of water to water pipes. The action levels established by the USEPA and CDPH are the same, thus these thresholds are labeled "AL-US" in this report.
- **TT – Treatment Technique.** Legally enforceable standards that apply to public-water systems and are designed to protect public health by limiting the levels of microbial constituents in drinking water. Detections of microbial constituents above the treatment-technique thresholds trigger requirements for mandatory additional disinfection during water treatment. The thresholds established by the USEPA and CDPH are the same, and are labeled "TT-US" in this report.
- **SMCL – Secondary Maximum Contaminant Level.** Non-enforceable standards applied to constituents that affect the aesthetic qualities of drinking water, such as taste, odor, and color, or technical qualities of drinking water, such as scaling and staining. Both the USEPA and CDPH define SMCLs, but unlike MCLs, SMCLs established by CDPH are not required to be at least as stringent as those established by USEPA. SMCLs established by CDPH are used in this report (SMCL-CA) for all constituents that have SMCL-CA values. The SMCL-US is used for pH because no SMCL-CA has been defined.
- **NL – Notification Level.** Health-based notification levels established by CDPH for some of the constituents in drinking water that lack MCLs (NL-CA). If a constituent is detected above its NL-CA, California state law requires timely notification of local governing bodies and recommends consumer notification.
- **HAL – Lifetime Health Advisory Level.** The maximum concentration of a constituent at which its presence in drinking water is not expected to cause any adverse carcinogenic effects for a lifetime of exposure. HALs are established by the USEPA (HAL-US) and are calculated assuming consumption of 2 L (2.1 qt) of water per day over a 70-yr lifetime by a 70-kg (154-lb) adult and that 20 percent of a person's exposure comes from drinking water.
- **RSD5 – Risk-Specific Dose.** The concentration of a constituent in drinking water corresponding to an excess estimated lifetime cancer risk of 1 in 100,000. RSD5 is an acronym for risk-specific dose at 10^{-5}. RSD5s are calculated by dividing the 10^{-4} cancer risk concentration established by the USEPA by 10 (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-US. For chloride, sulfate, specific conductance, and total dissolved solids, CDPH defines "recommended" and "upper" SMCL-CAs; detections of these constituents in ground-water samples were compared with both levels. Detected concentrations of constituents that lack an MCL and SMCL were compared to the NL-CA. 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-US, detected concentrations were compared with the RSD5-US. Note that this hierarchy of selection of comparison thresholds means that for constituents that have multiple types of established thresholds, the threshold used for comparison purposes may not be the one with the lowest concentration. The comparison thresholds used in this report are listed in tables 3A–K for all constituents and in tables 4–17 for constituents detected in ground-water samples from SFSG. Not all constituents analyzed for this study have established thresholds available.

Detections of constituents at concentrations greater than the selected comparison threshold are marked with an asterisk in tables 4–17. In this study, only six constituents (PCE, TCE, tetrachloromethane, NDMA, 1,2,3-TCP, and nitrate) were detected at concentrations above health-based thresholds. These detections occurred in five grid wells and two understanding wells. One additional constituent (total dissolved solids) was detected at concentrations above the threshold set for aesthetic qualities, and occurred in three of the grid wells and three understanding wells.

Ground-Water-Quality Data

Field Parameters

Field measurements of turbidity, dissolved oxygen, water temperature, pH, specific conductance, alkalinity (and associated parameters), and hydrogen sulfide are presented in table 4. Dissolved oxygen and alkalinity are used as indicators of processes that control water chemistry. Specific conductance is the unit electrical conductivity of the water and is proportional to amount of total dissolved solids (TDS) in the water. The pH value indicates the acidity or basicity of the water. Six grid and two understanding wells had specific conductance values above the recommended lower SMCL-CA threshold. Dissolved oxygen was detected in all 51 samples collected, typically at concentrations greater than 1 mg/L.

Organic Constituents

Volatile organic compounds (VOCs) are 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, hindering volatilization. Of the 88 VOCs analyzed, 33 were detected in ground-water samples; nearly all detections were below health-based thresholds, and most were less than one-tenth of the threshold values (table 5).

Fifteen VOCs were detected in more than 10 percent of samples from grid wells, and include: six solvents; three disinfection by-products; three refrigerants; two organic synthesis products; and one gasoline oxygenate. Of these 15 VOCs, 12 were detected at concentrations below a health-based threshold, and three were detected above: PCE in 3 wells, TCE in 3 wells, and carbon tetrachloride in 2 wells. In each of these wells, similarly high concentrations had been previously reported for these constituents in the CDPH database. One or more VOCs were detected in 33 of the 35 grid wells sampled; concentrations were below health-based thresholds in 31 of these wells, but above in 4 wells. Water from the four wells with concentrations above health-based thresholds is not served directly to consumers.

Pesticides include herbicides, insecticides, and fungicides and are used to control weeds, insects, fungi, and other pests in agricultural, urban, and suburban settings. Of the 122 pesticide or pesticide degradates analyzed, 22 were detected; all detections were below health-based thresholds, and nearly all were less than one-hundredth of the threshold values (table 6). Six pesticide compounds were detected in more than 10 percent of samples from grid wells, and include: four herbicides and two pesticide degradates. One or more pesticide compounds were detected in 31 of the 35 grid wells sampled.

Constituents of Special Interest

Perchlorate, NDMA, 1,4-dioxane, and 1,2,3-TCP are constituents of special interest in California because they may adversely affect water quality and recently have been found in water supplies (California Department of Public Health, 2007b). Samples for these analytes were collected at 7 intermediate wells and 17 slow wells. Perchlorate was detected in 10 of 24 ground-water samples however, all concentrations were less than the NL-CA of 6 µg/L (table 7). NDMA was detected in two samples; one sample (ULASGU-01) had a concentration (0.061 µg/L) greater than the NL-CA of 0.01 µg/L and had not been reported previously in the CDPH database. 1,4-dioxane was not detected (at or above the 2 µg/L reporting limit) in any of the 24 samples collected.

1,2,3-TCP was detected in two samples at or above the NL-CA of 0.005 µg/L (table 7). One detection (ULASG-14) was from one of the 24 intermediate or slow samples analyzed using the preferred analytical method (see table 3E), and had not been previously reported in the CDPH database. The other detection (ULASF-07) was from one of 52 samples analyzed using an analytical method with a higher reporting limit (see table 3A), and had been reported previously in the CDPH database. Water from these wells is not served directly to consumers.

Inorganic Constituents

Unlike the organic constituents and the constituents of special interest, most of the inorganic constituents are naturally present in ground water, although their concentrations may be influenced by human activities. Samples for inorganic constituents were collected at 7 intermediate and 17 slow wells.

Nutrients (nitrogen and phosphorus) and dissolved organic carbon present in ground water can affect biological activity in aquifers and in surface-water bodies that receive ground-water discharge. Nitrogen may be present in the form of ammonia, nitrite, or nitrate depending on the oxidation-reduction state of the ground water. High concentrations of nitrate can adversely affect human health, particularly that of infants.

Except for one sample, all concentrations of nitrate, nitrite, and ammonia measured in samples from SFSG wells were below health-based thresholds (table 8). In one sample, nitrate was detected (10.3 mg/L as N) slightly above the MCL-US of 10 mg/L as N. This well had a similarly high concentration previously reported in the CDPH database. Concentrations of orthophosphate and dissolved organic carbon were low.

The major-ion composition, total dissolved solids (TDS) content, and levels of certain trace elements in ground water (table 9) 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. CDPH has established non-enforceable thresholds (SMCL-CA) that are based on aesthetic or technical properties rather than health-based concerns for the major ions chloride and sulfate, for TDS, and for several trace elements.

The concentrations of chloride, fluoride, and sulfate measured in samples collected from 24 SFSG wells were all below the MCL-US and SMCL-CA (table 9). Six samples contained TDS above the recommended lower SMCL-CA of 500 mg/L, but below the upper SMCL-CA of 1,000 mg/L.

Eighteen of the 25 trace elements analyzed in this study have health-based thresholds. Detections of all trace elements in samples from all 24 SFSG wells were below health-based thresholds (table 10). Three trace elements (beryllium, silver, and thallium) were not detected in any samples. Iron was detected in nine of 24 samples, at low concentrations. Concentrations of manganese were detected in 19 of 24 samples with the highest value (34.8 µg/L) within half the SMCL of 50 µg/L. Chromium was detected in 17 of 24 samples, with the concentration of one sample (48.9 µg/L) near the MCL-CA of 50 µg/L.

Arsenic, iron, and chromium occur as different species depending on the oxidation-reduction state of the ground water. The oxidized and reduced species have different solubilities in ground water and may have different effects on human health. The relative proportions of the oxidized and reduced species of each element can be used to aid in interpretation of the oxidation-reduction state of the aquifer. The concentrations of total arsenic and iron, and the concentrations of the reduced species, arsenic-III and iron-II are shown in table 11. The concentrations of total chromium, and the concentrations of the oxidized species, chromium-VI is shown in table 12. Concentrations of the other species can be calculated by difference. The concentrations of arsenic, iron, and chromium reported in tables 11 and 12 may be different than those reported in table 10 because different analytical methods were used (see Appendix section "Constituents on Multiple Analytical Schedules"). The concentrations reported in table 10 are considered to be more accurate.

Inorganic Tracer Constituents

Stable isotope ratios, tritium and carbon-14 activities, and noble gas concentrations can be used as tracers of natural processes affecting ground-water composition. Hydrogen and oxygen stable isotope ratios of water (table 13) can aid in the 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. Noble gas concentrations (table 15) can be used to aid in the interpretation of ground-water recharge sources because the concentrations of the different noble gases depend on water temperature at the time of recharge.

Tritium (tables 13 and 15) and 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 produced continuously 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 1950s.

Helium isotope ratios (table 15) can be used in conjunction with tritium concentrations to estimate 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 produced continuously 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, or has interacted extensively with the aquifer matrix.

Of the inorganic tracer constituents analyzed for this study, the only one with a health-based threshold is tritium. All measured tritium activities in samples from SFSG wells were less than one hundredth of the MCL-CA (tables 13 and 15).

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 the 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 or 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 often is 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.

Samples for radioactive constituents were collected at 17 slow wells. None of these samples had an activity of radium or of gross alpha and beta emitters above established health-based thresholds (table 16). In 14 of 17 samples, the activity of radon-222 was above the proposed MCL-US of 300 pCi/L, but less than the proposed alternative MCL-US of 4,000 pCi/L.

Microbial Indicators

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

Samples for microbial indicators were collected at 17 slow wells. No samples contained the viral indicators F-specific and somatic coliphage and none contained the bacterial indicator Escherichia coli (E. coli), however there was one estimated detection of the bacterial indicator total coliforms (table 17). The threshold for total coliforms is based on recurring detections, thus, the detections reported here do not necessarily constitute an exceedance of the MCL-US.

Future Work

Subsequent reports will present analyses of 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. Water-quality data contained in the CDPH (formerly CADHS) and USGS NWIS databases, and water-quality data available from other State and local water agencies will be compiled, evaluated, and used in combination with the data presented in this report; results of these future efforts will appear in one or more subsequent reports.

Summary

Ground-water quality in the approximately 460 square-mile San Fernando-San Gabriel study unit (SFSG) was investigated between May and July 2005 as part of the Priority Basin Assessment Project of Groundwater 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 Priority Basin Assessment Project was designed by the SWRCB and the USGS in response to the Ground-Water Quality Monitoring Act of 2001 (Belitz and others, 2003; State Water Resources Control Board, 2003). This comprehensive assessment of statewide ground-water quality is designed to identify and characterize risks to ground-water resources, and to increase the availability of information about ground-water quality to the public. SFSG was the fifth study unit sampled as part of the project.

SFSG is in the central portion of the Transverse Range and Selected Peninsular Ranges hydrogeologic province and includes within it three major ground-water basins, as defined by the California Department of Water Resources (California Department of Water Resources, 2003). This report describes the hydrogeologic setting of the SFSG region, details the sampling, analytical, and quality-assurance methods used in the study, and presents the results of the chemical and microbial analyses of ground-water samples collected between May to July 2005. The SFSG study included assessment of ground-water quality from 52 wells in Los Angeles County. Thirty-five of the wells were selected using a spatially distributed, randomized grid approach to achieve statistically unbiased representation of ground-water used for public drinking-water supplies. Seventeen additional (non-grid) wells were selected to provide additional sampling density to aid in understanding processes affecting ground-water quality.

Ground-water samples were analyzed for VOCs, pesticides and pesticide degradates, constituents of special interest [perchlorate, *N*-nitrosodimethylamine (NDMA), 1,2,3-trichloropropane (1,2,3-TCP), and 1,4-dioxane], nutrients, major and minor ions, trace elements, radioactive constituents, and microbial indicators. Naturally occurring isotopes (stable isotopes of hydrogen, oxygen, and carbon, and activities of tritium and carbon-14) and dissolved noble gases also were measured to provide a data set that will be used to help interpret the source and age of the sampled ground water.

Quality-control samples (blanks, replicates, or samples for matrix spikes) were collected at about 20 percent 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 information resulted in censoring of less than 0.7 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 in the raw ground water were compared with health-based thresholds established by the U.S. Environmental Protection Agency (USEPA) and California Department of Public Health (CDPH).

Detections of constituents in the SFSG study unit at concentrations greater than the selected comparison threshold are marked with asterisks in tables 4–17. Four constituents (tetrachloroethene [PCE], trichloroethene [TCE], carbon tetrachloride, and nitrate) were detected at concentrations higher than the established maximum contaminant levels (MCLs). These detections occurred in 5 of the 35 grid wells and in 1 of the 17 understanding wells.

Two compounds had detections above CDPH notification levels (NL-CA): 1,2,3-trichloropropane (1,2,3-TCP) in 2 of 35 grid wells, and *N*-nitrosodimethylamine (NDMA) in 1 of 17 understanding wells.

Measurements of total dissolved solids (TDS) in 6 of 24 samples collected were between the lower and upper secondary maximum contaminant level (SMCL-CAs), non-enforceable thresholds set for aesthetic concerns. Specific conductance, measured in the field, also was above the threshold set for aesthetic concerns in six grid wells and two understanding wells. Future work will evaluate 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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Tables

Table 1. Identification, sampling, and construction information for wells sampled for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.

[Well sampling schedules are described in table 2. **GAMA well identification no.**: ULASF, San Fernando study area grid well; ULASFU, San Fernando study area understanding well; ULASG, San Gabriel study area grid well; ULASGU, San Gabriel study area understanding well. **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. **Abbreviations:** ft, feet; LSD, land surface datum; NAVD88, North American Vertical Datum 1988; na, not available]

GAMA well identification no.	Sampling information			Well depth (ft below LSD)	Construction information		
	Date	Sampling schedule	Well type		Top of highest perforation (ft below LSD)	Bottom perforation (ft below LSD)	Elevation of LSD (ft above NAVD88)
San Fernando study area							
ULASF_01	05-24-05	Fast	Public-supply	600	185	486	1,693
ULASF_02	05-24-05	Fast	Public-supply	488	230	435	1,143
ULASF_03	05-24-05	Fast	Public-supply	377	250	355	1,293
ULASF_04	05-25-05	Fast	Public-supply	800	400	780	823
ULASF_05	05-26-05	Fast	Public-supply	594	195	578	724
ULASF_06	05-26-05	Fast	Public-supply	490	242	418	570
ULASF_07	05-26-05	Fast	Public-supply	359	109	349	653
ULASF_08	06-06-05	Slow	Public-supply	400	200	380	465
ULASF_09	06-07-05	Slow	Public-supply	184	50	170	1,016
ULASF_10	06-08-05	Slow	Public-supply	930	268	894	662
ULASF_11	06-09-05	Fast	Irrigation	480	80	480	1,783
ULASF_12	06-09-05	Intermediate	Public-supply	199	84	174	448
ULASFU_01	05-25-05	Fast	Public-supply	267	138	248	1,253
ULASFU_02	05-25-05	Fast	Public-supply	196	110	196	1,383
ULASFU_03	06-09-05	Slow	Public-supply	268	100	253	393
ULASFU_04	06-16-05	Slow	Public-supply	800	400	780	823
ULASFU_05	07-19-05	Fast	Industrial	610	310	600	853
ULASFU_06	07-20-05	Slow	Public-supply	820	370	770	788
San Gabriel study area							
ULASG_01	06-07-05	Fast	Public-supply	810	670	790	462
ULASG_02	06-08-05	Fast	Public-supply	480	358	480	1,657
ULASG_03	06-08-05	Fast	Public-supply	372	62	370	1,153
ULASG_04	06-14-05	Fast	Public-supply	198	128	193	327
ULASG_05	06-14-05	Intermediate	Public-supply	1,290	1,013	1,275	302
ULASG_06	06-14-05	Slow	Public-supply	712	166	712	202
ULASG_07	06-14-05	Fast	Public-supply	587	260	587	1,203
ULASG_08	06-15-05	Slow	Public-supply	399	110	299	718
ULASG_09	06-15-05	Fast	Public-supply	600	300	580	451
ULASG_10	06-15-05	Fast	Public-supply	785	291	762	522
ULASG_11	06-16-05	Intermediate	Public-supply	490	160	365	1,153
ULASG_12	06-16-05	Fast	Public-supply	600	229	600	322
ULASG_13	06-16-05	Fast	Public-supply	970	320	970	312
ULASG_14	06-20-05	Slow	Industrial	1,000	500	1,000	553
ULASG_15	06-23-05	Slow	Public-supply	400	115	340	683
ULASG_16	07-11-05	Slow	Public-supply	414	157	233	800
ULASG_17	07-11-05	Fast	Public-supply	186	na	na	720
ULASG_18	07-12-05	Fast	Public-supply	700	286	585	963
ULASG_19	07-12-05	Fast	Industrial	804	260	804	305
ULASG_20	07-12-05	Fast	Public-supply	500	198	484	404
ULASG_21	07-12-05	Fast	Public-supply	1,152	792	1,132	503
ULASG_22	07-13-05	Fast	Public-supply	785	380	765	753
ULASG_23	07-13-05	Fast	Public-supply	300	na	na	1,379
ULASGU_01	06-08-05	Intermediate	Public-supply	699	143	437	1,228
ULASGU_02	06-13-05	Slow	Irrigation	312	40	312	1,199
ULASGU_03	06-15-05	Fast	Public-supply	507	280	500	609
ULASGU_04	06-21-05	Slow	Public-supply	664	178	400	252
ULASGU_05	06-22-05	Slow	Public-supply	1,008	360	1,008	382
ULASGU_06	07-11-05	Intermediate	Public-supply	1,089	270	1,058	870
ULASGU_07	07-12-05	Slow	Public-supply	800	450	780	549
ULASGU_08	07-13-05	Intermediate	Public-supply	942	292	918	352
ULASGU_09	07-13-05	Slow	Public-supply	600	298	581	372
ULASGU_10	07-14-05	Intermediate	Public-supply	264	25	260	187
ULASGU_11	07-14-05	Slow	Public-supply	580	250	580	425

Table 2. Water-quality indicators and classes of chemical and microbial constituents collected for the slow, intermediate, and fast well sampling schedules in the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.

[**Constituents of special interest** were analyzed at Montgomery Watson Harza Laboratory, Monrovia, California. **Microbial constituents** were analyzed at U.S. Geological Survey Ohio Microbiology Laboratory, Columbus, Ohio.]

Analyte classes	Analyte list table	Schedule		
		Slow	Intermediate	Fast
Water-quality indicators				
Dissolved oxygen, temperature, specific conductance		X	X	X
pH, alkalinity		X		
Turbidity		X		
Organic constituents				
Volatile organic compounds	3A	X	X	X
Gasoline additives and oxygenates	3B	X		
Pesticides	3C	X	X	X
Pesticide degradates	3D	X		
Constituents of special interest				
Perchlorate	3E	X	X	
1,4-dioxane	3E	X	X	
N-nitrosodimethylamine (NDMA)	3E	X	X	
1,2,3-trichloropropane (1,2,3-TCP)	3E	X	X	
Inorganic constituents				
Nutrients and dissolved organic carbon	3F	X	X	
Major and minor ions and trace elements	3G	X	X	
Chromium abundance and species	3H	X	X	X
Arsenic and iron abundances and species	3H	X	X	
Stable isotopes				
Stable isotopes of hydrogen and oxygen in water[1]	3I	X	X	X
Stable isotopes of carbon and carbon-14 activity[2,3]	3I	X		
Radioactivity and noble gases				
Tritium[4]	3I	X	X	X
Tritium and noble gases[5]	3J	X	X	
Radium isotopes[6]	3I	X		
Radon-222	3I	X		
Gross alpha and beta radioactivity[6]	3I	X		
Microbial constituents				
Microbial indicators	3K	X		
Viral indicators	3K	X		

[1] Analyzed at U.S. Geological Survey Stable Isotope Laboratory, Reston, Virginia.

[2] Analyzed at the University of Waterloo, Ontario, Canada.

[3] Analyzed at University of Arizona, Accelerator Mass Spectrometry Laboratory, Tucson, Arizona.

[4] Analyzed at U.S. Geological Survey Stable Isotope and Tritium Laboratory, Menlo Park, California.

[5] Analyzed at Lawrence Livermore National Laboratory, Livermore, California.

[6] Analyzed at Eberline Analytical Services, Richmond, California.

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.

[The five-digit USGS parameter code is used to uniquely identify a specific constituent or property. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. 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 notification level; RSD5-US, U.S. Environmental Protection Agency risk specific dose at a risk factor of $10E^{-5}$. **Abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; THM, trihalomethane; USGS, U.S. Geological Survey; D, detected; na, not available; µg/L, microgram per liter; —, not detected]

Constituent (synonym or abbreviation)	Primary use or source	USGS parameter code	CAS number	LRL (µg/L)	Threshold		Detection
					Type	Value (µg/L)	
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	—
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	0.1	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	D
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	—
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	802	D
1,2-Dibromo-3-chloropropane (DBCP)	Fumigant	82625	96-12-8	0.51	MCL-US	0.2	—
1,2-Dibromoethane (EDB)	Fumigant	77651	106-93-4	0.036	MCL-US	0.05	—
Dibromomethane	Solvent	30217	74-95-3	0.050	na	na	—
1,2-Dichlorobenzene	Solvent	34536	95-50-1	0.048	MCL-CA	600	D
1,3-Dichlorobenzene	Solvent	34566	541-73-1	0.03	HAL-US	600	D
1,4-Dichlorobenzene	Fumigant	34571	106-46-7	0.034	MCL-CA	5	D
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	D
1,1-Dichloroethane	Solvent	34496	75-34-3	0.035	MCL-CA	5	D
1,2-Dichloroethane	Solvent	32103	107-06-2	0.13	MCL-CA	0.5	D
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	D
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	D
Ethylbenzene	Gasoline hydrocarbon	34371	100-41-4	0.030	MCL-CA	300	—

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

[The five-digit USGS parameter code is used to uniquely identify a specific constituent or property. **Threshold type:** Mimum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. 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 notification level; RSD5-US, U.S. Environmental Protection Agency risk specific dose at a risk factor of 10E-5. **Abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; THM, trihalomethane; USGS, U.S. Geological Survey; D, detected; na, not available; µg/L, microgram per liter; —, not detected]

Constituent (synonym or abbreviation)	Primary use or source	USGS parameter code	CAS number	LRL (µg/L)	Threshold		Detection
					Type	Value (µg/L)	
Ethyl *tert*-butyl ether (ETBE)	Gasoline oxygenate	50004	637-92-3	0.030	na	na	—
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	D
Methyl iodide (iodomethane)	Organic synthesis	77424	74-88-4	0.50	na	na	—
Methyl isobutyl ketone (MIBK)	Solvent	78133	108-10-1	0.37	NL-CA	120	—
Methyl methacrylate	Organic synthesis	81597	80-62-6	0.20	na	na	—
Methyl *tert*-pentyl ether (*tert*-amyl methyl ether, TAME)	Gasoline oxygenate	50005	994-05-8	0.04	na	na	—
Naphthalene	Gasoline hydrocarbon	34696	91-20-3	0.52	NL-CA	17	—
n-propylbenzene	Solvent	77224	103-65-1	0.042	NL-CA	260	—
Styrene	Gasoline hydrocarbon	77128	100-42-5	0.042	MCL-US	100	—
1,1,1,2-Tetrachloroethane	Solvent	77562	630-20-6	0.03	HAL-US	70	D
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	D
1,1,2-Trichloroethane (1,1,2-TCA)	Solvent	34511	79-00-5	0.04	MCL-CA	5	D
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	D
m- and *p*-xylene	Gasoline hydrocarbon	85795	108-38-3 / 106-42-3	0.06	MCL-CA	[3]1,750	D
o-xylene	Gasoline hydrocarbon	77135	95-47-6	0.038	MCL-CA	[3]1,750	—

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

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

[3] The MCL-US threshold for xylenes is for the sum of *o*-xylene and *m*- and *p*-xylene.

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.

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

Constituent	Primary use or source	USGS parameter code	CAS number	LRL (µg/L)	Threshold		Detection
					Type	Value (µg/L)	
Acetone	Degradate	81552	67-64-1	1.2	na	na	—
tert-Amyl alcohol	Oxygenate	77073	75-85-4	1.0	na	na	—
tert-Butyl alcohol (TBA)	Degradate	77035	75-65-0	1	NL-CA	12	—
Diisopropyl ether (DIPE)	Oxygenate	81577	108-20-3	0.06	na	na	D
Ethyl *tert*-butyl ether (ETBE)	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)	Oxygenate	78032	1634-04-4	0.05	MCL-US	13	D
Methyl *tert*-pentyl ether (TAME)	Oxygenate	50005	994-05-8	0.05	na	na	—

Table 3C. 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.

[The five-digit USGS parameter code is used to uniquely identify a specific constituent or property. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; 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; RSD5-US, U.S. Environmental Protection Agency risk specific dose at a risk factor of $10E^{-5}$. **Abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; USGS, U.S. Geological Survey; D, detected; na, not available; µg/L, microgram per liter; —, not detected]

Constituent	Primary use or source	USGS parameter code	CAS number	LRL (µg/L)	Threshold		Detection
					Type	Value (µg/L)	
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	—
Azinphos-methyl-oxon	Insecticide degradate	61635	961-22-8	0.042	na	na	—
Benfluralin	Herbicide	82673	1861-40-1	0.01	na	na	—
Carbaryl	Insecticide	82680	63-25-2	0.041	RSD5-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	—
Chlorpyrifos	Insecticide	38933	2921-88-2	0.005	HAL-US	2	—
Chlorpyrofos, oxygen analog	Insecticide degradate	61636	5598-15-2	0.0562	na	na	—
Cyfluthrin	Insecticide	61585	68359-37-5	0.053	na	na	—
Cypermethrin	Insecticide	61586	52315-07-8	0.046	na	na	—
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	D
Desulfinylfipronil	Insecticide degradate	62170	na	0.012	na	na	D
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	—
Dicrotophos	Insecticide	38454	141-66-2	0.0843	na	na	—
Dieldrin	Insecticide	39381	60-57-1	0.009	RSD5-US	0.02	—
2,6-Diethylaniline	Solvent	82660	579-66-8	0.006	na	na	—
Dimethoate	Insecticide	82662	60-51-5	0.0061	na	na	—
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	—
Fenamiphos sulfoxide	Insecticide degradate	61646	31972-43-7	0.040	na	na	—
Fipronil	Insecticide	62166	120068-37-3	0.016	na	na	D
Fipronil sulfide	Insecticide degradate	62167	120067-83-6	0.013	na	na	D
Fipronil sulfone	Insecticide degradate	62168	120068-36-2	0.024	na	na	D
Fonofos	Insecticide	04095	944-22-9	0.0053	HAL-US	10	—
Hexazinone	Herbicide	04025	51235-04-2	0.026	HAL-US	400	D
Iprodione	Fungicide	61593	36734-19-7	0.026	na	na	—
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	D
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	D
1-Naphthol	Insecticide degradate	49295	90-15-3	0.0882	na	na	—

Table 3C. 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

[The five-digit USGS parameter code is used to uniquely identify a specific constituent or property. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; 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; RSD5-US, U.S. Environmental Protection Agency risk specific dose at a risk factor of $10E^{-5}$. **Abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; USGS, U.S. Geological Survey; D, detected; na, not available; µg/L, microgram per liter; —, not detected]

Constituent	Primary use or source	USGS parameter code	CAS number	LRL (µg/L)	Threshold		Detection
					Type	Value (µg/L)	
Paraoxon-methyl	Insecticide degradate	61664	950-35-6	0.019	na	na	—
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	—
Phorate	Insecticide	82664	298-02-2	0.055	na	na	—
Phorate oxon	Insecticide degradate	61666	2600-69-3	0.027	na	na	—
Phosmet	Insecticide	61601	732-11-6	0.0079	na	na	—
Phosmet oxon	Insecticide degradate	61668	3735-33-9	0.0511	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	D
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	—

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 2060.

[The five-digit USGS parameter code is used to uniquely identify a specific constituent or property. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; 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; RSD5-US, U.S. Environmental Protection Agency risk specific dose at a risk factor of 10E-5. **Abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; USGS, U.S. Geological Survey; D, detected; na, not available; µg/L, microgram per liter; —, not detected]

Constituent	Primary use or source	USGS parameter code	CAS number	LRL (µg/L)	Threshold		Detection
					Type	Value (µg/L)	
Acifluorfen	Herbicide	49315	50594-66-6	0.028	na	na	—
Aldicarb[1]	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-US	70	D
Bromoxynil	Herbicide	49311	1689-84-5	0.028	na	na	—
Caffeine	Beverages	50305	58-08-2	0.018	na	na	D
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	D
Clopyralid	Herbicide	49305	1702-17-6	0.024	na	na	—
Cycloate	Herbicide	04031	1134-23-2	0.014	na	na	—
2,4-D plus 2,4-D methyl ester (summed on a molar basis)[2]	Herbicide	66496	na	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	—
Deethylatrazine (2-chloro-4-isopropylamino-6-amino-*s*-triazine)	Degradate	04040	6190-65-4	0.028	na	na	D
Deisopropyl atrazine (2-chloro-6-ethylamino-4-amino-*s*-triazine)	Solvent	04038	1007-28-9	0.08	na	na	D
Dicamba	Herbicide	38442	1918-00-9	0.036	HAL-US	4,000	—
Dichlorprop	Herbicide	49302	120-36-5	0.028	na	na	—
Dinoseb	Herbicide	49301	88-85-7	0.038	MCL-CA	7	—
Diphenamid	Herbicide	04033	957-51-7	0.010	HAL-US	200	D
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	—
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	D
3-Hydroxycarbofuran	Degradate	49308	16655-82-6	0.008	na	na	—
Imazaquin	Herbicide	50356	81335-37-7	0.036	na	na	—
Imazethapyr	Herbicide	50407	81335-77-5	0.038	na	na	D
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	—
Metalaxyl	Fungicide	50359	57837-19-1	0.012	na	na	D
Methiocarb	Insecticide	38501	2032-65-7	0.010	na	na	—

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 2060.—Continued

[The five-digit USGS parameter code is used to uniquely identify a specific constituent or property. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; 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; RSD5-US, U.S. Environmental Protection Agency risk specific dose at a risk factor of $10E^{-5}$. **Abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; USGS, U.S. Geological Survey; D, detected; na, not available; µg/L, microgram per liter; —, not detected]

Constituent	Primary use or source	USGS parameter code	CAS number	LRL (µg/L)	Threshold		Detection
					Type	Value (µg/L)	
Methomyl	Insecticide	49296	16752-77-5	0.020	HAL-US	200	—
Metsulfuron methyl[1]	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	—
Norflurazon	Herbicide	49293	27314-13-2	0.020	na	na	—
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	HAL-US	3	—
Siduron	Herbicide	38548	1982-49-6	0.020	na	na	—
Sulfometuron-methyl	Herbicide	50337	74222-97-2	0.038	na	na	D
Tebuthiuron	Herbicide	82670	34014-18-1	0.026	HAL-US	500	D
Terbacil	Herbicide	04032	5902-51-2	0.016	HAL-US	90	—
Triclopyr	Herbicide	49235	55335-06-3	0.026	na	na	—

[1]Although listed as LRLs, these constituents are reported using method reporting levels (MRLs).

[2]The MCL-US threshold shown is for 2,4-D (2,4-dichlorophenoxyacetic acid); no threshold currently exists for 2,4-D methyl ester.

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

[The five-digit USGS parameter code is used to uniquely identify a specific constituent or property. The laboratory entity code for the Montgomery Watson Harza Laboratory in the U.S. Geological Survey National Water Information System (NWIS) is CA-MWHL. **Threshold type:** NL-CA, California notificaiton level. **Abbreviations:** CAS, Chemical Abstract Service; MRL, minimum reporting level; USGS, U.S. Geological Survey; D, detected; µg/L, microgram per liter; —, not detected]

Constituent	Primary use or source	USGS parameter code	CAS number	MRL (µg/L)	Threshold		Detection
					Type	Value (µg/L)	
Perchlorate	Rocket fuel, fireworks, flares	61209	14797-73-0	0.5	NL-CA	6	D
1,2,3-Trichloropropane (TCP)	Industrial solvent, organic synthesis	77443	96-18-4	0.005	NL-CA	0.005	D
1,4-Dioxane	Industrial solvent, solvent stabilizer	81582	123-91-1	2	NL-CA	3	—
N-Nitrosodimethylamine (NDMA)	Disinfection-by-product, rocket fuel, plasticizer	34438	62-75-9	0.002	NL-CA	0.010	D

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

[The five-digit USGS parameter code is used to uniquely identify a specific constituent or property. **Threshold type and value:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory Level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level. **Abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; USGS, U.S. Geological Survey; D, detected; µg/L, microgram per liter; —, not detected]

Constituent	USGS parameter code	CAS number	LRL (µg/L)	Threshold		Detection
				Type	Value (µg/L)	
Ammonia (as nitrogen)	00608	7664-41-7	0.010	HAL-US	30	—
Nitrite (as nitrogen)	00613	14797-65-0	0.008	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 3G. Major and minor ions and trace elements, comparative thresholds, and reporting information for the U.S. Geological Survey National Water Quality Laboratory schedule 1948.

[The five-digit USGS parameter code is used to uniquely identify a specific constituent or property. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; AL-US, U.S. Environmental Protection Agency 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 notification level; SMCL-CA, California Department of Public Health secondary maximum contaminant level. **Abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; USGS, U.S. Geological Survey; D, detected; mg/L, milligram per liter; µg/L, microgram per liter; —, not detected]

Constituent	USGS parameter code	CAS number	LRL (µg/L)	Threshold		Detection
				Type	Value (µg/L)	
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	[1] 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	[1] 250 (500)	D
Residue on evaporation (total dissolved solids, TDS)	70300	na	10	SMCL-US	[1] 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	D
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	—
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

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

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

[The five-digit USGS parameter code is used to uniquely identify a specific constituent or property. The laboratory entity code for the U.S. Geoogical Survey Trace Metal Laboratory in the U.S. Geological Survey National Water Information System (NWIS) is USGSTMCO. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; 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. **Abbreviations:** CAS, Chemical Abstract Service; MDL, method detection limit; USGS, U.S. Geological Survey; D, detected; na, not available; µg/L, microgram per liter; —, not detected]

Constituent (valence state)	USGS parameter code	CAS number	MDL (µg/L)	Threshold		Detection
				Type	Value (µg/L)	
Arsenic (III)	99034	22569-72-8	1	na	na	—
Arsenic (total)	01000	7440-38-2	0.5	MCL-US	10	D
Chromium (VI)	01032	18540-29-9	1	na	na	D
Chromium (total)	01030	7440-47-3	1	MCL-CA	50	D
Iron (II)	01047	7439-89-6	2	na	na	D
Iron (total)	01046	7439-89-6	2	HAL-US	300	D

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

[The five-digit USGS parameter code is used to uniquely identify a specific constituent or property. Laboratory entity codes are listed in the footnotes. 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. **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 when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists. 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. **Abbreviations:** CAS, Chemical Abstract Service; USGS, U.S. Geological Survey; D, detected; pCi/L, picocuries per liter]

Constituent	USGS parameter code	CAS number	Reporting level type	Reporting level or uncertainty	Threshold		Detection
					Type	Value (pCi/L)	
Stable isotope ratios (per mil)							
$\delta^{2}H$ of water[1]	82082	na	MU	2	na	na	D
$\delta^{18}O$ of water[1]	82085	na	MU	0.20	na	na	D
$\delta^{13}C$ of dissolved carbonates[2]	82081	na	1 sigma	0.05	na	na	D
Radioactive constituents (percent modern)							
Carbon-14[3]	49933	14762-75-5	1 sigma	0.0015	na	na	D
Radioactive constituents (pCi/L)							
Gross-alpha radioactivity, 72-hour count[4]	62636	12587-46-1	SSMDC	0.42–1.9	MCL-US	15	D
Gross-alpha radioactivity, 30-day count[4]	62639	12587-46-1	SSMDC	0.31–2.0	MCL-US	15	D
Gross-beta radioactivity, 72-hour count[4]	62642	12587-47-2	SSMDC	0.52–1.0	MCL-CA	50	D
Gross-beta radioactivity, 30-day count[4]	62645	12587-47-2	SSMDC	0.5–1.3	MCL-CA	50	D
Radium-226[4]	09511	13982-63-3	SSMDC	0.009–0.019	MCL-US	[5] 5	D
Radium-228[4]	81366	15262-20-1	SSMDC	0.08–0.19	MCL-US	[5] 5	D
Radon-222[6]	82303	14859-67-7	SSMDC	14–35	Prop. MCL-US	[7] 300 (4,000)	D
Tritium[8,9]	07000	10028-17-8	MRL	1	MCL-CA	20,000	D

[1] U.S. Geological Survey Stable Isotope Laboratory, Reston, Virginia (USGSSIVA).

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

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

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

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

[6] U.S. Geological Survey National Water Quality Laboratory (USGSNWQL).

[7] Two MCLs have been proposed for Radon-222. The proposed alternative MCL is in parentheses.

[8] U.S. Geological Survey Stable Isotope and Tritium Laboratory, Menlo Park, California (USGSH3CA).

[9] Lawrence Livermore National Laboratory (CA-LLNL).

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

[The five-digit USGS parameter code is used to uniquely identify a specific constituent or property. The laboratory entity code for the Lawrence Livermore National Laboratory in the U.S. Geological Survey National Water Information System (NWIS) is CA-LLNL. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level. **Abbreviations:** CAS, Chemical Abstract Service; MU, method uncertainty; USGS, U.S. Geological Survey; D, detected; na, not available; cm^3STP/g, cubic centimeters of gas at standard temperature and pressure per gram of water; pCi/L, picocuries per liter]

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

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

[The five-digit USGS parameter code is used to uniquely identify a specific constituent or property. The laboratory entity code for the U.S. Geological Survey Ohio Microbiology Laboratory in the U.S. Geological Survey National Water Information System (NWIS) is USGSOHML. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; MCL-CA, California Department of Public Health maximum contaminant level; 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. **Abbreviations:** MDL, method detection limit; mL, milliliter; USGS, U.S. Geological Survey; D, detected; na, not available; —, not detected]

Constituent	USGS parameter code	Primary source	MDL	Threshold		Detection
				Type	Value	
Escherichia coli[1]	90901	Sewage and animal waste indicator	1 colony/ 100 mL	TT-US	Zero	—
Total coliform—including fecal coliform and *E. coli*[1]	90900	Sewage and animal waste indicator	1 colony/ 100 mL	MCL-US	5 percent of samples positive per month	D
F-specific coliphage[2]	99335	Sewage and animal waste indicator	na	TT-US	99.99 percent killed/ inactivated	—
Somatic coliphage[2]	99332	Sewage and animal waste indicator	na	TT-US	99.99 percent killed/ inactivated	—

[1] Analyzed in the field.

[2] Analyzed by the U.S. Geological Survey Ohio Microbiology Laboratory (laboratory entity code USGSOHML).

Table 4. Water-quality indicators determined in the field for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.

[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 well identification no:** ULASF, San Fernando study area grid well; ULASG, San Gabriel study area grid well; ULASFU, San Fernando study area understanding well; ULASGU, San Gabriel study area understanding well. **Threshold type:** SMCL-CA, California Department of Public Health secondary maximum contaminant level; SMCL-US, U.S. Environmental Protection Agency secondary maximum contaminant level. The SMCL-CA for specific conductance has recommended and upper threshold values. The upper value is shown in parentheses. **Abbreviations:** GAMA, Ground water Ambient Monitoring and Assessment; M, detected, not quantified; NTU, nephelometric turbidity unit; RL, reporting limit or range; *, value exceeds threshold; E, estimated; na, not available; nc, sample not collected; mg/L, milligram per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; $CaCO_3$, calcium carbonate; >, greater than; <, less than; —, not detected]

GAMA well identification no.	Turbidity (NTU) (63676)	Dissolved oxygen (mg/L) (00300)	Water temperature (degrees Celsius) (00010)	pH, field (standard units) (00400)	Specific conductance, field (µS/cm @ 25 degrees C) (00095)	Alkalinity, field (mg/L as $CaCO_3$) (29802)	Bicarbonate (mg/L) (63786)	Carbonate (mg/L) (63788)	Sulfide (unfiltered, sniff test) (71875)
Threshold type	**na**	**na**	**na**	**SMCL-US**	**SMCL-CA**	**na**	**na**	**na**	**na**
Threshold level	**na**	**na**	**na**	**<6.5, >8.5**	**900 (1,600)**	**na**	**na**	**na**	**na**
Grid wells									
ULASF-01	nc	7.0	22.0	nc	405	nc	nc	nc	—
ULASF-02	nc	5.8	21.5	nc	455	nc	nc	nc	—
ULASF-03	nc	7.4	19.5	nc	555	nc	nc	nc	M
ULASF-04	nc	1.5	18.0	nc	447	nc	nc	nc	—
ULASF-05	nc	0.5	23.5	nc	* 1,240	nc	nc	nc	M
ULASF-06	nc	0.6	23.5	nc	* 1,300	nc	nc	nc	—
ULASF-07	nc	4.4	21.5	nc	685	nc	nc	nc	—
ULASF-08	0.1	4.2	23.5	7.4	758	187	226	<1	—
ULASF-09	0.1	5.8	20.0	6.6	* 1,080	167	204	<1	—
ULASF-10	<0.1	4.2	22.5	7.7	740	174	211	<1	—
ULASF-11	nc	1.5	24.5	nc	* 1,110	nc	nc	nc	nc
ULASF-12	nc	6.9	23.0	nc	822	[1]213	259	<1	nc
ULASG-01	nc	3.4	21.0	nc	* 1,140	nc	nc	nc	nc
ULASG-02	nc	12	18.5	nc	430	nc	nc	nc	nc
ULASG-03	nc	8.6	20.0	nc	429	nc	nc	nc	nc
ULASG-04	nc	7.8	19.5	nc	474	nc	nc	nc	—
ULASG-05	nc	8.7	20.5	nc	427	[1]182	221	1	—
ULASG-06	0.1	1.5	19.0	7.4	852	183	222	1	—
ULASG-07	nc	9.0	16.0	nc	498	nc	nc	nc	—
ULASG-08	0.2	7.6	22.0	7.5	636	155	188	1	nc
ULASG-09	nc	E8	19.5	nc	292	nc	nc	nc	—
ULASG-10	nc	8.2	19.5	nc	581	nc	nc	nc	—
ULASG-11	nc	11	18.0	nc	543	[1]172	209	<1	—
ULASG-12	nc	nc	18.0	nc	480	nc	nc	nc	—
ULASG-13	nc	1.8	24.0	nc	310	nc	nc	nc	—
ULASG-14	4.4	4.6	21.5	7.6	495	182	221	1	—
ULASG-15	0.2	5.2	16.5	7.4	313	151	183	<1	—
ULASG-16	0.2	6.5	21.5	7.0	564	132	160	<1	—
ULASG-17	nc	2.6	21.5	nc	* 1,100	nc	nc	nc	—
ULASG-18	nc	8.3	20.0	nc	492	nc	nc	nc	—
ULASG-19	nc	4.9	22.5	nc	382	nc	nc	nc	—
ULASG-20	nc	2.5	22.5	nc	488	nc	nc	nc	—
ULASG-21	nc	7.9	21.0	nc	674	nc	nc	nc	—
ULASG-22	nc	6.2	21.0	nc	450	nc	nc	nc	—
ULASG-23	nc	9.3	19.0	nc	485	nc	nc	nc	—

Table 4. Water-quality indicators determined in the field for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.—Continued

[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 well identification no:** ULASF, San Fernando study area grid well; ULASG, San Gabriel study area grid well; ULASFU, San Fernando study area understanding well; ULASGU, San Gabriel study area understanding well. **Threshold type:** SMCL-CA, California Department of Public Health secondary maximum contaminant level; SMCL-US, U.S. Environmental Protection Agency secondary maximum contaminant level. The SMCL-CA for specific conductance has recommended and upper threshold values. The upper value is shown in parentheses. **Abbreviations:** GAMA, Ground water Ambient Monitoring and Assessment; M, detected, not quantified; NTU, nephelometric turbidity unit; RL, reporting limit or range; *, value exceeds threshold; E, estimated; na, not available; nc, sample not collected; mg/L, milligram per liter; µS/cm, microsiemens per centimeter at 25 degrees Celsius; $CaCO_3$, calcium carbonate; >, greater than; <, less than; —, not detected]

GAMA well identification no.	Turbidity (NTU) (63676)	Dissolved oxygen (mg/L) (00300)	Water temperature (degrees Celsius) (00010)	pH, field (standard units) (00400)	Specific conductance, field (µS/cm @ 25 degrees C) (00095)	Alkalinity, field (mg/L as $CaCO_3$) (29802)	Bicarbonate (mg/L) (63786)	Carbonate (mg/L) (63788)	Sulfide (unfiltered, sniff test) (71875)
Threshold type	**na**	**na**	**na**	**SMCL-US**	**SMCL-CA**	**na**	**na**	**na**	**na**
Threshold level	**na**	**na**	**na**	**<6.5, >8.5**	**900 (1,600)**	**na**	**na**	**na**	**na**
Understanding wells									
ULASFU-01	nc	6.8	20.0	nc	792	nc	nc	nc	—
ULASFU-02	nc	5.6	20.5	nc	823	nc	nc	nc	M
ULASFU-03	0.1	4.7	21.0	6.9	* 957	222	270	<1	—
ULASFU-04	0.1	7.6	17.0	7.3	637	230	279	<1	nc
ULASFU-05	nc	3.4	17.5	nc	559	nc	nc	nc	nc
ULASFU-06	0.2	8.1	18.5	7.2	605	188	228	1	nc
ULASGU-01	nc	11	20.5	nc	475	[1] 135	164	<1	—
ULASGU-02	0.1	3.3	18.5	6.6	* 906	230	281	<1	nc
ULASGU-03	nc	5.5	18.5	nc	532	nc	nc	nc	—
ULASGU-04	0.1	7.4	21.5	7.5	484	176	213	<1	—
ULASGU-05	0.2	6.5	21.0	7.5	394	163	198	<1	—
ULASGU-06	nc	6.2	22.0	nc	559	[1] 131	159	<1	—
ULASGU-07	<0.1	2.6	24.0	8.2	351	109	129	2	—
ULASGU-08	nc	6.1	20.5	nc	360	[1] 164	199	<1	M
ULASGU-09	0.1	4.8	16.5	7.5	445	203	245	1	—
ULASGU-10	nc	7.2	22.0	nc	820	[1] 159	194	<1	—
ULASGU-11	0.1	8.3	17.0	7.5	329	142	172	1	—

[1] Alkalinity determined by fixed endpoint (pH 4.5) titration at the U.S. Geological Survey, National Water Quality Laboratory, Denver, Colorado.

Table 5. Volatile organic compounds (VOCs) and gasoline oxygenates and degradates detected in samples collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.

[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. Samples from all 52 wells were analyzed, but only samples with detections are listed. **GAMA well identification no**: ULASF, San Fernando study area grid well; ULASG, San Gabriel study area grid well; ULASFU, San Fernando study area understanding well; ULASGU, San Gabriel study area understanding well. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; MCL-CA, California Department of Public Health maximum contaminant level; NL-CA, California Department of Health notification level. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; VOC, volatile organic compounds; E, estimated; na, not available; *, indicates value above threshold value; µg/L, microgram per liter; —, not detected]

GAMA well identification no.	Solvent								
	Tetrachloroethene (µg/L) (34475)	Trichloroethene (µg/L) (39180)	1,1-Dichloroethane (µg/L) (34496)	*cis*-1,2-Dichloroethene (µg/L) (77093)	Tetrachloromethane (µg/L) (32102)	1,1,1-Trichloroethane (µg/L) (34506)	1,2-Dichlorobenzene (µg/L) (34536)	*trans*-1,2-Dichloroethene (µg/L) (34546)	1,1,1,2-Trichloroethane (µg/L) (77562)
Threshold type	**MCL-US**	**MCL-US**	**MCL-CA**	**MCL-CA**	**MCL-CA**	**MCL-US**	**MCL-US**	**MCL-CA**	**HAL-US**
Threshold level	**5**	**5**	**5**	**6**	**0.5**	**200**	**600**	**10**	**70**
LRL	**0.03**	**0.038**	**0.035**	**0.024**	**0.06**	**0.032**	**0.048**	**0.032**	**0.03**
Grid wells (n = 35 wells)									
ULASF-01	E 0.09	—	—	—	—	—	—	—	—
ULASF-02	E0.01	0.38	E 0.01	—	—	—	—	—	—
ULASF-03	—	—	—	—	—	—	—	—	—
ULASF-04	0.47	0.84	—	E 0.03	—	—	—	—	—
ULASF-05	E0.04	0.11	—	—	—	—	—	—	—
ULASF-06	0.20	0.23	—	E0.02	—	E 0.01	—	—	—
ULASF-07	* 220	* 40.3	E0.03	1.30	0.31	E0.02	—	E 0.01	E 0.06
ULASF-08	* 37.4	* 77.6	—	0.31	0.41	—	—	E0.01	—
ULASF-09	1.89	0.11	E0.06	E0.02	E0.03	—	—	—	—
ULASF-10	1.18	3.65	E0.04	0.15	E0.06	—	—	—	—
ULASF-11	—	—	—	—	—	—	—	—	—
ULASF-12	* 12.9	* 24.5	E0.06	0.17	* 0.85	E0.03	—	E0.01	E0.03
ULASG-01	0.18	—	—	—	—	—	—	—	—
ULASG-02	E0.02	—	—	—	—	E0.02	—	—	—
ULASG-03	E0.03	—	—	—	—	—	—	—	—
ULASG-04	0.73	—	—	—	—	E0.01	—	—	—
ULASG-05	—	—	—	—	0.30	—	—	—	—
ULASG-06	2.82	0.38	E0.04	0.21	—	—	—	—	—
ULASG-07	0.47	2.93	E0.09	E0.02	* 2.77	—	—	—	—
ULASG-08	0.23	1.44	0.18	0.39	E0.04	—	—	—	—
ULASG-10	3.70	E0.04	—	—	E0.03	—	E 0.02	—	—
ULASG-11	0.12	E0.08	E0.03	—	—	—	—	—	—
ULASG-12	E0.05	0.17	E0.04	E0.01	—	—	—	—	—
ULASG-13	E0.03	E0.02	—	—	—	—	—	—	—
ULASG-14	—	—	—	—	—	—	—	—	—
ULASG-16	0.13	—	—	—	—	—	—	—	—
ULASG-17	1.79	E0.06	E0.03	—	E0.04	E0.02	—	—	—
ULASG-18	E0.02	—	E0.06	—	—	—	E0.04	—	—
ULASG-19	E0.14	1.37	—	E0.04	—	—	—	—	—
ULASG-20	E0.10	0.27	E0.02	E0.01	—	—	—	—	—
ULASG-21	E0.16	—	—	—	—	—	E0.04	—	—
ULASG-22	E0.02	—	—	—	E0.03	—	—	—	—
ULASG-23	E0.03	—	—	—	—	—	—	—	—
Number of detections	29	19	13	13	11	6	3	3	2
Detection frequency (percent)	83	54	37	37	31	17	9	9	6

Table 5. Volatile organic compounds (VOCs) and gasoline oxygenates and degradates detected in samples collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.—Continued

[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. Samples from all 52 wells were analyzed, but only samples with detections are listed. **GAMA well identification no**: ULASF, San Fernando study area grid well; ULASG, San Gabriel study area grid well; ULASFU, San Fernando study area understanding well; ULASGU, San Gabriel study area understanding well. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; MCL-CA, California Department of Public Health maximum contaminant level; NL-CA, California Department of Health notification level. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; VOC, volatile organic compounds; E, estimated; na, not available; *, indicates value above threshold value; µg/L, microgram per liter; —, not detected]

GAMA well identification no.	Solvent						Gasoline		
	1,1,2-Trichloroethane (µg/L) (34511)	1,2-Dichloroethane (µg/L) (32103)	Dichloromethane (µg/L) (34423)	1,2-Dichloropropane (µg/L) (34541)	1,3-Dichlorobenzene (µg/L) (34566)	Chlorobenzene (µg/L) (34301)	Benzene (µg/L) (34030)	Toluene (µg/L) (34010)	*m*-Xylene- plus *p*-xylene (µg/L) (85795)
Threshold type	**MCL-US**	**MCL-CA**	**MCL-US**	**MCL-US**	**HAL-US**	**MCL-CA**	**MCL-CA**	**MCL-CA**	**MCL-CA**
Threshold level	**5**	**5**	**5**	**5**	**600**	**70**	**1**	**150**	**1,750**
LRL	**0.04**	**0.13**	**0.06**	**0.029**	**0.03**	**0.028**	**0.021**	**0.02**	**0.06**
Grid wells (n = 35 wells)									
ULASF-01	—	—	—	—	—	—	—	—	—
ULASF-02	—	—	—	—	—	—	—	—	—
ULASF-03	—	—	—	—	—	—	—	—	—
ULASF-04	—	—	—	—	—	—	—	—	—
ULASF-05	—	—	—	—	—	—	—	—	—
ULASF-06	—	—	—	—	—	—	—	—	—
ULASF-07	0.15	E 0.1	—	E 0.06	—	—	E 0.01	0.26	—
ULASF-08	—	—	—	—	—	—	—	—	—
ULASF-09	—	—	—	—	—	—	—	—	—
ULASF-10	—	—	—	—	—	—	—	—	—
ULASF-11	—	—	—	—	—	—	—	0.35	—
ULASF-12	E0.07	E0.1	—	—	—	—	E0.01	—	—
ULASG-01	—	—	—	—	—	—	—	—	—
ULASG-02	—	—	—	—	—	—	—	—	—
ULASG-03	—	—	—	—	—	—	—	0.03	—
ULASG-04	—	—	—	—	—	—	—	—	—
ULASG-05	—	—	—	—	—	—	—	—	—
ULASG-06	—	—	—	—	—	—	—	—	—
ULASG-07	—	—	—	—	—	—	—	—	—
ULASG-08	—	—	E 0.04	—	—	—	—	—	—
ULASG-10	—	—	—	—	—	—	—	—	—
ULASG-11	—	—	—	—	—	—	—	—	—
ULASG-12	—	—	—	—	—	—	—	—	—
ULASG-13	—	—	—	—	—	—	—	—	—
ULASG-14	—	—	—	—	—	—	—	—	—
ULASG-16	—	—	—	—	—	—	—	—	—
ULASG-17	—	—	—	—	—	—	—	—	—
ULASG-18	—	—	—	—	E 0.02	—	—	—	—
ULASG-19	—	—	—	—	—	—	—	—	—
ULASG-20	—	—	—	—	—	—	—	—	—
ULASG-21	—	—	—	—	—	—	—	—	—
ULASG-22	—	—	—	—	—	—	—	—	—
ULASG-23	—	—	E0.04	—	—	—	—	—	—
Number of detections	2	2	2	1	1	—	2	2	—
Detection frequency (percent)	6	6	6	3	3	—	6	6	—

Table 5. Volatile organic compounds (VOCs) and gasoline oxygenates and degradates detected in samples collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.—Continued

[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. Samples from all 52 wells were analyzed, but only samples with detections are listed. **GAMA well identification no**: ULASF, San Fernando study area grid well; ULASG, San Gabriel study area grid well; ULASFU, San Fernando study area understanding well; ULASGU, San Gabriel study area understanding well. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; MCL-CA, California Department of Public Health maximum contaminant level; NL-CA, California Department of Health notification level. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; VOC, volatile organic compounds; E, estimated; na, not available; *, indicates value above threshold value; µg/L, microgram per liter; —, not detected]

GAMA well identification no.	Gasoline oxygenate		Fumigant	Disinfection by-product				Solvent, organic
	Methyl *tert*-butyl ether (µg/L) (78032)	Diisopropyl ether (µg/L) (81577)	1,4-Dichloro-benzene (µg/L) (34571)	Trichloro-methane (µg/L) (32106)	Bromodi-chloro-methane (µg/L) (32101)	Dichloro-difluoro-methane (µg/L) (32105)	Tribromo-methane (µg/L) (32104)	1,2,3-Trichloro-propane (µg/L) (77443)
Threshold type	**MCL-CA**	**na**	**MCL-CA**	**MCL-US**	**MCL-US**	**MCL-US**	**MCL-US**	**NL-CA**
Threshold level	**13**	**na**	**5**	**[1]80**	**[1]80**	**[1]80**	**[1]80**	**0.005**
LRL	**0.04**	**0.04**	**0.034**	**0.024**	**0.028**	**0.1**	**0.1**	**0.18**
				Grid wells (n = 35 wells)				
ULASF-01	—	—	—	E 0.03	—	—	—	—
ULASF-02	—	—	—	0.11	—	—	—	—
ULASF-03	—	—	—	0.54	E 0.03	—	—	—
ULASF-04	E 0.04	—	—	E0.04	—	—	—	—
ULASF-05	—	—	—	—	—	—	—	—
ULASF-06	—	—	—	E0.05	—	—	—	—
ULASF-07	—	E 0.03	—	2.40	E0.06	—	—	* 0.40
ULASF-08	—	—	—	0.33	—	—	—	—
ULASF-09	0.2	—	—	0.44	0.14	—	—	—
ULASF-10	—	—	—	0.17	—	—	—	—
ULASF-11	—	—	—	—	—	—	—	—
ULASF-12	E0.1	—	—	0.74	E0.08	—	—	—
ULASG-01	—	—	—	0.29	E0.08	—	—	—
ULASG-02	E0.1	—	—	0.97	0.17	—	—	—
ULASG-03	—	—	—	0.34	E0.09	—	—	—
ULASG-04	0.1	—	—	E0.02	—	—	—	—
ULASG-05	—	—	—	—	—	—	—	—
ULASG-06	0.8	—	—	E0.08	—	—	—	—
ULASG-07	—	—	—	0.95	E0.05	—	—	—
ULASG-08	—	—	—	0.82	0.27	E 0.1	—	—
ULASG-10	—	—	—	E0.05	—	—	—	—
ULASG-11	—	—	—	1.16	0.19	—	—	—
ULASG-12	0.2	—	—	0.79	0.11	0.2	0.40	—
ULASG-13	—	—	—	—	—	—	—	—
ULASG-14	—	—	—	E0.03	—	—	—	—
ULASG-16	—	—	—	E0.09	E0.05	—	—	—
ULASG-17	E0.1	—	—	3.23	0.12	—	—	—
ULASG-18	—	—	E0.03	0.90	0.13	—	—	—
ULASG-19	—	—	—	E0.06	E0.03	E0.1	0.31	—
ULASG-20	0.2	—	—	E0.07	—	—	—	—
ULASG-21	—	—	—	E0.07	E0.03	—	—	—
ULASG-22	0.2	—	—	E0.02	—	—	—	—
ULASG-23	—	—	—	7.46	0.58	E0.1	—	—
Number of detections	10	1	1	29	17	4	2	1
Detection frequency (percent)	29	3	3	83	49	11	6	3

Table 5. Volatile organic compounds (VOCs) and gasoline oxygenates and degradates detected in samples collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.—Continued

[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. Samples from all 52 wells were analyzed, but only samples with detections are listed. **GAMA well identification no**: ULASF, San Fernando study area grid well; ULASG, San Gabriel study area grid well; ULASFU, San Fernando study area understanding well; ULASGU, San Gabriel study area understanding well. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; MCL-CA, California Department of Public Health maximum contaminant level; NL-CA, California Department of Health notification level. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; VOC, volatile organic compounds; E, estimated; na, not available; *, indicates value above threshold value; µg/L, microgram per liter; —, not detected]

GAMA well identification no.	Refrigerant				Organic synthesis			VOC detections per well
	Dichlorodifluoromethane (µg/L) (34668)	1,1,2-Trichloro-1,2,2-trifluoroethane (µg/L) (77652)	Trichlorofluoromethane (µg/L) (34488)	1,1-Dichloroethene (µg/L) (34501)	Carbon disulfide (µg/L) (77041)	1,2,4-Trimethylbenzene (µg/L) (77222)	Vinyl chloride (µg/L) (39175)	
Threshold type	**NL-CA**	**MCL-CA**	**MCL-CA**	**MCL-CA**	**NL-CA**	**NL-CA**	**MCL-CA**	
Threshold level	**1,000**	**1,200**	**150**	**6**	**160**	**330**	**0.5**	
LRL	**0.18**	**0.038**	**0.08**	**0.024**	**0.038**	**0.056**	**0.08**	
Grid wells (n = 35 wells)								
ULASF-01	—	—	—	—	—	—	—	2
ULASF-02	—	—	—	E 0.02	—	—	—	5
ULASF-03	—	—	—	—	—	—	—	2
ULASF-04	E 0.06	—	0.52	0.11	—	—	—	8
ULASF-05	—	—	—	—	—	—	—	2
ULASF-06	—	—	—	—	—	—	—	5
ULASF-07	—	E 0.15	—	0.63	—	—	—	19
ULASF-08	—	—	—	0.21	—	—	—	7
ULASF-09	E0.13	—	—	—	—	—	—	9
ULASF-10	E0.32	—	—	E0.02	—	—	—	8
ULASF-11	—	—	—	—	—	—	—	1
ULASF-12	—	E0.02	0.41	1.10	—	—	—	17
ULASG-01	—	—	—	—	—	—	—	3
ULASG-02	—	—	—	—	—	—	—	5
ULASG-03	—	—	—	0.12	—	—	—	4
ULASG-04	—	1.42	0.34	—	—	—	—	6
ULASG-05	—	—	—	—	—	—	—	1
ULASG-06	—	—	—	E0.06	—	—	—	7
ULASG-07	—	E0.14	—	E0.09	—	—	—	9
ULASG-08	—	—	—	E0.04	—	—	—	10
ULASG-10	—	—	—	—	—	—	—	5
ULASG-11	E0.17	—	—	—	—	—	—	6
ULASG-12	E0.06	—	—	—	—	—	—	10
ULASG-13	—	—	—	—	—	—	—	2
ULASG-14	—	—	—	—	—	—	—	1
ULASG-16	—	—	—	—	—	—	—	3
ULASG-17	—	1.26	E0.09	E0.07	E 0.03	—	—	12
ULASG-18	—	—	—	—	E0.06	—	—	8
ULASG-19	E0.18	—	—	—	E0.03	—	—	9
ULASG-20	E0.10	—	—	—	—	—	—	7
ULASG-21	—	—	—	—	E0.03	—	—	5
ULASG-22	—	—	—	—	E0.03	—	—	5
ULASG-23	—	—	—	—	E0.03	—	—	6
Number of detections	7	5	4	11	6	—	—	209
Detection frequency (percent)	20	14	11	31	17	—	—	[2]94

Table 5. Volatile organic compounds (VOCs) and gasoline oxygenates and degradates detected in samples collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.—Continued

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	Solvent								
GAMA well identification no.	**Tetrachloroethene (µg/L) (34475)**	**Trichloroethene (µg/L) (39180)**	**1,1-Dichloroethene (µg/L) (34496)**	***cis*-1,2-Dichloroethene (µg/L) (77093)**	**Tetrachloromethane (µg/L) (32102)**	**1,1,1-Trichloroethane (µg/L) (34506)**	**1,2-Dichlorobenzene (µg/L) (34536)**	***trans*-1,2-Dichloroethene (µg/L) (34546)**	**1,1,1,2-Trichloroethane (µg/L) (77562)**
Threshold type	**MCL-US**	**MCL-US**	**MCL-CA**	**MCL-CA**	**MCL-CA**	**MCL-US**	**MCL-US**	**MCL-CA**	**HAL-US**
Threshold level	**5**	**5**	**5**	**6**	**0.5**	**200**	**600**	**10**	**70**
LRL	**0.03**	**0.038**	**0.035**	**0.024**	**0.06**	**0.032**	**0.048**	**0.032**	**0.03**
Understanding wells (n = 17 wells)									
ULASFU-01	2.58	0.14	0.13	0.22	—	—	E 0.03	—	—
ULASFU-02	0.33	E0.04	E0.08	—	—	—	—	—	—
ULASFU-03	*12.1	*11.9	E0.03	0.38	0.21	E 0.02	—	—	—
ULASFU-04	0.84	3.29	E0.03	E0.05	E0.02	E0.07	—	—	—
ULASFU-05	E0.07	E0.03	E0.07	.10	—	—	—	—	—
ULASFU-06	E0.08	0.45	—	E0.03	E0.07	E0.06	—	—	—
ULASGU-01	E0.06	—	—	—	E0.03	—	—	—	—
ULASGU-02	—	—	—	—	—	—	—	—	—
ULASGU-03	—	—	—	—	—	—	—	—	—
ULASGU-04	0.95	0.14	—	0.13	—	—	—	—	—
ULASGU-05	E0.05	E0.05	—	—	—	—	—	—	—
ULASGU-06	E0.06	—	—	—	0.23	—	—	—	—
ULASGU-07	—	—	—	—	E0.01	—	—	—	—
ULASGU-08	E0.04	0.19	—	—	—	—	—	—	—
ULASGU-10	—	—	—	—	—	—	—	—	—
ULASGU-11	0.43	0.12	—	E0.04	—	—	—	—	—

Table 5. Volatile organic compounds (VOCs) and gasoline oxygenates and degradates detected in samples collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.—Continued

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GAMA well identification no.	Solvent						Gasoline		
	1,1,2-Trichloroethane (µg/L) (34511)	1,2-Dichloroethane (µg/L) (32103)	Dichloromethane (µg/L) (34423)	1,2-Dichloropropane (µg/L) (34541)	1,3-Dichlorobenzene (µg/L) (34566)	Chlorobenzene (µg/L) (34301)	Benzene (µg/L) (34030)	Toluene (µg/L) (34010)	*m*-Xylene- plus *p*-xylene (µg/L) (85795)
Threshold type	**MCL-US**	**MCL-CA**	**MCL-US**	**MCL-US**	**HAL-US**	**MCL-CA**	**MCL-CA**	**MCL-CA**	**MCL-CA**
Threshold level	**5**	**5**	**5**	**5**	**600**	**70**	**1**	**150**	**1,750**
LRL	**0.04**	**0.13**	**0.06**	**0.029**	**0.03**	**0.028**	**0.021**	**0.02**	**0.06**
Understanding wells (n = 17 wells)									
ULASFU-01	—	—	E 0.10	—	E 0.05	—	—	—	—
ULASFU-02	—	—	E0.03	—	—	—	—	—	—
ULASFU-03	—	E 0.1	—	—	—	—	—	—	—
ULASFU-04	—	—	—	—	—	—	—	—	—
ULASFU-05	—	—	—	E 0.06	—	E 0.04	E 0.02	—	—
ULASFU-06	—	0.2	—	—	—	—	—	—	E 0.02
ULASGU-01	—	—	—	—	—	—	—	—	—
ULASGU-02	—	—	—	—	—	—	—	—	—
ULASGU-03	—	—	—	—	—	—	—	—	—
ULASGU-04	—	—	—	—	—	—	—	—	—
ULASGU-05	—	—	—	—	—	—	—	—	—
ULASGU-06	—	—	—	—	—	—	—	—	—
ULASGU-07	—	—	—	—	—	—	—	—	—
ULASGU-08	—	—	—	—	—	—	—	—	—
ULASGU-10	—	—	—	—	—	—	—	—	—
ULASGU-11	—	—	—	—	—	—	—	—	—

Table 5. Volatile organic compounds (VOCs) and gasoline oxygenates and degradates detected in samples collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.—Continued

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GAMA well identification no.	Gasoline oxygenate		Fumigant	Disinfection by-product				Solvent, organic
	Methyl *tert*-butyl ether (µg/L) (78032)	Diisopropyl ether (µg/L) (81577)	1,4-Dichloro-benzene (µg/L) (34571)	Trichloro-methane (µg/L) (32106)	Bromodi-chloro-methane (µg/L) (32101)	Dibromo-chloro-methane (µg/L) (32105)	Tribromo-methane (µg/L) (32104)	1,2,3-Trichloro-propane (µg/L) (77443)
Threshold type	**MCL-CA**	**na**	**MCL-CA**	**MCL-US**	**MCL-US**	**MCL-US**	**MCL-US**	**NL-CA**
Threshold level	**13**	**na**	**5**	**[1]80**	**[1]80**	**[1]80**	**[1]80**	**0.005**
LRL	**0.04**	**0.04**	**0.034**	**0.024**	**0.028**	**0.1**	**0.1**	**0.18**
Understanding wells (n = 17 wells)								
ULASFU-01	0.3	—	E 0.02	1.62	0.22	E 0.1	—	—
ULASFU-02	0.3	—	—	1.65	0.84	0.3	—	—
ULASFU-03	E0.1	—	—	0.71	0.15	—	—	—
ULASFU-04	—	—	—	E0.08	—	—	—	—
ULASFU-05	E0.1	—	0.26	E0.03	E0.02	—	—	—
ULASFU-06	—	—	—	E0.06	—	—	—	—
ULASGU-01	0.1	—	—	.19	E0.07	—	—	—
ULASGU-02	—	—	—	E0.02	—	—	—	—
ULASGU-03	—	—	—	E0.02	—	—	—	—
ULASGU-04	—	—	—	E0.02	—	—	—	—
ULASGU-05	—	—	—	—	—	—	—	—
ULASGU-06	1.2	—	—	0.15	E0.04	—	—	—
ULASGU-07	—	—	—	—	—	—	—	—
ULASGU-08	—	—	—	E0.01	—	—	—	—
ULASGU-10	—	—	—	—	—	—	—	—
ULASGU-11	—	—	—	—	—	—	—	—

Table 5. Volatile organic compounds (VOCs) and gasoline oxygenates and degradates detected in samples collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.—Continued

[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. Samples from all 52 wells were analyzed, but only samples with detections are listed. **GAMA well identification no**: ULASF, San Fernando study area grid well; ULASG, San Gabriel study area grid well; ULASFU, San Fernando study area understanding well; ULASGU, San Gabriel study area understanding well. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; MCL-CA, California Department of Public Health maximum contaminant level; NL-CA, California Department of Health notification level. **Abbreviations:** GAMA, Ground water Ambient Monitoring and Assessment; VOC, volatile organic compounds; E, estimated; na, not available; *, indicates value above threshold value; µg/L, microgram per liter; —, not detected]

GAMA well identification no.	Refrigerant				Organic synthesis			VOC detections per well
	Dichlorodifluoromethane (µg/L) (34668)	1,1,2-Trichloro-1,2,2-trifluoroethane (µg/L) (77652)	Trichlorofluoromethane (µg/L) (34488)	1,1-Dichloroethene (µg/L) (34501)	Carbon disulfide (µg/L) (77041)	1,2,4-Trimethylbenzene (µg/L) (77222)	Vinyl chloride (µg/L) (39175)	
Threshold type	**NL-CA**	**MCL-CA**	**MCL-CA**	**MCL-CA**	**NL-CA**	**NL-CA**	**MCL-CA**	
Threshold level	**1,000**	**1,200**	**150**	**6**	**160**	**330**	**0.5**	
LRL	**0.18**	**0.038**	**0.08**	**0.024**	**0.038**	**0.056**	**0.08**	
Understanding wells (n = 17 wells)								
ULASFU-01	E 0.40	—	—	—	—	—	—	13
ULASFU-02	—	E 0.03	—	—	—	—	—	9
ULASFU-03	E0.29	E0.02	0.22	0.25	—	—	—	14
ULASFU-04	E0.08	0 .24	24	0.25	—	—	—	11
ULASFU-05	—	—	—	—	—	—	0.1	12
ULASFU-06	—	—	—	E0.03	—	0.14	—	10
ULASGU-01	—	—	—	—	—	—	—	5
ULASGU-02	—	—	—	—	—	—	—	1
ULASGU-03	—	—	—	—	—	—	—	1
ULASGU-04	—	—	—	—	—	—	—	4
ULASGU-05	—	—	—	—	—	—	—	2
ULASGU-06	E0.09	—	—	—	E 0.02	—	—	7
ULASGU-07	—	—	—	—	—	—	—	1
ULASGU-08	E0.03	—	—	—	E0.04	—	—	5
ULASGU-10	—	—	—	—	E0.04	—	—	1
ULASGU-11	—	—	—	E0.03	—	—	—	4

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

[2] Frequency of detection of at least one VOC in the grid wells.

Table 6. Pesticides and pesticide degradates detected in samples collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.

[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. Samples from all 51 wells were analyzed on schedule 2003, and 24 wells on schedule 2060, but only samples with detections are listed. **GAMA well identification no:** ULASF, San Fernando study area grid well; ULASG, San Gabriel study area grid well; ULASFU, San Fernando study area understanding well; ULASGU, San Gabriel study area understanding well. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; MCL-CA, California Department of Public Health maximum contaminant level; RSD5-US, U.S. Environmental Protection Agency risk specific does at a risk factor of $10E^{-5}$. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; LRL, laboratory reporting level; E, estimated value; nc, not collected or not computed; µg/L, microgram per liter; —, not detected]

GAMA well identification no.	Degradate							
	2-Chloro-4-isopropylamino-6-amino-*s*-triazine (µg/L) (04040)	3,4-Dichloroaniline (µg/L) (61625)	2-Chloro-6-ethylamino-4-amino-*s*-triazine (µg/L) (04038)	3-(4-Chlorophenyl)-1-methyl urea (µg/L) (61692)	Fipronil sulfide (µg/L) (62167)	2-Hydroxy-4-isopropylamino-6-ethylamino-*s*-triazine (µg/L) (50355)	Desulfinyl fipronil (µg/L) (62170)	Fipronil sulfone (µg/L) (62168)
Threshold type								
Threshold level								
LRL	**0.006**	**0.0045**	**0.08**	**0.036**	**0.013**	**0.032**	**0.012**	**0.024**
Grid wells (n = 35 wells)								
ULASF-01	—	—	nc	nc	—	nc	—	—
ULASF-02	—	—	nc	nc	—	nc	—	—
ULASF-04	E0.009	—	nc	nc	—	nc	—	—
ULASF-05	E0.003	—	nc	nc	—	nc	—	—
ULASF-06	E0.004	—	nc	nc	—	nc	—	—
ULASF-07	E0.044	—	nc	nc	—	nc	—	—
ULASF-08	E0.004	—	—	—	—	—	—	—
ULASF-09	E0.014	—	E0.02	—	—	—	—	—
ULASF-10	E0.007	—	E0.01	—	—	—	—	—
ULASF-12	E0.005	—	—	—	—	—	—	—
ULASG-01	E0.018	—	nc	nc	—	nc	—	—
ULASG-02	E0.009	—	nc	nc	—	nc	—	—
ULASG-03	E0.006	—	nc	nc	—	nc	—	—
ULASG-04	E0.045	—	nc	nc	—	nc	—	—
ULASG-06	E0.021	E0.006	E0.01	E0.01	E0.007	—	—	—
ULASG-07	E0.005	—	nc	nc	—	nc	—	—
ULASG-08	E0.021	—	—	—	—	—	—	—
ULASG-09	—	—	nc	nc	—	nc	—	—
ULASG-10	E0.022	E0.007	nc	nc	—	nc	—	—
ULASG-11	E0.014	E0.002	E0.02	—	—	—	—	—
ULASG-12	E0.042	—	nc	nc	—	nc	—	—
ULASG-14	E0.004	—	—	—	—	—	—	—
ULASG-15	—	E0.003	—	—	—	—	—	—
ULASG-16	E0.025	E0.007	E0.01	—	—	—	—	—
ULASG-17	E0.037	—	nc	nc	—	nc	—	—
ULASG-18	E0.006	—	nc	nc	—	nc	—	—
ULASG-19	E0.005	—	nc	nc	—	nc	—	—
ULASG-20	E0.010	E0.009	nc	nc	—	nc	—	—
ULASG-21	E0.008	—	nc	nc	—	nc	—	—
ULASG-22	E0.019	E0.002	nc	nc	—	nc	—	—
ULASG-23	E0.005	—	nc	nc	—	nc	—	—
Number of detections	27	7	nc	nc	1	nc	nc	nc
Detection frequency (percent)	77	20	nc	nc	3	nc	nc	nc

Table 6. Pesticides and pesticide degradates detected in samples collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.—Continued

[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. Samples from all 51 wells were analyzed on schedule 2003, and 24 wells on schedule 2060, but only samples with detections are listed. **GAMA well identification no:** ULASF, San Fernando study area grid well; ULASG, San Gabriel study area grid well; ULASFU, San Fernando study area understanding well; ULASGU, San Gabriel study area understanding well. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; MCL-CA, California Department of Public Health maximum contaminant level; RSD5-US, U.S. Environmental Protection Agency risk specific does at a risk factor of $10E^{-5}$. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; LRL, laboratory reporting level; E, estimated value; nc, not collected or not computed; µg/L, microgram per liter; —, not detected]

GAMA well identification no.	Herbicide								
	Simazine (µg/L) (04035)	Atrazine (µg/L) (39632)	Prometon (µg/L) (04037)	Tebuthiuron (µg/L) (82670)	Diuron (µg/L) (49300)	Hexazinone (µg/L) (04025)	Bromacil (µg/L) (04029)	Metolachlor (µg/L) (39415)	Diphenamid (µg/L) (04033)
Threshold type	**MCL-US**	**MCL-CA**	**HAL-US**	**HAL-US**	**RSD5-US**	**HAL-US**	**HAL-US**	**HAL-US**	**HAL-US**
Threshold level	**4**	**1**	**100**	**500**	**20**	**400**	**700**	**700**	**200**
LRL	**0.005**	**0.007**	**0.01**	**0.016**	**0.015**	**0.0129**	**0.018**	**0.006**	**0.01**
Grid wells (n = 35 wells)									
ULASF-01	0.015	—	—	—	nc	—	nc	—	nc
ULASF-02	0.013	—	—	—	nc	—	nc	—	nc
ULASF-04	0.045	0.008	E0.01	0.02	nc	—	nc	—	nc
ULASF-05	—	—	—	—	nc	—	nc	—	nc
ULASF-06	—	—	—	—	nc	—	nc	—	nc
ULASF-07	0.026	0.023	—	—	nc	—	nc	—	nc
ULASF-08	0.012	E0.006	E0.01	—	—	—	—	—	—
ULASF-09	0.044	0.026	—	E0.02	—	—	E0.01	—	—
ULASF-10	0.005	0.009	—	—	—	—	—	—	—
ULASF-12	0.005	E0.006	—	—	—	—	0.04	—	—
ULASG-01	0.072	0.020	—	0.03	nc	—	nc	—	nc
ULASG-02	0.030	0.007	—	—	nc	—	nc	—	nc
ULASG-03	0.005	—	—	—	nc	—	nc	—	nc
ULASG-04	0.067	0.081	—	—	nc	—	nc	—	nc
ULASG-06	0.067	0.030	0.01	E0.01	0.05	E0.007	—	E0.002	—
ULASG-07	0.015	E0.007	—	—	nc	—	nc	—	nc
ULASG-08	0.010	0.029	—	—	0.02	—	—	—	E0.01
ULASG-09	0.011	—	—	—	nc	—	nc	—	nc
ULASG-10	0.022	0.116	—	—	nc	—	nc	—	nc
ULASG-11	0.023	0.018	—	—	—	—	—	—	—
ULASG-12	0.125	0.084	—	—	nc	—	nc	—	nc
ULASG-14	0.017	—	—	—	—	—	—	—	—
ULASG-15	0.008	—	—	—	—	—	—	—	—
ULASG-16	0.023	0.028	E0.01	—	0.07	—	—	—	—
ULASG-17	0.012	0.047	—	0.14	nc	0.058	nc	—	nc
ULASG-18	0.009	E0.007	—	—	nc	—	nc	—	nc
ULASG-19	—	E0.005	—	—	nc	—	nc	—	nc
ULASG-20	0.140	0.150	E0.01	—	nc	E0.007	nc	E0.002	nc
ULASG-21	—	—	—	—	nc	—	nc	—	nc
ULASG-22	0.030	0.021	—	—	nc	—	nc	—	nc
ULASG-23	0.010	E0.004	E0.01	—	nc	—	nc	—	nc
Number of detections	27	22	6	5	nc	3	nc	2	nc
Detection frequency (percent)	77	63	17	14	nc	9	nc	6	nc

Table 6. Pesticides and pesticide degradates detected in samples collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.—Continued

[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. Samples from all 51 wells were analyzed on schedule 2003, and 24 wells on schedule 2060, but only samples with detections are listed. **GAMA well identification no:** ULASF, San Fernando study area grid well; ULASG, San Gabriel study area grid well; ULASFU, San Fernando study area understanding well; ULASGU, San Gabriel study area understanding well. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; MCL-CA, California Department of Public Health maximum contaminant level; RSD5-US, U.S. Environmental Protection Agency risk specific does at a risk factor of $10E^{-5}$. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; LRL, laboratory reporting level; E, estimated value; nc, not collected or not computed; µg/L, microgram per liter; —, not detected]

GAMA well identification no.	Herbicide		Fungicide		Insecticide	Pesticide detections per well
	Imazethapyr (µg/L) (50407)	Sulfometuron (µg/L) (50337)	Metalaxyl (µg/L) (61596)	Myclobutanil (µg/L) (61599)	Fipronil (µg/L) (62166)	
Threshold type						
Threshold level						
LRL	**0.038**	**0.038**	**0.0051**	**0.008**	**0.016**	
Grid wells (n = 35 wells)						
ULASF-01	nc	nc	—	—	—	1
ULASF-02	nc	nc	—	—	—	1
ULASF-04	nc	nc	—	—	—	5
ULASF-05	nc	nc	—	—	—	1
ULASF-06	nc	nc	—	—	—	1
ULASF-07	nc	nc	—	—	—	3
ULASF-08	—	—	—	—	—	4
ULASF-09	—	—	—	—	—	4
ULASF-10	—	—	—	—	—	3
ULASF-12	—	—	—	—	—	3
ULASG-01	nc	nc	—	—	—	4
ULASG-02	nc	nc	—	—	—	3
ULASG-03	nc	nc	—	—	—	2
ULASG-04	nc	nc	—	—	—	3
ULASG-06	E0.02	—	0.015	—	E0.008	15
ULASG-07	nc	nc	—	—	—	3
ULASG-08	—	—	—	—	—	5
ULASG-09	nc	nc	—	—	—	1
ULASG-10	nc	nc	—	—	—	4
ULASG-11	—	—	—	—	—	5
ULASG-12	nc	nc	—	—	—	3
ULASG-14	—	—	—	—	—	2
ULASG-15	—	—	—	—	—	2
ULASG-16	—	—	—	—	—	7
ULASG-17	nc	nc	—	—	—	5
ULASG-18	nc	nc	—	—	—	3
ULASG-19	nc	nc	—	—	—	2
ULASG-20	nc	nc	0.144	0.009	—	9
ULASG-21	nc	nc	—	—	—	1
ULASG-22	nc	nc	—	—	—	4
ULASG-23	nc	nc	—	—	—	4
Number of detections	nc	nc	2	1	1	113
Detection frequency (percent)	nc	nc	6	3	3	[1]89

Table 6. Pesticides and pesticide degradates detected in samples collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.—Continued

[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. Samples from all 51 wells were analyzed on schedule 2003, and 24 wells on schedule 2060, but only samples with detections are listed. **GAMA well identification no:** ULASF, San Fernando study area grid well; ULASG, San Gabriel study area grid well; ULASFU, San Fernando study area understanding well; ULASGU, San Gabriel study area understanding well. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; MCL-CA, California Department of Public Health maximum contaminant level; RSD5-US, U.S. Environmental Protection Agency risk specific does at a risk factor of $10E^{-5}$. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; LRL, laboratory reporting level; E, estimated value; nc, not collected or not computed; µg/L, microgram per liter; —, not detected]

GAMA well identification no.	Degradate							
	2-Chloro-4-isopropylamino-6-amino-*s*-triazine (µg/L) (04040)	3,4-Dichloroaniline (µg/L) (61625)	2-Chloro-6-ethylamino-4-amino-*s*-triazine (µg/L) (04038)	3-(4-Chlorophenyl)-1-methyl urea (µg/L) (61692)	Fipronil sulfide (µg/L) (62167)	2-Hydroxy-4-isopropylamino-6-ethylamino-*s*-triazine (µg/L) (50355)	Desulfinyl fipronil (µg/L) (62170)	Fipronil sulfone (µg/L) (62168)
Threshold type								
Threshold level								
LRL	**0.006**	**0.0045**	**0.08**	**0.036**	**0.013**	**0.032**	**0.012**	**0.016**
Understanding wells (n = 16 wells)								
ULASFU-01	E0.011	—	nc	nc	—	nc	—	—
ULASFU-02	E0.009	—	nc	nc	—	nc	—	—
ULASFU-03	E0.012	—	—	—	—	—	—	—
ULASFU-04	E0.014	E0.013	E0.02	—	—	—	—	—
ULASFU-05	E0.005	—	nc	nc	—	nc	—	—
ULASFU-06	E0.015	E0.005	E0.03	—	—	—	—	—
ULASGU-01	E0.010	—	E0.02	—	—	—	—	—
ULASGU-02	E0.005	—	E0.02	—	—	—	—	—
ULASGU-03	nc	nc	nc	nc	nc	nc	nc	nc
ULASGU-04	E0.005	—	—	—	—	—	—	—
ULASGU-06	E0.004	—	—	—	—	—	—	—
ULASGU-07	—	—	—	—	—	—	—	—
ULASGU-09	E0.004	—	—	—	—	—	—	—
ULASGU-10	E0.006	E0.003	—	E0.01	E0.006	0.035	E0.005	E0.006
ULASGU-11	E0.007	—	—	—	—	—	—	—

Table 6. Pesticides and pesticide degradates detected in samples collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.—Continued

[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. Samples from all 51 wells were analyzed on schedule 2003, and 24 wells on schedule 2060, but only samples with detections are listed. **GAMA well identification no:** ULASF, San Fernando study area grid well; ULASG, San Gabriel study area grid well; ULASFU, San Fernando study area understanding well; ULASGU, San Gabriel study area understanding well. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; MCL-CA, California Department of Public Health maximum contaminant level; RSD5-US, U.S. Environmental Protection Agency risk specific does at a risk factor of $10E^{-5}$. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; LRL, laboratory reporting level; E, estimated; nc, not collected or not computed; µg/L, microgram per liter; —, not detected]

GAMA well identification no.	Herbicide								
	Simazine (µg/L) (04035)	Atrazine (µg/L) (39632)	Prometon (µg/L) (04037)	Tebu-thiuron (µg/L) (82670)	Diuron (µg/L) (49300)	Hexa-zinone (µg/L) (04025)	Bromacil (µg/L) (04029)	Meto-lachlor (µg/L) (39415)	Diphen-amid (µg/L) (04033)
Threshold type	**MCL-US**	**MCL-CA**	**HAL-US**	**HAL-US**	**RSD5-US**	**HAL-US**	**HAL-US**	**HAL-US**	**HAL-US**
Threshold level	**4**	**1**	**100**	**500**	**20**	**400**	**70**	**700**	**200**
LRL	**0.05**	**0.007**	**0.01**	**0.016**	**0.015**	**0.0129**	**0.0018**	**0.006**	**0.01**
Understanding wells (n = 16 wells)									
ULASFU-01	0.013	0.015	—	—	nc	—	nc	—	nc
ULASFU-02	0.012	0.009	—	0.03	nc	—	nc	—	nc
ULASFU-03	0.012	0.014	E0.01	E0.04	—	—	—	—	—
ULASFU-04	0.067	0.015	—	E0.01	0.05	—	—	E0.004	—
ULASFU-05	0.015	E0.005	—	0.04	nc	—	nc	—	nc
ULASFU-06	0.042	0.021	—	—	0.05	—	—	—	—
ULASGU-01	0.007	0.011	—	—	—	—	—	—	0.01
ULASGU-02	0.031	—	—	—	—	—	—	—	—
ULASGU-03	nc	nc	nc	nc	nc	nc	nc	nc	nc
ULASGU-04	0.008	E0.007	—	0.02	—	—	—	E0.005	—
ULASGU-06	0.009	E0.004	E0.01	—	—	—	—	—	0.02
ULASGU-07	—	E0.004	—	—	—	—	—	—	—
ULASGU-09	0.007	E0.006	—	—	—	—	—	—	—
ULASGU-10	0.051	0.008	0.01	—	0.10	—	—	—	—
ULASGU-11	0.014	E0.007	0.04	—	—	—	—	—	—

Table 6. Pesticides and pesticide degradates detected in samples collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.—Continued

[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. Samples from all 51 wells were analyzed on schedule 2003, and 24 wells on schedule 2060, but only samples with detections are listed. **GAMA well identification no:** ULASF, San Fernando study area grid well; ULASG, San Gabriel study area grid well; ULASFU, San Fernando study area understanding well; ULASGU, San Gabriel study area understanding well. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; MCL-CA, California Department of Public Health maximum contaminant level; RSD5-US, U.S. Environmental Protection Agency risk specific does at a risk factor of $10E^{-5}$. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; LRL, laboratory reporting level; E, estimated value; nc, not collected or not computed; µg/L, microgram per liter; —, not detected]

GAMA well identification no.	Herbicide		Fungicide		Insecticide	Pesticide detections per well
	Imazethapyr (µg/L) (50407)	Sulfometuron (µg/L) (50337)	Metalaxyl (µg/L) (61596)	Myclobutanil (µg/L) (61599)	Fipronil (µg/L) (62166)	
Threshold type						
Threshold level						
LRL	**0.038**	**0.038**	**0.00051**	**0.008**	**0.016**	
Understanding wells (n = 16 wells)						
ULASFU-01	nc	nc	—	—	—	3
ULASFU-02	nc	nc	—	—	—	4
ULASFU-03	—	—	—	—	—	5
ULASFU-04	—	—	—	—	—	8
ULASFU-05	nc	nc	—	—	—	4
ULASFU-06	—	—	—	—	—	6
ULASGU-01	—	—	—	—	—	5
ULASGU-02	—	—	—	—	—	3
ULASGU-03	nc	nc	nc	nc	nc	—
ULASGU-04	—	—	E0.004	—	—	6
ULASGU-06	—	—	—	—	—	5
ULASGU-07	—	—	—	—	—	1
ULASGU-09	—	—	—	—	—	3
ULASGU-10	—	0.064	—	—	E0.008	13
ULASGU-11	—	—	—	—	—	4

[1]Frequency of detection of at least one pesticide or pesticide degradate in the grid wells.

Table 7. Constituents of special interest: perchlorate, *N*-nitrosodimethylamine (NDMA), 1,2,3-trichloropropane (1,2,3-TCP), and 1,4-dioxane in the ground-water samples collected in the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.

[The five-digit number in parentheses below the constituent name is the U.S. Geological Survey (USGS) parameter code used to uniquely identify a specific constituent or property. The laboratory entity code for the Montgomery Watson Harza Laboratory in the USGS National Water Information System (NWIS) is CA-MWHL. Samples from 24 intermediate and slow wells were analyzed; only wells with at least one detection are listed. **GAMA well identification no.:** ULASF, San Fernando study area grid well; ULASFU, San Fernando study area understanding well; ULASG, San Gabriel study area grid well; ULASGU, San Gabriel study area understanding well. **Threshold type:** NL-CA, California Department of Public Health notification level. **Abbreviations:** GAMA, Ground water Ambient Monitoring and Assessment; MRL, method reporting limit; µg/L, microgram per liter; *, indicates value equal to or above threshold level; —, not detected]

GAMA well identification no.	Perchlorate (µg/L) (61209)	*N*-nitroso-dimethylamine (NMDA) (µg/L) (34438)	1,2,3-trichloro-propane (µg/L) (77443)	1,4-dioxane (µg/L) (81582)
Threshold type	**NL-CA**	**NL-CA**	**NL-CA**	**NL-CA**
Threshold level	**6**	**0.01**	**0.005**	**3**
MRL	**0.5**	**0.002**	**0.005**	**2**
ULASF-12	2.3	—	—	—
ULASFU-03	2.7	—	—	—
ULASFU-04	2.0	—	—	—
ULASFU-06	3.1	—	—	—
ULASG-06	—	0.0044	—	—
ULASG-08	3.8	—	—	—
ULASG-11	2.5	—	—	—
ULASG-14	—	—	* 0.005	—
ULASG-16	0.77	—	—	—
ULASGU-01	4.1	* 0.061	—	—
ULASGU-02	1.7	—	—	—
ULASGU-07	0.76	—	—	—

Table 8. Nutrients and dissolved organic carbon in samples collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.

[The five-digit number in parentheses below the constituent name is the U.S. Geological Survey (USGS) parameter code used to uniquely identify a specific constituent or property. Samples from 24 intermediate and slow wells were analyzed; only wells with at least one detection are listed. **GAMA well identification no.:** ULASF, San Fernando study area grid well; ULASFU, San Fernando study area understanding well; ULASG, San Gabriel study area grid well; ULASGU, San Gabriel study area understanding well. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; 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. **Abbreviations:** GAMA, Ground water Ambient Monitoring and Assessment; LRL, laboratory reporting level; E, estimated value; V, analyte detected in sample and an associated blank, thus data are not included in ground-water quality assessment; mg/L, milligram per liter; na, not available; *, indicates value above threshold level; —, not detected]

GAMA well identification no.	Ammonia, as nitrogen (mg/L) (00608)	Nitrite plus nitrate, as nitrogen (mg/L) (00631)	Nitrite, as nitrogen (mg/L) (00613)	Total nitrogen (nitrate + nitrite + ammonia + organic-nitrogen) as nitrogen (mg/L) (62854)	Phosphorus, as ortho-phosphate (mg/L) (00671)	Dissolved organic carbon (DOC) (mg/L) (00681)
Threshold type	**HAL-US**	**MCL-US**	**MCL-US**	**na**	**na**	**na**
Threshold level	**25**	**10**	**1**	**na**	**na**	**na**
LRL	**0.010**	**0.060**	**0.008**	**0.06**	**0.006**	**0.33**
ULASF-08	—	3.02	E0.006	3.06	0.015	V0.3
ULASF-09	—	9.74	—	[1] 9.61	0.024	V1.0
ULASF-10	—	1.90	—	[1] 1.83	0.022	V0.2
ULASF-12	—	8.98	—	[1] 8.37	0.046	nc
ULASFU-03	—	8.70	—	8.73	0.075	V0.5
ULASFU-04	—	2.97	—	3.06	0.051	V0.5
ULASFU-06	—	3.05	—	3.30	0.037	V0.4
ULASG-05	—	0.66	—	[1] 0.65	0.040	nc
ULASG-06	—	1.91	—	2.03	0.008	V0.7
ULASG-08	—	*10.3	—	10.5	0.018	V0.4
ULASG-11	—	5.00	—	[1] 4.91	0.020	nc
ULASG-14	—	1.09	—	[1] 1.08	E0.005	V0.2
ULASG-15	—	0.79	—	0.85	E0.003	V0.6
ULASG-16	—	3.59	—	3.69	0.036	V0.4
ULASGU-01	—	8.51	—	8.67	0.008	nc
ULASGU-02	—	6.06	—	[1] 5.84	0.019	V0.8
ULASGU-04	—	1.47	—	[1] 1.41	0.031	V0.3
ULASGU-05	—	3.64	—	[1] 3.63	0.046	V0.3
ULASGU-06	—	5.80	—	[1] 5.66	0.022	nc
ULASGU-07	—	2.56	—	2.67	0.012	V0.3
ULASGU-08	—	1.17	—	1.20	0.048	nc
ULASGU-09	—	0.54	—	0.56	0.006	V0.4
ULASGU-10	—	2.05	—	[1] 2.00	0.017	nc
ULASGU-11	—	0.97	—	0.98	0.006	V0.5

[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 total dissolved solids detected in samples collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.

[The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Samples from 24 intermediate and slow wells were analyzed. **GAMA well identification no.:** ULASF, San Fernando study area grid well; ULASFU, San Fernando study area understanding well; ULASG, San Gabriel study area grid well; ULASGU, San Gabriel study area understanding well. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; MCL-CA, California Department of Public Healtlh 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, Ground water Ambient Monitoring and Assessment; LRL, laboratory reporting level; E, estimated value; mg/L, milligram per liter; *, indicates value above threshold level; —, not detected]

GAMA well 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)
Threshold type	**na**	**na**	**na**	**na**	**na**	**SMCL-CA**	**MCL-CA**	**na**	**na**	**SMCL-CA**	**SMCL-CA**
Threshold level	**na**	**na**	**na**	**na**	**na**	**250 (500)**	**2**	**na**	**na**	**250 (500)**	**500 (1,000)**
LRL	**0.02**	**0.008**	**0.16**	**0.2**	**0.02**	**0.2**	**0.1**	**0.002**	**0.04**	**0.18**	**10**
ULASF_08	76.8	19.4	4.26	52.0	0.22	44.2	0.5	0.034	24.7	122	490
ULASF_09	113	41.9	3.44	44.2	0.23	111	0.2	0.005	45.6	166	* 702
ULASF_10	63.3	14.3	3.88	68.8	0.31	58.5	0.4	0.055	24.3	101	454
ULASF_12	94.2	34.4	2.42	39.5	0.28	66.1	0.3	E0.002	39.7	103	* 549
ULASFU_03	96.0	36.6	2.90	54.0	0.35	75.1	0.3	0.003	40.8	121	* 608
ULASFU_04	81.7	21.3	3.77	27.4	0.13	16.1	0.5	E0.001	28.7	73.3	394
ULASFU_06	81.0	18.6	4.16	24.3	0.10	16.7	0.3	E0.002	24.7	91.7	383
ULASG_05	52.7	12.4	3.00	19.1	0.02	12.1	0.5	—	28.0	25.7	272
ULASG_06	96.5	19.2	5.39	50.4	0.20	82.6	0.3	0.014	22.7	116	* 543
ULASG_08	65.2	20.2	2.25	35.6	0.11	40.4	0.7	E0 .001	26.1	65.0	400
ULASG_11	67.5	22.0	2.32	18.6	0.08	25.9	0.6	E0 .001	29.6	60.7	354
ULASG_14	58.1	13.7	4.39	28.0	0.10	29.0	0.3	—	18.3	30.1	287
ULASG_15	38.6	11.2	3.07	21.7	0.02	6.39	0.3	E0 .001	14.3	17.0	199
ULASG_16	48.7	17.7	2.78	43.3	0.20	58.4	0.6	E0 .001	26.2	54.1	353
ULASGU_01	52.7	6.86	1.86	35.7	0.06	16.7	0.2	—	22.5	52.4	318
ULASGU_02	98.2	35.2	3.04	41.2	0.17	62.2	0.8	0.008	33.8	108	* 599
ULASGU_04	56.5	13.0	3.49	34.3	0.06	23.3	0.4	E0 .002	27.6	41.0	302
ULASGU_05	47.4	13.2	1.43	24.0	0.03	9.73	0.8	—	27.1	17.1	242
ULASGU_06	56.5	14.6	1.78	32.8	0.08	32.6	1.1	—	24.2	66.8	339
ULASGU_07	20.4	1.24	0.64	52.5	0.05	13.1	1.1	0.007	15.3	33.1	222
ULASGU_08	40.4	10.5	1.03	24.0	0.14	6.87	0.9	—	25.2	13.5	224
ULASGU_09	64.9	13.3	3.61	10.6	0.16	10.4	0.3	E0 .001	17.0	23.4	268
ULASGU_10	60.8	15.3	5.66	91.2	—	90.3	0.4	0.014	19.5	121	* 511
ULASGU_11	46.1	8.80	3.08	9.91	0.04	7.57	0.3	E0.001	16.2	18.3	200

Table 10. Trace elements detected in samples collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.

[The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Samples from 24 intermediate and slow wells were analyzed. **GAMA well identification no.:** ULASF, San Fernando study area grid well; ULASFU, San Fernando study area understanding well; ULASG, San Gabriel study area grid well; ULASGU, San Gabriel study area understanding well. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; AL-US, U.S. Environmental Protection Agency action level; NL-CA, California Department of Public Health notification level; SMCL-CA, California Department of Public Health secondary maximum contaminant level. **Abbreviations:** GAMA. Groundwater Ambient Monitoring and Assessment; LRL, laboratory reporting level; E, estimated value; µg/L, microgram per liter; *, indicates value above threshold level; —, not detected]

GAMA well identification no.	Aluminum (µg/L) (01106)	Antimony (µgL) (01095)	Arsenic (µg/L) (01000)	Barium (µg/L) (01005)	Boron (µg/L) (01020)	Cadmium (µg/L) (01025)	Chromium (µg/L) (01030)	Cobalt (µg/L) (01035)	Copper (µg/L) (01040)	Iron (µg/L) (01046)	Lead (µg/L) (01049)
Threshold type	**MCL-CA**	**MCL-US**	**MCL-US**	**MCL-CA**	**NL-CA**	**MCL-US**	**MCL-CA**	**na**	**AL-US**	**SMCL-CA**	**AL-US**
Threshold level	**1,000**	**6**	**10**	**1,000**	**1,000**	**5**	**50**	**na**	**1,300**	**300**	**15**
LRL	**1.6**	**0.2**	**0.12**	**0.2**	**8**	**0.04**	**0.04**	**0.04**	**0.4**	**6**	**0.08**
ULASF_08	E1.5	—	0.6	66	241	0.05	4.8	0.199	50.4	E5	0.34
ULASF_09	—	—	0.5	121	123	E0.02	E0.5	0.374	4.0	E4	0.43
ULASF_10	E1.1	—	0.6	69	295	E0.03	2.4	0.098	1.2	—	0.09
ULASF_12	E1.3	—	0.6	72	87	—	48.9	00.153	32.1	—	1.07
ULASFU_03	E1.1	—	0.6	86	221	E0.04	3.3	0.197	3.2	—	0.49
ULASFU_04	E1.1	—	0.3	111	190	—	E0.5	0.142	0.8	—	0.16
ULASFU_06	1.8	—	0.4	105	106	—	1.6	0.156	2.0	—	0.25
ULASG_05	E1.2	E 0.15	2.7	109	38	E0.02	6.0	E0.339	2.0	—	0.11
ULASG_06	2.3	E0.18	1.5	117	163	0.04	1.8	1.78	3.2	—	0.67
ULASG_08	E1.4	E0.14	0.7	41	128	—	5.1	0.127	3.6	—	0.55
ULASG_11	E0.9	E0.18	0.8	36	87	—	—	0.109	4.4	E5	2.80
ULASG_14	E1.0	0.38	3.1	114	78	—	—	0.102	1.3	6	0.57
ULASG_15	E1.5	0.46	2.5	84	78	—	—	0.081	1.5	—	0.10
ULASG_16	E0.8	—	0.6	74	183	E0.03	—	0.09	4.3	23	1.23
ULASGU_01	E0.9	—	1.4	46	52	—	2.4	0.086	1.5	—	0.41
ULASGU_02	—	—	0.4	121	66	—	—	0.194	3.1	—	0.42
ULASGU_04	E0.8	E0.16	2.6	127	57	—	5.5	00.196	0.9	—	1.16
ULASGU_05	E1.4	—	0.6	19	269	—	8.8	0.085	2.2	—	0.56
ULASGU_06	1.8	0.25	0.8	31	98	0.04	5.7	0.097	1.5	7	0.58
ULASGU_07	5.1	E0.18	3.4	11	153	E0.03	4.6	0.039	0.5	—	0.15
ULASGU_08	—	—	0.8	22	206	—	8.6	0.043	1.8	E3	0.34
ULASGU_09	E1.1	0.22	2.0	154	64	—	1.0	0.102	1.0	E5	0.37
ULASGU_10	—	E0.18	1.9	53	252	0.04	—	2.88	3.4	7	0.11
ULASGU_11	E1.5	0.28	2.2	98	63	—	—	.093	1.4	—	0.39

Table 10. Trace elements detected in samples collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.—Continued

[The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Samples from 24 intermediate and slow wells were analyzed. **GAMA well identification no.:** ULASF, San Fernando study area grid well; ULASFU, San Fernando study area understanding well; ULASG, San Gabriel study area grid well; ULASGU, San Gabriel study area understanding well. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; AL-US, U.S. Environmental Protection Agency action level; NL-CA, California Department of Public Health notification level; SMCL-CA, California Department of Public Health secondary maximum contaminant level. **Abbreviations:** GAMA. Groundwater Ambient Monitoring and Assessment; LRL, laboratory reporting level; E, estimated value; µg/L, microgram per liter; *, indicates value above threshold level; —, not detected]

GAMA well identification no.	Lithium (µg/L) (01130)	Manganese (µgL) (01056)	Mercury (µg/L) (71890)	Molybdenum (µg/L) (01060)	Nickel (µg/L) (01065)	Selenium (µg/L) (01145)	Strontium (µg/L) (01080)	Tungsten (µg/L) (01155)	Uranium (µg/L) (22703)	Vanadium (µg/L) (01085)	Zinc (µg/L) (01090)
Threshold type	**na**	**SMCL-CA**	**MCL-US**	**HAL-US**	**MCL-CA**	**MCL-US**	**HAL-US**	**na**	**MCL-US**	**NL-CA**	**SMCL-CA**
Threshold level	**na**	**50**	**2**	**40**	**100**	**50**	**4,000**	**na**	**30**	**50**	**5,000**
LRL	**0.6**	**0.2**	**0.01**	**0.4**	**0.06**	**0.08**	**0.4**	**0.06**	**0.04**	**0.1**	**0.6**
ULASF_08	3.6	9.7	—	10.2	4.11	2.4	653	—	6.12	5.3	4.1
ULASF_09	3.4	E0.1	E 0.007	4.2	5.74	0.8	925	—	9.25	4.2	3.7
ULASF_10	3.5	1.1	0.019	13.9	1.71	0.7	559	—	3.12	7.5	E0.4
ULASF_12	2.4	E0.1	—	2.8	2.45	0.7	550	—	3.23	6.6	6.8
ULASFU_03	2.8	E0.1	—	2.4	3.68	1.4	590	—	4.53	6.6	1.9
ULASFU_04	1.8	—	—	7.2	2.99	0.7	594	—	5.15	3.7	1.0
ULASFU_06	0.8	E0.2	E0.010	3.4	2.71	2.4	526	—	4.28	3.7	2.7
ULASG_05	1.4	E0.1	—	5.8	3.26	0.5	281	—	2.63	5.0	2.2
ULASG_06	1.3	0.3	—	1.3	4.54	E 0.3	646	—	3.47	2.3	8.8
ULASG_08	3.7	0.8	0.383	7.2	2.62	0.5	474	—	13.0	6.7	3.3
ULASG_11	0.6	E0.1	0.020	5.3	2.31	0.4	465	—	12.4	3.3	11.2
ULASG_14	E0.3	1.6	—	1.5	9.92	0.5	559	—	2.16	2.0	8.7
ULASG_15	2.4	—	—	2.2	1.81	E 0.3	336	—	1.48	1.6	2.6
ULASG_16	0.6	2.7	—	3.6	2.05	1.4	265	—	1.98	4.3	7.2
ULASGU_01	1.7	E0.1	—	1.9	1.53	0.5	395	—	1.8	7.1	9.7
ULASGU_02	4.8	E0.2	0.012	2.2	3.62	E0.2	563	—	2.12	2.8	22.8
ULASGU_04	1.7	—	—	4.6	2.29	0.5	333	—	1.75	5.5	1.2
ULASGU_05	E0.6	E0.1	—	5.0	2.36	E0.4	273	—	2.50	5.6	3.5
ULASGU_06	E0.5	2.0	—	15.1	1.92	E0.4	393	—	15.2	10.9	5.3
ULASGU_07	0.6	—	E0.005	11.0	0.72	—	179	2.9	2.60	24.5	0.7
ULASGU_08	0.7	0.7	—	3.3	1.75	E0.4	248	—	1.64	5.1	5.2
ULASGU_09	E0.5	E0.1	—	1.6	2.46	—	606	—	3.04	1.8	0.9
ULASGU_10	3.0	34.8	—	4.3	5.71	1.7	420	—	1.36	2.3	2.8
ULASGU_11	E0.4	—	—	1.7	1.38	E0.3	420	—	1.68	2.4	1.7

Table 11. Inorganic arsenic and iron species detected in samples collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.

[The five-digit number in parentheses below the constituent name is the U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. The laboratory entity code for the USGS Trace Metals Laboratory in the USGS National Water Information System (NWIS) is USGSTMCO. Samples from 24 intermediate and slow wells were analyzed; only wells with at least one detection are listed. **GAMA well identification no.:** ULASF, San Fernando study area grid well; ULASFU, San Fernando study area understanding well; ULASG, San Gabriel study area grid well; ULASGU, San Gabriel study area understanding well. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; 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. **Abbreviations:** GAMA, Ground water Ambient Monitoring and Assessment; MDL, method detection limit; na, not available; µg/L, microgram per liter; —, not detected]

GAMA well identification no.	Arsenic (µg/L) (99033)	Arsenic III (µgL) (99034)	Iron (µg/L) (01046)	Iron III (µg/L) (01047)
Threshold type	**MCL-US**	**na**	**SMCL-CA**	**na**
Threshold level	**10**	**na**	**300**	**na**
MDL	**0.5**	**2**	**2**	**2**
ULASF_08	—	—	4	—
ULASF_09	—	—	—	—
ULASF_10	—	—	—	—
ULASF_12	—	—	—	—
ULASFU_03	—	—	—	—
ULASFU_04	—	—	—	—
ULASFU_06	—	—	—	—
ULASG_05	2.2	—	—	—
ULASG_06	1.5	—	—	—
ULASG_08	0.9	—	3	—
ULASG_11	0.6	—	3	—
ULASG_14	2.9	—	4	—
ULASG_15	2.1	—	—	—
ULASG_16	0.6	—	23	14
ULASGU_01	1.0	—	2	—
ULASGU_02	—	—	—	—
ULASGU_04	1.5	—	—	—
ULASGU_05	—	—	—	—
ULASGU_06	0.9	—	5	—
ULASGU_07	2.6	—	—	—
ULASGU_08	0.5	—	—	—
ULASGU_09	1.7	—	—	—
ULASGU_10	1.7	—	4	3
ULASGU_11	1.9	—	—	—

Table 12. Chromium species detected in samples collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.

[The five-digit number in parentheses below the constituent name is the U.S. Geological Survey (USGS) parameter code used to uniquely identify a specific constituent or property. The laboratory entity code for the USGS Trace Metals Laboratory in the USGS National Water Information System (NWIS) is USGSTMCO. Samples from 52 wells were analyzed for chromium. **GAMA well identification no.:** ULASF, San Fernando study area grid well; ULASFU, San Fernando study area understanding well; ULASG, San Gabriel study area grid well; ULASGU, San Gabriel study area understanding well. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level. **Abbreviations:** GAMA, Ground water Ambient Monitoring and Assessment; MDL, method detection limit; µg/L, micrograms per liter; *, indicates value above threshold level; V, analyte detected in sample and an associated blank, thus data are not included in ground-water quality assessment; —, not detected]

GAMA well identification no.	Chromium (µg/L) (01030)	Chromium (VI) (µgL) (01032)
Threshold type	**MCL-CA**	**na**
Threshold level	**50**	**na**
MDL	**1**	**1**
Grid wells (n = 35 wells)		
ULASF_01	11.5	11.7
ULASF_02	12.7	13.4
ULASF_03	13.0	13.1
ULASF_04	9.3	9.8
ULASF_05	15.8	13.3
ULASF_06	17.9	16.5
ULASF_07	14.7	16.9
ULASF_08	18.4	13.2
ULASF_09	11.8	11.0
ULASF_10	V2.6	V2.2
ULASF_11	17.7	11.9
ULASF_12	* 62.2	58.9
ULASG_01	22.1	20.0
ULASG_02	17.6	18.3
ULASG_03	22.3	17.5
ULASG_04	1.3	1.9
ULASG_05	6.0	5.4
ULASG_06	V1.9	V1.3
ULASG_07	2.9	2.1
ULASG_08	V7.2	V5.2
ULASG_09	1.0	—
ULASG_10	5.0	3.8
ULASG_12	1.7	1.5
ULASG_13	3.2	2.9
ULASG_15	1.9	2.1
ULASG_16	2.4	2.1
ULASG_17	2.5	1.8
ULASG_18	2.8	2.4
ULASG_19	17.3	27.2
ULASG_20	—	1.9
ULASG_21	5.7	5.5
ULASG_22	8.5	8.2
ULASG_23	5.6	6.0
Number of detections	29	29
Detection frequency (percent)	91	91

GAMA well identification no.	Chromium (µg/L) (01030)	Chromium (VI) (µgL) (01032)
Threshold type	**MCL-CA**	**na**
Threshold level	**50**	**na**
MDL	**1**	**1**
Understanding wells (n = 17 wells)		
ULASFU_01	12.8	11.4
ULASFU_02	14.1	13.4
ULASFU_03	V3.5	V3.9
ULASFU_04	V1.1	V—
ULASFU_05	1.7	1.8
ULASFU_06	3.2	4.1
ULASGU_01	23.5	18.4
ULASGU_04	V6.5	V5.2
ULASGU_05	11.1	10.9
ULASGU_06	4.8	5.3
ULASGU_07	7.7	6.8
ULASGU_08	11.9	11.5
ULASGU_09	2.3	2.0
ULASGU_10	4.9	5.4
ULASGU_11	2.3	1.9

Table 13. Hydrogen and oxygen isotope ratios for water, and tritium activities, in samples collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.

[The five-digit number in parentheses below the constituent name is the U.S. Geological Survey (USGS) parameter code used to uniquely identify a specific constituent or property. Samples from all 52 wells were analyzed for stable isotopes of water; samples from 51 wells were analyzed for tritium. 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 well identification No.:** ULASF, San Fernando study area grid well; ULASFU, San Fernando study area understanding well; ULASG, San Gabriel study area grid well; ULASGU, San Gabriel study area understanding well. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level. **Laboratory:** Isotopes analyzed at USGS Stable Isotope Laboratory, Reston, Virginia (USGSSIVA); Tritium analyzed at USGS Stable Isotope and Tritium Laboratory, Menlo Park, California (USGSH3CA). **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; pCi/L, picocuries per liter; na, not available; nc, sample not collected; —, not detected]

GAMA well identification no.	δ^2H (per mil) (82082	$\delta^{18}O$ (per mil) (82085)	Tritium (pCi/L) (07000)
Threshold type	**na**	**na**	**MCL-CA**
Threshold level	**na**	**na**	**20,000**
Grid wells (n = 35 wells)			
ULASF_01	–44.2	–6.80	4.8
ULASF_02	–54.8	–8.25	5.1
ULASF_03	–52.9	–8.00	3.5
ULASF_04	–51.7	–8.02	16.3
ULASF_05	–41.5	–6.71	—
ULASF_06	–49.2	–7.14	3.5
ULASF_07	–54.7	–7.90	14.1
ULASF_08	–52.4	–7.67	3.2
ULASF_09	–54.5	–7.61	20.5
ULASF_10	–51.6	–7.66	3.8
ULASF_11	–53.4	–8.30	—
ULASF_12	–46.3	–6.71	7.0
ULASG_01	–45.4	–6.45	8.0
ULASG_02	–56.2	–8.63	9.9
ULASG_03	–59.9	–8.96	10.9
ULASG_04	–48.0	–6.41	18.6
ULASG_05	–51.5	–7.81	—
ULASG_06	–59.1	–8.36	19.5
ULASG_07	–49.6	–7.57	17.0
ULASG_08	–47.6	–7.20	6.1
ULASG_09	–61.2	–9.27	12.8
ULASG_10	–43.6	–6.52	5.1
ULASG_11	–48.9	–7.57	15.0
ULASG_12	–50.6	–6.94	13.8
ULASG_13	–47.0	–7.28	—
ULASG_14	–59.4	–8.42	13.4
ULASG_15	–60.5	–9.22	14.7
ULASG_16	–61.4	–8.57	12.2
ULASG_17	–50.8	–7.68	9.0
ULASG_18	–47.7	–7.46	10.9
ULASG_19	–47.0	–7.34	4.5
ULASG_20	–59.2	–8.27	13.4
ULASG_21	–45.4	–7.00	5.1
ULASG_22	–45.9	–7.29	7.0
ULASG_23	–60.8	–9.27	14.7
Number of detections			31
Detection frequency (percent)			89

GAMA well identification No.	δ^2H (per mil) (82082	$\delta^{18}O$ (per mil) (82085)	Tritium (pCi/L) (07000)
Threshold type	**na**	**na**	**MCL-CA**
Threshold level	**na**	**na**	**20,000**
Understanding wells (n = 17 wells)			
ULASFU_01	–50.1	–7.70	13.1
ULASFU_02	–50.4	–7.81	18.6
ULASFU_03	–47.4	–7.01	16.0
ULASFU_04	–54.6	–8.05	10.9
ULASFU_05	–54.8	–7.57	15.4
ULASFU_06	–54.3	–8.01	6.7
ULASGU_01	–60.2	–9.13	7.7
ULASGU_02	–47.7	–7.26	14.1
ULASGU_03	–59.2	–8.62	nc
ULASGU_04	–51.8	–8.06	2.9
ULASGU_05	–44.1	–7.09	—
ULASGU_06	–47.3	–7.33	9.0
ULASGU_07	–47.1	–7.11	1.0
ULASGU_08	–46.0	–7.38	—
ULASGU_09	–58.0	–8.53	13.4
ULASGU_10	–55.6	–7.78	22.7
ULASGU_11	–61.3	–9.00	17.0

Table 14. Carbon isotopes in samples collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.

[The five-digit number in parentheses below the constituent name is the U.S. Geological Survey parameter code used to uniquely identify a specific constituent or property. Samples from 17 slow wells were analyzed for the isotopes of carbon. 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. **Laboratory:** carbon stable isotopes analyzed at University of Waterloo (contract laboratory) (CAN-UWIL); Carbon-14 analyzed at University of Arizona, Accelerator Mass Spectrometry Laboratory (contract laboratory) (AZ-UAMSL). **GAMA well identification no.:** ULASF, San Fernando study area grid well; ULASFU, San Fernando study area understanding well; ULASG, San Gabriel study area grid well; ULASGU, San Gabriel study area understanding well. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; na, not available]

GAMA well identification no.	$\delta^{13}C$ (per mil) (82081)	Carbon-14 (percent modern) (49933)
Threshold type	**na**	**na**
Threshold level	**na**	**na**
ULASF_08	–13.8	78.4
ULASF_09	–16.0	99.5
ULASF_10	–14.9	79.1
ULASFU_03	–16.7	104
ULASFU_04	–14.3	104
ULASFU_06	–12.4	102
ULASG_06	–13.2	91.9
ULASG_08	–14.9	93.0
ULASG_14	–12.7	97.1
ULASG_15	–11.4	96.4
ULASG_16	–15.2	103
ULASGU_02	–15.3	105
ULASGU_04	–11.8	83.2
ULASGU_05	–13.2	85.8
ULASGU_07	–14.6	72.4
ULASGU_09	–13.2	98.9
ULASGU_11	–11.5	99.9

Table 15. Results for analyses of noble gases and tritium in samples collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.

[The five-digit number in parentheses below the constituent name is the U.S. Geological Survey (USGS) parameter code used to uniquely identify a specific constituent or property. The laboratory entity code for the Lawrence Livermore National Laboratory in the USGS National Water Information System (NWIS) is CA-LLNL. Samples collected from 24 intermediate and slow wells were analyzed. **GAMA well identification no.:** ULASF, San Fernando study area grid well; ULASFU, San Fernando study area understanding well; ULASG, San Gabriel study area grid well; ULASGU, San Gabriel study area understanding well. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; 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; cm^3 STP g^{-1}, cubic centimeters at standard temperature and pressure per gram of water; na, not available; nc, sample not collected; pCi/L, picocuries per liter]

GAMA well 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)	Helium-4 (85561)	Neon (61046)	Argon (85563)	Krypton (85565)	Xenon (85567)
						(cm^3 STP g^{-1})				
					$\times 10^{-6}$	$\times 10^{-7}$	$\times 10^{-7}$	$\times 10^{-4}$	$\times 10^{-7}$	$\times 10^{-8}$
Threshold type	**MCL-CA**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**
Threshold level	**20,000**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**	**na**
ULASF_08	06-06-05	3.8	0.2	08-10-05	0.73	3.00	4.28	4.83	0.96	1.19
ULASF_09	06-07-05	20.9	0.8	08-10-05	1.29	0.66	2.51	3.66	0.79	1.02
ULASF_10	06-08-05	4.7	0.3	08-10-05	0.31	7.32	4.59	4.93	0.99	1.24
ULASF_12	06-09-05	7.0	0.5	08-10-05	1.07	1.31	4.03	4.98	0.97	1.16
ULASFU_03	06-09-05	16.2	0.7	08-10-05	1.28	0.76	2.37	3.55	0.77	1.01
ULASFU_04	06-16-05	11.0	0.5	08-11-05	1.43	1.73	6.56	6.31	1.17	1.37
ULASFU_06	07-20-05	8.1	0.4	08-18-05	1.49	1.07	4.20	4.97	0.99	1.21
ULASG_05	06-14-05	1.0	0.2	08-11-05	1.25	1.69	3.91	4.55	0.92	1.18
ULASG_06	06-14-05	21.4	0.8	08-11-05	1.64	0.71	2.83	3.83	0.81	1.04
ULASG_07	06-14-05	15.8	0.7	08-11-05	1.41	2.56	9.35	8.03	1.34	1.53
ULASG_08	06-15-05	nc	nc	08-11-05	1.52	0.67	2.67	3.75	0.83	1.04
ULASG_14	06-20-05	16.1	0.7	08-12-05	1.37	1.57	6.55	6.65	1.21	1.43
ULASG_15	06-23-05	13.5	0.6	08-12-05	1.36	0.83	3.39	4.24	0.92	1.19
ULASG_16	07-11-05	nc	nc	08-17-05	1.39	1.04	4.36	5.01	0.93	1.12
ULASGU_01	06-08-05	7.7	0.4	08-10-05	1.29	1.32	4.84	5.60	1.07	1.34
ULASGU_02	06-13-05	16.6	0.7	08-11-05	1.11	0.85	2.37	3.61	0.80	1.07
ULASGU_04	06-21-05	4.3	0.3	08-12-05	1.17	1.93	3.55	4.31	0.91	1.13
ULASGU_05	06-22-05	1.1	0.1	08-12-05	1.06	1.08	3.29	4.27	0.90	1.12
ULASGU_06	07-11-05	9.7	0.5	08-17-05	0.53	2.43	3.07	3.94	0.83	1.10
ULASGU_07	07-12-05	0.9	0.2	08-17-05	0.29	5.22	2.74	3.90	0.85	1.13
ULASGU_08	07-13-05	1.5	0.2	08-17-05	1.13	1.10	3.54	4.52	0.95	1.22
ULASGU_09	07-13-05	12.8	0.6	08-17-05	1.42	1.17	4.69	5.00	1.01	1.25
ULASGU_10	07-14-05	23.0	0.9	08-17-05	1.38	1.50	5.88	6.60	1.26	1.37
ULASGU_11	07-14-05	14.6	0.7	08-17-05	1.40	1.72	6.61	6.05	1.14	1.38

Table 16. Radioactive constituents detected in samples collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.

[The five-digit number in parentheses below the constituent name is the U.S. Geological Survey (USGS) parameter code used to uniquely identify a specific constituent or property. Samples from 17 slow wells were analyzed. **GAMA well identification no.:** ULASF, San Fernando study area grid well; ULASFU, San Fernando study area understanding well; ULASG, San Gabriel study area grid well; ULASGU, San Gabriel study area understanding well. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level. The MCL-US threshold for radium is the sum of radium-226 and radium-228. Two MCLs have been proposed for radon-222. The proposed alternative MCL is in parenthesis. **Laboratory**: All constituents except radon-222 were analyzed at Eberline Analytical Services (contract laboratory) (CA-EBERL); Radon-222 was analyzed at the USGS National Water Quality Laboratory (USGSNWQL). **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; E, estimated value; V, analyte detected in sample and an associated blank, thus data are not included in ground-water quality assessment; nc, sample not collected; pCi/L, picocuries per liter; *, indicates value above threshold level; <, less than]

GAMA well identification no.	Gross-alpha radioactivity (pCi/L)		Gross-beta radioactivity (pCi/L)		Radium-226 (pCi/L) (09511)	Radium-228 (pCi/L) (81366)	Radon-222 (pCi/L) (82303)
	72-hour count (62636)	30-day count (62639)	72-hour count (62642)	30-day count (62645)			
Threshold type	**MCL-US**	**MCL-US**	**MCL-CA**	**MCL-CA**	**MCL-US**	**MCL-US**	**Proposed MCL-US**
Threshold level	**15**	**15**	**50**	**50**	**5**	**5**	**300, (4,000)**
ULASF_08	E4.40	< 2.40	6.00	5.90	0.089	E0.41	* 360
ULASF_09	11.80	11.50	5.53	11.50	0.146	0.58	* 660
ULASF_10	E2.08	< 2.00	4.19	4.81	E0.052	<0.44	* 330
ULASFU_03	3.75	E0.88	E2.84	4.43	E0.056	<0.44	* 500
ULASFU_04	4.92	E3.18	4.46	5.59	0.075	<0.50	* 440
ULASFU_06	3.46	E2.48	5.38	4.45	0.144	<0.55	* 410
ULASG_06	E2.77	<2.30	6.67	6.60	E0.076	<0.51	nc
ULASG_08	12.00	12.70	4.58	9.10	0.091	<0.62	* 840
ULASG_14	E0.91	E1.43	4.83	4.95	E0.064	<0.46	* 380
ULASG_15	2.64	E0.98	3.88	3.19	V0.023	E0.28	20
ULASG_16	E2.02	E1.24	E3.14	E3.49	0.086	<0.42	* 930
ULASGU_02	E2.50	E1.04	E3.97	4.21	0.094	V0.23	* 460
ULASGU_04	E2.69	E1.98	3.91	3.58	E0.053	E0.29	260
ULASGU_05	E2.36	E2.82	E1.58	E2.21	E0.046	E0.38	* 360
ULASGU_07	E2.70	E1.48	<2.40	E1.43	V0.016	<0.42	* 490
ULASGU_09	E1.82	E1.77	E2.60	4.13	0.068	<0.42	* 350
ULASGU_11	<1.90	E0.58	E4.20	4.42	0.077	<0.53	* 360

Table 17. Microbial indicators detected in samples collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.

[The five-digit number in parentheses below the constituent name is the U.S. Geological Survey (USGS) parameter code used to uniquely identify a specific constituent or property. Samples from 17 slow wells were analyzed. **GAMA well identification no.:** ULASF, San Fernando study area grid well; ULASFU, San Fernando study area understanding well; ULASG, San Gabriel study area grid well; ULASGU, San Gabriel study area understanding well. **Threshold type:** Maximum contaminant level thresholds are listed as MCL-US when the MCL-US and MCL-CA are identical, and as MCL-CA when the MCL-CA is lower than the MCL-US or no MCL-US exists; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; TT-US, U.S. Environmental Protection Agency treatment technique. **Laboratory**: F-specific and somatic coliphage were analyzed by the USGS Ohio Microbiology Laboratory (laboratory entity code USGSOHML); *E. coli* and total coliform colonies were analyzed in the field. **Abbreviations:** GAMA, Groundwater Ambient Monitoring and Assessment; E, estimated value; mL, milliliter; nc, not collected; —, not detected]

GAMA well identification no.	F-specific coliphage (99335)	Somatic coliphage (99332)	*E.-coli* colonies/ 100 mL (90901)	Total coliforms colonies/ 100 mL (90900)
Threshold type	**TT-US**	**TT-US**	**TT-US**	**MCL-US**
Threshold level	**99.9 percent killed/ inactive**	**99.9 percent killed/ inactive**	**No fecal coliforms are allowed**	**5 percent of samples per month**
ULASFU_06	—	—	nc	nc
ULASG_08	nc	nc	—	—
ULASGU_11	——	——	—	E5

Appendix

This appendix includes discussions of the methods used to collect and analyze ground-water samples and report the data for SFSG. These methods were selected to obtain representative samples of the ground water from each well and to minimize the potential for contamination of the samples or bias in the data. Procedures used to collect and assess quality-control data, and the results of the quality-control assessments also are discussed.

Sample Collection and Analysis

Ground-water samples were collected using standard and modified protocols in the USGS National Field Manual (U.S. Geological Survey, variously dated) and by Koterba and others (1995), and protocols described by Weiss (1968); Shelton and others (2001); Ball and McClesky (2003a,b); and Wright and others (2005). Prior to sampling, each well was pumped continuously o 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 always was located upstream of any well-head treatment system or water storage tank. If a chlorinating system was attached to the well, the chlorinator was shut off at least 24 hours prior to purging and sampling the well to remove all chlorine from the system. For the fast and intermediate schedules (see table 1), 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 10–50 ft length of the Teflon tubing (Lane and others, 2003). All fittings and lengths of tubing were cleaned between samples (Wilde, 2004).

Field measurements were made in accordance with protocols in the USGS National Field Manual (Radtke and others, 1998a,b; Rounds and Wilde, 2001; Radtke and others, 2003; Anderson, 2004; Radtke and others, 2004). At wells on the fast or intermediate schedule, SC and temperature were measured directly by dipping a conductivity probe and thermometer into a sample cup. DO was measured by a modified Winkler titration procedure. Sulfide (presence or absence of a “rotten egg” smell in the water) was determined by a serendipitous sniff test (J. Barbash, USGS, written commun., 2002). At wells on the slow schedule, ground water was diverted through a flow-through chamber fitted with a multi-probe sonde that simultaneously measures turbidity, DO, temperature, pH, and SC. All probes were calibrated daily. Measured 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.

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; 2004). Prior to sample collection, polyethylene sample bottles were pre-rinsed two times using deionized water, and then rinsed once with sample water 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 and during daily shipping to the various laboratories. The non-temperature sensitive samples for tritium, noble gases, chromium species, and stable isotopes were shipped monthly, while samples for volatile organic compounds, pesticides, compounds of special interest, dissolved organic carbon, radium isotopes, gross alpha and beta radioactivity, and radon-222 samples were shipped daily.

Detailed sampling protocols for individual analyses and groups of analytes are described in Koterba and others (1995) and the USGS National Field Manual (Wilde and others, 1999; 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, and 1,2,3-trichloropropane (1,2,3-TCP) samples were collected in 40-mL sample baked amber glass vials that were purged with three vial volumes of sample water before bottom filling to eliminate atmospheric contamination. Six normal (6 N) hydrochloric acid (HCl) was added as a preservative to the VOC samples, but not to the gasoline oxygenate and degradate samples, or the 1,2,3-TCP samples. Perchlorate samples were collected in a 125-mL polyethylene bottle. 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. Samples for analysis of the stable isotopes of water were collected in 60-mL clear glass bottles filled with unfiltered water, sealed with a conical cap, and secured with electrical tape to prevent leakage and evaporation.

Pesticides and pesticide degradation products, 1,4-Dioxane, and *N*-nitrosodimethylamine (NDMA) samples were collected in 1-L baked amber glass bottles. Pesticide samples were filtered through a glass-fiber membrane during collection, 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 groundwater, and one 500-mL and one 250-mL polyethylene bottle with filtered ground water (Wilde and others, 2004). Filtration was achieved using a Whatman capsule filter with a 0.45 µm pore size. Each 250-mL filtered sample then was preserved with 7.5-N nitric acid. Mercury samples were collected by filtering ground water into 250-mL glass bottles and preserving each with 6-N hydrochloric acid. Samples for arsenic and iron species were filtered into 250-mL polyethylene bottles that were covered with opaque 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 500-mL polyethylene bottles.

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 polyethersulfone 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 chromium species were collected from the hose bib at the well head using a 10-mL syringe with an attached 0.45-µm disk filter. After the syringe was rinsed thoroughly and filled with ground water, 4 mL was forced through the disk filter; the next 2 mL of the ground water was filtered slowly into a small centrifuge vial for analysis of total chromium. Hexavalent chromium, Cr (VI), was then collected by attaching a small cation exchange column to the syringe filter, and after conditioning the column with 2 mL of sample water, 2 mL was collected in a second centrifuge vial. Both vials were preserved with 10 µL of 7.5-N nitric acid (Ball and McClesky, 2003a,b).

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

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

Samples for analysis of microbial constituents also were collected at the well head (Bushon, 2003; Myers, 2004). Prior to the collection of samples, the sampling port was sterilized using isopropyl alcohol and ground water was run through the sampling port for at least 3 minutes to remove any traces of the sterilizing agent. Two sterilized 250-mL bottles then were filled with ground water for coliform analyses (total and Escherichia coliform determinations), and one sterilized 3-L carboy was filled for coliphage analyses (F-specific and somatic coliphage determinations).

Nine laboratories performed chemical and microbial analyses for the SFSG study (table A1), although most of the analyses were performed at the NWQL or at laboratories contracted by the NWQL. The NWQL maintains a rigorous quality assurance program (Pirkey and Glodt, 1998; 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 tested continuously 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 the 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 also are stored in NWIS.

Turbidity, alkalinity, total coliforms and *Escherichia* coliform (*E. coli*) were measured in the mobile laboratory at the well site. Turbidity was measured in the field with a calibrated turbidity meter. Total coliforms and *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. Alkalinity and the concentrations of bicarbonate (HCO_3^-) and carbonate (CO_3^{2-}) were measured on filtered samples by Gran's titration method (Gran, 1950; 1952). Concentrations of HCO_3^- and CO_3^{2-} also were calculated from the laboratory alkalinity and pH measurements. Calculations were made using the advanced speciation method (http://or.water.usgs.gov/alk/methods.html) with $pK_1 = 6.35$, $pK_2 = 10.33$, and $pK_W = 14$.

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 actually is it present in a sample) to less than 1 percent (Childress and others, 1999). The LRL usually 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. 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 monitors and updates LT-MDLs and LRLs regularly, and the values in this report were in effect during the period of analyses for samples from the SFSG study unit.

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 chromatographic retention times. E-coded values also may result from detections outside the range of calibration standards, from detections that did not meet all laboratory quality-control criteria, and from 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. The MRL is the smallest measurable concentration of a constituent that may be reported reliably using a given analytical method (Timme, 1995). The method uncertainty generally indicates the precision of a particular analytical measurement; it gives a range of values wherein the true value will be found.

Detections that may 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 some radiochemical constituents (gross-alpha radioactivity, gross-beta radioactivity, radium-226, and radium-228) are based on a sample-specific minimum detectable concentration (SSMDC), a sample-specific critical value, and the combined standard uncertainty (CSU) (Bennett and others, 2006). 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 analytical result was less than the critical value (case 1), the analyte was considered not detected, and the concentration was reported on table 16 as less than the SSMDC. If the analytical result was greater than the critical value, the ratio of the CSU to the analytical result was calculated as a percent (percent relative CSU). For those samples with percent relative CSU greater than 20 percent (case 2), concentrations were reported as estimated values (designated by an "E" preceding the value). For those samples with percent relative CSU less than 20 percent (case 3), concentrations were reported on table 16 with no qualifiers.

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

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

Where

^{i}E is the heavier isotope (O^{18} Ç ^{12}or, $H)^{2}$,

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

$R_{reference}$ is the ratio of the abundance of the heavier isotope to the lighter isotope $\left(^{16}O,\ ^{12}C,\ \text{or}\ ^{1}H\right)$ 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. The reference material for carbon is Vienna Peedee Belemnite (VPDB), which is assigned a $\delta^{13}C$ value of 0 per mil. Positive values indicate enrichment of the heavier isotope and negative values indicate depletion of the heavier isotope, compared to the ratios observed in the standard reference material.

Constituents on Multiple Analytical Schedules

Fifteen constituents targeted in the SFSG 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). Methods with full approval are preferred over those with provisional approval and approved methods are favored over research methods. The method with greater accuracy and precision and lower LRLs for the overlapping constituents is preferred. A method may be selected as the preferred method to provide consistency with historical data analyzed by the same method. If a VOC, gasoline oxygenate or degradate, pesticide, or pesticide degradate appears on multiple 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. For 1,2,3-TCP, the method used by the MWH Laboratory is preferred over the method used by the NWQL, although both are reported. Tritium results from both the USGS Stable Isotope and Tritium Laboratory and LLNL are reported.

Quality Assurance

The purpose of quality-assurance is to identify which data best represent environmental conditions and which may have been affected by contamination or bias during sample collection, processing, storage, transportation, or laboratory analysis. Four types of quality-control (QC) tests were used in this study: blank samples were collected to assess contamination; replicate samples were collected to assess reproducibility; matrix spike tests were done to assess accuracy of laboratory analytical methods; and surrogate compounds were added to samples analyzed for organic constituents to assess bias of laboratory analytical methods. In this report, detections of analytes in ground-water samples that may have resulted from contamination were censored. Censored data were included in the data tables and flagged with a "V" remark, but was not included in assessments of ground-water quality. The evaluation of QC data presented in this report was based on results for QC samples collected for SFSG. A holistic evaluation using results from QC samples collected from many study units will be presented in a subsequent report.

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

Blanks

The primary purposes of collecting blank samples (blanks) are to evaluate the magnitude of potential contamination of samples with analytes of interest, and to identify and mitigate sources of contamination. Blanks were collected using water (nitrogen-purged "universal" blank water) certified by the NWQL to contain less than the LRL or MRL of the analytes investigated in the study. At about 10 percent of the SFSG wells sampled, 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 the analytes of interest. Field blanks were collected to assess potential contamination of samples during collection, processing, transport, and analysis. Blanks were analyzed for VOCs, gasoline oxygenates and degradates, pesticides, pesticide degradates, perchlorate, NDMA, 1,4-dioxane, 1,2,3-TCP, nutrients, dissolved organic carbon, major and minor ions, trace elements, iron, arsenic, and chromium species, and radioactive constituents (table A3). Blank samples were not collected for the following constituents: stable isotopes, tritium, carbon isotopes, or noble gases.

Source-solution blanks were collected at selected sampling sites 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 either was 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.

All detections of the constituents of interest in field blanks required investigation of the magnitude and potential source of the contamination. If a constituent was detected in a source-solution blank at a concentration similar to that in field blanks from the same lot of blank water, then the source blank water was interpreted as the origin of the contamination in the field blanks, and detections of that constituent in field blanks collected using the same lot of source blank water could not be used to evaluated potential contamination during collection, processing, transport, or analysis of the samples. If a field blank detection could not be attributed to the source blank water, then the ground-water samples collected prior to, and following the contaminated field blank were evaluated. If the constituent was not detected in the ground-water sample collected prior to the contaminated field blank, then contamination of that field blank due to carry-over was ruled out. If non-detections were reported in field blanks or ground-water samples collected after ground-water samples containing high concentrations of the constituent, then carry-over contamination was considered unlikely in the whole dataset. If carry-over contamination in the dataset could not be ruled out, then all detections in ground-water samples and field blanks collected after a ground-water sample containing a high concentration of the constituent were examined for potential censoring.

The censoring level was defined as the highest concentration of the constituent detected in a field blank plus one-half the LRL for that constituent. Detections of the constituent in ground-water samples at concentrations less than this censoring level were censored. Censored values are indicated by a 'V' preceding the value in the data tables, and these values are excluded from the assessment of ground-water quality.

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 in determining 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 were 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). If one value in a sample pair was reported as an estimate below the LRL or MRL, and the other value was greater than the LRL or MRL, no adjustment was made for the RSD calculation. 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 be the result of analytical uncertainty at low concentrations, particularly for concentrations within an order of magnitude of LT-MDL or MDL. Sequential replicate samples were collected at up to 18 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. Low matrix-spike recovery may indicate that the compound might not be detected in some samples if it were present at very low concentrations. Low and high matrix-spike recoveries may be a potential concern if the concentration of a compound in a ground-water sample is close to the MCL: a low recovery could result in a measured concentration falsely below the MCL, whereas, a high recovery could result in a measured concentration falsely 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 70–130 percent for constituents listed in tables 3A and 3B (Connor and others, 1998; Zaugg and others, 2002; Rose and Sandstrom, 2003), and 60–120 percent for constituents listed in table 3C and 3D (Sandstrom and others, 2001). Based on these ranges, 70–130 percent was defined as the acceptable range for matrix-spike recoveries for organic compounds in the SFSG study.

Matrix spikes were performed for VOCs, gasoline oxygenate and degradate compounds, pesticide and pesticide degradates compounds, and NDMA, 1,4-dioxane, and 1,2,3-TCP because the analytical methods for these constituents are chromatographic methods that may be susceptible to matrix interferences. Replicate samples for matrix-spike additions were collected at 8 percent of the wells sampled in SFSG, although not all analyte classes were tested at every well (tables A5A–D).

Surrogates

Surrogate compounds (surrogates) 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 oxygenate and degradates, pesticide compounds, NDMA, 1,4-dioxane, and 1,2,3-TCP (table A6). Most of the surrogate compounds are deuterated analogs of compounds being analyzed. For example, the surrogate toluene-*d*8 used 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-*d*8 and toluene behave very similarly in the analytical procedure, but the small mass difference between the two results in slightly different chromatographic retention times, thus, the use of a toluene-*d*8 surrogate does not interfere with the analysis of toluene (Grob, 1995). Only 0.015 percent of hydrogen atoms are deuterium (Firestone and others, 1996), thus, deuterated compounds like toluene-*d*8 do not occur naturally and are not found in environmental samples. Surrogates are used to identify general problems that may arise during sample analysis that could affect the analysis results for all compounds in that sample. Potential problems include matrix interferences (such as high levels of dissolved organic carbon) that produce a positive bias, or incomplete laboratory recovery (possibly due to improper maintenance and calibration of analytical equipment) that produces a negative bias. A 70–130 percent recovery of surrogates generally is 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

Field and source-solution blanks were collected at approximately 10 percent of the sites sampled in SFSG. Table A3 presents a summary of constituents detected in the field blanks. Seven organic compounds were detected.

Caffeine was detected in one of the five field blanks at a concentration of 0.007 µg/L. Caffeine was not detected in ground-water samples collected the day of and the day following the field blank detection; hence, no ground-water sample detections were censored as a result.

Six VOCs were detected in three of the five field blank samples, while no VOCs were detected in the other two blank samples. The six VOCs (maximum blank concentration in parentheses) include: ethylbenzene (0.06 µg/L), m-xylene plus p-xylene (E0.33 µg/L), o-xylene (E0.12 µg/L), tetrachloroethene (E0.15 µg/L), toluene (0.08 µg/L), and trichloroethene (0.09 µg/L). Ground-water samples collected the day prior to, the day of, and the day following each of the field blanks with detections of ethylbenzene, m-xylene plus p-xylene, or o-xylene were free from these constituents; hence no ground-water sample detections were censored as a result of these blank detections.

Toluene was detected in three of the five field blanks. Toluene blank detections were examined, relative to the well-sampling schedule, to evaluate the potential for contamination from the sampling equipment used. Two field blank detections occurred at sites collected on the slow well schedule. However, toluene was not detected in any ground-water sample collected on the slow well schedule; therefore, these ground-water samples were not censored. The third field blank (collected on the fast well schedule) had a toluene concentration equal to the associated source-solution blank (E0.01 µg/L). However, toluene was not detected in ground-water samples collected on the day of (nor at the site prior to or following) the third blank detection. Additionally, toluene was not detected in two other field blank samples collected on the fast well schedule. Therefore, no ground-water sample detections of toluene (collected on the fast well schedule) were censored. Toluene concentrations observed in the environmental samples had a maximum concentration of 0.03 µg/L, which is less than one thousandth the MCL-CA of 150 µg/L.

Tetrachloroethene (PCE) and trichloroethene (TCE) were each detected in one field blank that was collected on the slow well schedule during the first week of sampling (June 6–9). These two constituents also were detected in every ground-water sample collected on the slow schedule during the same week. Given the relatively high concentration of PCE and TCE (37.4 and 77.6 µg/L, respectively) in water sampled from the first ground-water well (ULASF-08), and non-detection in the associated source-solution blank, the effect of "carryover" was evaluated as a plausible source of bias in the VOC concentrations during the week of June 6. Carry-over between samples is very rare because the procedures used to clean the equipment between samples have been developed and extensively tested to assure that carry-over does not occur. Potential carry-over was evaluated using time-series analysis to look for patterns suggestive of carry-over of constituents from a sample with high concentrations to the next ground-water sample or field blank collected with the same equipment. For each VOC detected in the ULASF-08 sample, the concentration of that particular VOC in subsequent samples did not show a consistent decreasing pattern; rather, the concentration always increased at some point during the week. Also, there was not a general agreement in the change of VOCs, relative to one another. Finally, a non-detection of both PCE and TCE in ground water sampled from the first slow well during the following week (ULASG-05) effectively limits this evaluation to the week of June 6.

Field blanks were collected at 3 of the 24 (intermediate and slow) sites sampled for the analysis of major ions, trace elements, and nutrients. Bromide was detected in one field blank at a concentration of E0.01 mg/L, and silica was detected in all three field blanks at a maximum concentration of 0.28 mg/L. All of the environmental samples analyzed had concentrations of bromide and silica 10 times and 50 times greater (respectively) than the blank detections; thus no ground-water detections were censored on the basis of detections in the field blanks. Nickel was detected in one field blank at a concentration of 0.04 µg/L. All of the environmental samples analyzed during this week had nickel concentrations 50 times greater than the blank; thus, no ground-water detections of nickel were censored. Total nitrogen (TN) was detected in two of three field blanks at a maximum concentration of 0.20 mg/L. The corresponding environmental samples had concentrations of TN 20 times greater than the blank detections. Additionally, neither blank sample had a detection of ammonia, nitrite, or nitrate. As a result, no ground-water detections of TN were censored.

Field blanks were collected at 3 of the 52 sites sampled for chromium speciation analysis at the USGS Trace Metal Laboratory (TML); 3 of the 17 sites also were sampled for arsenic and iron speciation analyses. One field blank contained 10 µg/L total chromium and 9.9 µg/L chromium VI; these species were not detected in the field blank collected at the same time for analysis by the NWQL. As a result, six detections of chromium species in ground-water samples analyzed by the TML at concentrations less than 11 µg/L were censored (table 12). None of the field blanks contained arsenic or iron.

Field blanks were collected at 2 of the 17 sites sampled for the analysis of dissolved organic carbon (DOC). DOC was detected in both field blanks at concentrations of 0.9 and 4.3 mg/L, and greater than nearly all of the environmental detections. As a result, all 17 ground-water detections for DOC were censored (with a 'V' code). Low concentrations of DOC were detected in field blanks collected in previous GAMA study units (Bennett and others, 2006; Kulongoski and Belitz, 2007).

Field blanks for the analysis of radioactive constituents (Radium-226 and -228, gross alpha and gross beta radioactivity) were collected at 2 of the 17 slow sites. Radium-226 was detected at an activity of E0.028 pCi/L in one blank, and 2 of 17 detections in the ground-water samples were censored (with a 'V' code) as a result. Radium-288 was detected at an activity of E0.24 pCi/L in the same blank, and one of six detections were censored as a result. No other radioactive constituents were detected in the field blanks.

No compounds were detected in field blanks for pesticides or pesticide degradates (five field blanks), arsenic and iron speciation analyses at the USGS Trace Metal Laboratory (three field blanks), and four constituents of special interest (perchlorate, NDMA, 1,2,3-TCP, and 1,4-dioxane; three field blanks each).

Variability in Replicate Samples

Table A4 summarize the results of replicate analyses for constituents detected in ground-water samples collected in the SFSG study. A total of 286 replicate analyses were made for constituents detected in at least one ground-water sample. 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. Most replicate analyses collected during SFGS had RSD values less than 5 percent.

Twelve constituents had RSD values greater than the acceptable limit of 20 percent, and include: perchlorate, aluminum, arsenic, copper, lead, manganese, thallium, zinc, gross alpha radioactivity, tritium analyzed by the USGS Tritium Laboratory; and total iron and total chromium analyzed by the USGS Trace Metal Laboratory. Except for aluminum, replicate analyses with RSD values greater than 20 percent had an absolute uncertainty less than twice the LRL for their respective constituents. At these low concentrations, small deviations in measured values result in a large RSD value. The cause for the large absolute uncertainty (14.9 µg/L) between one set of replicate analyses for aluminum is unknown.

The tritium replicate analyses were within laboratory analytical uncertainty of one another. Since the variability in measurements of most replicate analyses occurred at low concentrations, and all well below regulatory thresholds, variability was not of QC concern. Therefore, no SFSG data were censored as a result of variability in replicate analyses.

Matrix-Spike Recoveries

Tables A5A–D present a summary of matrix-spike recoveries for the SFSG study unit. Four environmental samples were spiked with VOCs to calculate matrix-spike recoveries (table A5A). Sixty-five of the 88 VOCs had spike recoveries within the acceptable range of 70 and 130 percent. Fourteen of 33 VOCs detected in ground-water samples had spike recoveries within the acceptable range. Twenty-two VOCs had at least one matrix-spike recovery greater than 130 percent, and 14 of these compounds were detected in ground-water samples. Of these 14 compounds, PCE and tetrachloromethane had 4 and 1 detections (respectively) above a health-based threshold. To evaluate the potential affect of a high matrix-spike recovery for these compounds,

Concentrations in the ground-water samples were compared to the MCLs (or other health-based thresholds) and multiplied by their respective maximum spike recoveries. In this scenario, all previous detections above the MCL remained above their respective spike-adjusted MCLs. Styrene had 1 of 4 matrix-spike recoveries below 70 percent and was not detected in any ground-water samples. [NOTE—low recoveries may indicate that the compound might not have been detected in some samples if it was present at very low concentrations].

Four ground-water samples were spiked with pesticide compounds in order to calculate matrix spike recoveries (for NWQL schedule 2003; table 3C). Thirty-three of the 60 pesticide compounds had spike recoveries within the acceptable range of 70 and 130 percent (table A5B). Eleven of the 14 pesticide compounds detected in ground-water samples had spike recoveries within the acceptable range. Four compounds had at least one spike recovery greater than 130 percent, and two of these compounds (hexazinone, tebuthiuron) were detected in ground-water samples. Twenty-four compounds had at least one spike recovery below 70 percent and four of these compounds (deethylatrazine, 3,4-dichloroaniline, fipronil sulfone, hexazinone) were detected in ground-water samples. [NOTE—low recoveries may indicate that the compound might not have been detected in some samples if it was present at very low concentrations].

One ground-water sample was spiked with polar pesticide or pesticide degradate compounds to calculate matrix-spike recoveries (for NWQL schedule 2060; table 3D). Forty-seven of the 57 compounds had recoveries within the acceptable range of 70–130 percent (table A5C). Eight of nine polar pesticide or pesticide degradate compounds detected in ground-water samples had spike recoveries within the acceptable range. Four compounds had a recovery greater than 130 percent, and none of these were detected in ground-water samples. Six compounds had a recovery less than 70 percent, and only one (deisopropyl atrazine) was detected in ground-water samples. [NOTE—low recoveries may indicate that the compound might not have been detected in some samples if it was present at very low concentrations].

Two ground-water samples were spiked with perchlorate, 1,2,3-TCP, 1,4-dioxane, and NDMA. All spike recoveries for these compounds were within the acceptable range of 70–130 percent (table A5D). No ground-water sample data were adjusted on the basis of matrix-spike recovery data.

Surrogate Compound Recoveries

Surrogate recovery data are provided in table A6, including the identity of each surrogate; the analytical schedule on which it was applied; the number of analyses for blanks and ground-water samples; the number of surrogate recoveries below 70 percent, and the number of surrogate recoveries above 130 percent for the blank and environmental samples. Blank 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 blank and environmental samples were observed. Greater than 90 percent of the blank and environmental samples had surrogate recoveries between the acceptable limit of 70 and 130 percent. Surrogate recoveries were in the acceptable range of 70–130 percent recovery for 95 percent of VOC and gasoline oxygenate and degradate analyses, 92 percent of pesticide analyses, and 83 percent of analyses for 1,2,3-TCP, 1,4-dioxane, and NDMA. No ground-water sample detections were censored as a result of surrogate recovery data.

Appendix Tables

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.

[**Analytical method:** MI agar, supplemental nutrient agar in which coliforms (total and *Escherichia*) produce distinctly different fluorescence under ultraviolet lighting. **Abbreviations:** NWQL, National Water-Quality Laboratory; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; UV, ultraviolte; VOCs, volatile organic compounds]

Analyte	Analytical method	Laboratory and analytical schedule	Citation(s)
Water-quality indicators			
Field parameters	Calibrated field meters and kits	USGS field measurement	U.S. Geological Survey, 2005
Organic constituents			
VOCs	Purge and trap capillary gas chromatography/mass spectrometry	NWQL, schedule 2020	Connor and others, 1998
Gasoline oxygenates	Heated purge and trap/gas chromatography/mass spectrometry	NWQL, schedule 4024	Rose and Sandstrom, 2003
Pesticides	Solid-phase extraction and gas chromatography/mass spectrometry	NWQL, schedules 2003 and 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	Ion chromatography and mass spectrometry	Montgomery Watson Harza Laboratory	Hautman and others, 1999
N-Nitrosodimethylamine	Gas chromatography and mass spectrometry	Montgomery Watson Harza Laboratory	U.S. Environmental Protection Agency, 1996; 1999
1,2,3-Trichloropropane	Gas chromatography/electron capture detector	Montgomery Watson Harza Laboratory	U.S. Environmental Protection Agency, 1995
1,4-Dioxane	Gas chromatography and mass spectrometry	Montgomery Watson Harza Laboratory	U.S. Environmental Protection Agency, 1996
Inorganic constituents			
Nutrients	Alkaline persulfate digestion, Kjedahl digestion	NWQL, schedule 2755	Fishman, 1993; Patton and Kryskalla, 2003
Dissolved organic carbon	UV-promoted persulfate oxidation and infrared spectrometry	NWQL, schedule 2613	Brenton and Arnett, 1993
Major and minor ions, trace elements and nutrients	Atomic absorption spectrometry, colorimetry, ion-exchange chromatography, inductively-coupled plasma atomic emission spectrometry and mass spectrometry	NWQL, schedule 1948	Fishman and Friedman, 1989; Fishman, 1993; Faires, 1993; McLain, 1993; Garbarino, 1999; Garbarino and Damrau, 2001; American Public Health Association, 1998; Garbarino and others, 2006
Chromium, arsenic and iron species	Various techniques of ultraviolet visible (UV-VIS) spectrophotometry and atomic absorbance spectroscopy	USGS Trace Metal Laboratory, Boulder, Colorado	Stookey, 1970; To and others, 1998; Ball and McCleskey, 2003a,b; 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

[**Analytical method:** MI agar, supplemental nutrient agar in which coliforms (total and *Escherichia*) produce distinctly different fluorescence under ultraviolet lighting. **Abbreviations:** NWQL, National Water-Quality Laboratory; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; UV, ultraviolte; VOCs, volatile organic compounds]

Analyte	Analytical method	Laboratory and analytical schedule	Citation(s)
		Stable isotopes	
Stable isotopes of water	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	Accelerator mass spectrometry	University of Waterloo, Environmental Isotope Lab; University of Arizona Accelerator Mass Spectrometry Lab	Donahue and others, 1990; Jull and others, 2004
		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	Moran and others, 2002; Eaton and others, 2004
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)
		Microbial constituents	
F-specific and somatic coliphage	Single-agar layer (SAL) and two-step enrichment methods	USGS Ohio Water Microbiology Laboratory	U.S. Environmental Protection Agency, 2001
Total and *escherichia* coliform	Membrane filter technique with "MI agar"	USGS field measurement	U.S. Environmental Protection Agency, 2002b

Table A2. Preferred analytical schedules for constituents appearing on multiple schedules for samples collected for the San Fernando–San Gabriel (SFSG) Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.

[**Preferred analytical schedule,** the method of analysis with the greatest accuracy and precision out of the ones used for a particular compound. 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. **Abbreviations:** VOC, volatile organic compound]

Constituent	Primary constituent classification	Analytical schedules	Preferred analytical schedule
Results from preferred method reported			
Acetone	VOC, gasoline degradate	2020, 4024	2020
Atrazine	Pesticide	2003, 2060	2003
Carbaryl	Pesticide	2003, 2060	2003
Deethyl atrazine (2-Chloro-4-isopropylamino-6-amino-*s*-triazine)	Pesticide degradate	2003, 2060	2003
Diisopropyl ether (DIPE)	VOC, gasoline oxygenate	2020, 4024	2020
Ethyl *tert*-butyl ether (ETBE)	VOC, gasoline oxygenate	2020, 4024	2020
Metalaxyl	Pesticide	2003, 2060	2003
Methyl *tert*-butyl ether (MTBE)	VOC, gasoline oxygenate	2020, 4024	2020
Methyl *tert*-pentyl ether	VOC, gasoline oxygenate	2020, 4024	2020
Tebuthiuron	Pesticide	2003, 2060	2003
1,2,3-Trichloropropane (1,2,3-TCP)	VOC	2020, MHW	MWH
Results from both methods reported			
Arsenic, total	Trace element	1948, TML	1948
Chromium, total	Trace element	1948, TML	1948
Iron, total	Trace element	1948, TML	1948
Tritium	Radioactive	LLNL, SITL	both

Table A3. Constituents detected in field blanks collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.

[Censored data are reported but not used in summary statistics. **Abbreviations:** E, estimated value; mg/L, milligram per liter; pCi/L, picocuries per liter; <, less than; µg/L, microgram per liter; —, not detected]

Constituent	Number of field blank detections/ analyses	Maximum concentration detected in field blanks	Minimum concentration detected in ground-water samples	Number of ground-water samples censored
Organic constituents (µg/L)				
Caffeine	1/5	E0.007	0.012	0
Ethylbenzene[1]	2/5	0.06	—	0
m-Xylene plus p-Xylene[1]	2/5	0.33	E0.02	0
o-Xylene[1]	2/5	0.12	—	0
Tetrachloroethene	1/5	0.15	E0.01	0
Toluene[1]	3/5	0.08	0.03	0
Trichloroethene	1/5	0.09	E0.02	0
Inorganic constituents (mg/L)				
Dissolved organic carbon	2/2	4.3	0.20	17
Bromide	1/3	E0.01	0.10	0
Chromium, total[2]	1/3	0.010	<0.001	6
Chromium, VI[2]	1/3	0.009	<0.001	6
Nickel	1/3	[3] E0.04	0.72 [3]	0
Silica	3/3	0.28	14.3	0
Total nitrogen (as N)	2/3	0.20	0.56	0
Radioactive constituents (pCi/L)				
Radium-226	1/2	0.028	0.016	2
Radium-228	1/2	0.24	0.23	1

[1] Constituent detected in source-solution and associated field blank.

[2] Chromium analyses made by U.S. Geological Survey Trace Metal Laboratory.

[3] Concentration in microgram per liter (µg/L).

Table A4. Quality-control summary for replicate analyses collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.

[**Abbreviations:** RSD, relative standard deviation in percent; na, not applicable (no pairs with RSDs greater than 20 percent); <, less than; — , not detected]

Constituent	Number of RSDs greater than 20 percent/number of replicate pairs	Maximum RSD (percent)	Median of RSDs greater than zero (percent)	Concentrations for pairs with RSD greater than 20 percent (environmental/ replicate)
Organic constituents				
Volatile organic compounds	0/5	15	<1	na
Gasoline oxygenates and degradates	0/2	—	—	na
Pesticides and degradates	0/5	14	<1	na
Polar pesticides and degradates	0/3	11	<1	na
Constituents of special interest				
Perchlorate	1/3	20	12	(2.0/1.5)
1,2,3-Trichloropropane, 1,4-Dioxane, and *N*-Nitrosodimethylamine	0/3	—	—	na
Nutrients, major and minor ions				
All nutrients, major and minor ions	0/3	9	<1	na
Trace elements				
Aluminum	1/3	123	63	(1.1/16)
Arsenic	1/3	20	11	(0.3/0.4)
Copper	1/3	47	8	(0.5/1.0)
Lead	1/3	26	13	(0.16/0.11)
Manganese	1/3	47	47	(E0.1/E0.2)
Thallium	1/3	106	106	(<0.04/0.07)
Zinc	1/3	35	9	(1.0/E0.6)
All additional trace elements	0/3	18	1	na
U.S. Geological Survey Trace Metals Laboratory				
Iron, total	1/3	35	35	(3/5)
Iron (II)	0/3	—	—	na
Arsenic, total	0/3	17	8	na
Arsenic (III)	0/3	—	—	na
Chromium, total	1/5	26	13	(1.01/1.6)
Chromium (VI)	0/5	16	9	na
Istopes, radioactivity, and noble gases				
Gross-alpha radioactivity, 30-day count	1/1	79	—	(E3.2/E0.9)
Carbon-13/carbon-12 ratio; carbon-14	0/2	14	1	na
Noble gases	0/1	1	1	na
Deuterium/protium ratio; oxygen-18/oxygen-16 ratio	0/5	2	<1	na
Tritium[1]	1/5	35	9	(1.0/0.6)
Microbial indicators				
F-specific and somatic coliphage, *E. Coli*, and total coliforms	0/2	—	—	na

[1]Analyses performed at U.S. Geological Survey, Meno Park, California.

Table A5A. Quality-control summary for matrix-spike recoveries of volatile organic compounds (VOCs) and gasoline oxygenates and degradates in samples collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.

[Acceptable recovery range is between 70 and 130 percent]

Constituent	Number of spiked samples	Recovery (percent)		
		Minimum	Maximum	Median
Acetone[1]	4	100	122	117
tert-Amyl alcohol	2	98	98	98
Acrylonitrile	4	97	133	115
Benzene[2]	4	109	132	119
Bromobenzene	4	100	115	110
Bromochloromethane	4	103	132	114
Bromodichloromethane[2]	4	106	132	119
Bromoform (tribromomethane)[2]	4	104	113	108
2-Butanone (MEK, methyl ethyl ketone)	4	102	116	111
tert-butyl alcohol (TBA)	2	92	92	92
n-Butylbenzene	4	88	110	99
sec-Butylbenzene	4	98	130	114
tert-Butylbenzene	4	103	136	119
Carbon disulfide[2]	4	89	117	108
Carbon tetrachloride (tetrachloromethane)[2]	4	102	139	124
Chlorobenzene[2]	4	98	110	107
Chloroethane	4	106	133	119
Chloroform (trichloromethane)[2]	4	106	311	125
Chloromethane	4	106	131	119
3-chloro-1-propene	4	101	127	119
2-chlorotoluene	4	100	121	112
4-chlorotoluene	4	95	118	107
Dibromochloromethane[2]	4	101	125	115
1,2-Dibromo-3-chloropropane (DBCP)	4	98	117	114
1,2-Dibromoethane (EDB)	4	100	117	110
Dibromomethane	4	102	126	117
1,2-Dichlorobenzene[2]	4	94	132	116
1,3-Dichlorobenzene[2]	4	94	126	116
1,4-Dichlorobenzene[2]	4	96	123	114
trans-1,4-Dichloro-2-butene	4	105	147	129
Dichlorodifluoromethane (CFC-12)[2]	4	76	98	87
1,1-Dichloroethane[2]	4	100	133	118
1,2-Dichloroethane[2]	4	107	131	119
1,1-Dichloroethene (DCE)[2]	4	98	122	112
cis-1,2-Dichloroethene[2]	4	103	128	117
trans-1,2-Dichloroethene[2]	4	102	130	118
Dichloromethane (methylene chloride)[2]	4	103	131	113
1,2-Dichloropropane[2]	4	98	117	107
1,3-Dichloropropane	4	107	125	116
2,2-Dichloropropane	4	92	117	112
1,1-Dichloropropene	4	102	125	116
cis-1,3-Dichloropropene	4	93	105	97
trans-1,3-Dichloropropene	4	98	124	115
Diethyl ether	4	100	113	113
Diisopropyl ether (DIPE)[1,2]	4	98	111	105

Table A5A. Quality-control summary for matrix-spike recoveries of volatile organic compounds (VOCs) and gasoline oxygenates and degradates in samples collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.—Continued

[Acceptable recovery range is between 70 and 130 percent]

Constituent	Number of spiked samples	Recovery (percent)		
		Minimum	Maximum	Median
Ethylbenzene	4	102	123	113
Ethyl tert-butyl ether (ETBE)[1]	4	94	104	102
Ethyl methacrylate	4	94	105	100
1-Ethyl-2-methylbenzene (*o*-ethyl toluene)	4	93	121	108
Hexachlorobutadiene	4	99	115	103
Hexachloroethane	4	101	123	112
2-Hexanone (*n*-butyl methyl ketone)	4	104	118	111
Isopropylbenzene (cumene)	4	104	128	113
4-Isopropyl-1-methylbenzene	4	94	127	111
Methyl acetate	2	103	106	104
Methyl acrylate	4	100	120	111
Methyl acrylonitrile	4	99	128	113
Methyl bromide (bromomethane)	4	98	151	143
Methyl *tert*-butyl ether (MTBE)[1,2]	4	92	110	102
Methyl iodide (iodomethane)	4	77	120	108
Methyl isobutyl ketone (MIBK)	4	94	105	103
Methyl methacrylate	4	93	93	93
Methyl *tert*-pentyl ether (*tert*-amyl methyl ether, TAME)[1]	4	96	105	101
Naphthalene	4	94	126	104
n-propylbenzene	4	96	121	109
Styrene	4	9	130	99
1,1,1,2-Tetrachloroethane[2]	4	102	127	113
1,1,2,2-Tetrachloroethane	4	103	127	118
Tetrachloroethene (PCE)[2]	4	108	225	155
Tetrahydrofuran	4	102	123	112
1,2,3,4-tetramethylbenzene	4	111	126	118
1,2,3,5-tetramethylbenzene	4	115	128	124
Toluene[2]	4	102	119	113
1,2,3-trichlorobenzene	4	102	110	108
1,2,4-Trichlorobenzene	4	88	106	97
1,1,1-Trichloroethane (1,1,1-TCA)[2]	4	104	132	122
1,1,2-Trichloroethane (1,1,2-TCA)[2]	4	100	129	116
Trichloroethene (TCE)[2]	4	92	118	111
Trichlorofluoromethane (CFC-11)[2]	4	–200	132	115
1,2,3-Trichloropropane (1,2,3-TCP)[2]	4	98	121	112
1,1,2-Trichloro-1,2,2-trifluoroethane (CFC-113)[2]	4	102	277	120
1,2,3-Trimethylbenzene	4	97	124	111
1,2,4-Trimethylbenzene[2]	4	95	130	116
1,3,5-Trimethylbenzene	4	91	128	111
Vinyl bromide (bromoethene)	4	106	138	125
Vinyl chloride (chloroethene)[2]	4	115	144	135
m- and *p*-Xylene[2]	4	100	120	109
o-Xylene	4	98	118	106

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

[2] Constituents detected in ground-water samples.

Table A5B. Quality-control summary for matrix-spike recoveries of pesticides and pesticide degradates in samples collected (for U.S. Geological Survey National Water Quality Laboratory schedule 2003) for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.

[Acceptable recovery range is between 70 and 130 percent]

Constituent	Number of spiked samples	Recovery (percent)		
		Minimum	Maximum	Median
Acetochlor	4	86	108	98
Alachlor	4	93	108	103
Atrazine[1,2]	4	91	108	107
Azinphos-methyl	4	58	101	79
Azinphos-methyl-oxon	4	41	73	59
Benfluralin	4	62	73	72
Carbaryl[2]	4	102	136	114
2-Chloro-2,6-diethylacetanilide	4	95	116	107
4-Chloro-2-methylphenol	4	56	75	59
Chlorpyrifos	4	98	113	101
Chlorpyrofos, oxygen analog	4	18	56	34
Cyfluthrin	4	46	69	54
Cypermethrin	4	47	65	53
Dacthal (DCPA)	4	102	114	103
Deethylatrazine (2-chloro-4-isopropylamino-6-amino-*s*-triazine)[1,2]	4	41	48	46
Desulfinylfipronil[1]	4	89	99	93
Desulfinylfipronil amide	4	62	77	71
Diazinon	4	91	108	96
Diazinon, oxon	4	83	99	92
3,4-Dichloroaniline[1]	4	59	85	79
Dichlorvos	4	27	56	48
Dicrotophos	4	27	37	34
Dieldrin	4	84	116	97
2,6-Diethylaniline	4	90	96	92
Dimethoate	4	26	35	29
Ethion	4	75	90	85
Ethion monoxon	4	72	93	91
2-Ethyl-6-methylaniline	4	80	94	88
Fenamiphos	4	73	93	86
Fenamiphos sulfone	4	58	80	70
Fenamiphos sulfoxide	4	36	47	44
Fipronil[1]	4	73	91	90
Fipronil sulfide[1]	4	84	96	89
Fipronil sulfone[1]	4	53	81	67
Fonofos	4	90	100	93
Hexazinone[1]	4	68	141	80
Isofenphos	4	102	113	107
Malaoxon	4	80	106	96
Malathion	4	104	137	110
Metalaxyl[1,2]	4	91	104	100
Methidathion	4	92	111	100
Metolachlor[1]	4	109	122	114
Metribuzin	4	78	88	86
Myclobutanil[1]	4	79	95	89
1-Naphthol	4	18	54	20
Paraoxon-methyl	4	62	74	63
Parathion-methyl	4	73	86	83
Pendimethalin	4	74	105	92
cis-Permethrin	4	58	71	62
Phorate	4	49	91	82

Table A5B. Quality-control summary for matrix-spike recoveries of pesticides and pesticide degradates in samples collected (for U.S. Geological Survey National Water Quality Laboratory schedule 2003) for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.—Continued

[Acceptable recovery range is between 70 and 130 percent]

Constituent	Number of spiked samples	Recovery (percent)		
		Minimum	Maximum	Median
Phorate oxon	4	64	102	96
Prometon[1]	4	93	108	97
Prometryn	4	97	112	106
Pronamide (Propyzamide)	4	91	100	100
Simazine[1]	4	88	104	97
Tebuthiuron[1,2]	4	99	233	170
Terbufos	4	73	108	88
Terbufos oxon sulfone	4	93	112	109
Terbuthylazine	4	102	110	105
Trifluralin	4	70	80	77

[1] Constituents detected in ground-water samples.

[2] Constituents on schedules 2003 and 2060; only values from schedule 2003 are reported because it is the preferred analytical schedule.

Table A5C. Quality-control summary for matrix-spike recoveries of pesticides and pesticide degradates in samples collected (for U.S. Geological Survey National Water Quality Laboratory schedule 2060) for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.

[Acceptable recovery range is between 70 and 130 percent]

Constituent	Number of spiked samples	Recovery (percent)
Acifluorfen	1	122
Aldicarb	1	15
Aldicarb sulfone	1	66
Aldicarb sulfoxide	1	12
Atrazine[1]	1	87
Bendiocarb	1	95
Benomyl	1	80
Bensulfuron-methyl	1	91
Bentazon	1	102
Bromacil[1]	1	95
Bromoxynil	1	84
Caffeine[1]	1	106
Carbaryl	1	110
Carbofuran	1	105
Chloramben, methyl ester	1	91
Chlorimuron-ethyl	1	61
Clopyralid	1	69
Cycloate	1	99
2,4-D plus 2,4-D methyl ester (summed on a molar basis)	1	106
2,4-DB [4-(2,4-dichlorophenoxy) butyric acid]	1	77
DCPA (dacthal) monoacid	1	117
Deethylatrazine (2-chloro-4-isopropylamino-6-amino-*s*-triazine)[1]	1	68
Deisopropyl atrazine (2-chloro-6-ethylamino-4-amino-*s*-triazine)[1]	1	62
Dicamba	1	99
Dichlorprop	1	95
Dinoseb	1	110
Diphenamid[1]	1	106
Diuron[1]	1	128
Fenuron	1	106
Flumetsulam	1	142
Fluometuron	1	113
Hydroxyatrazine (2-hydroxy-4-isopropylamino-6-ethylamino-*s*-triazine)[1]	1	122
3-Hydroxycarbofuran	1	95
Imazaquin	1	142
Imazethapyr[1]	1	117
Imidacloprid	1	131
Linuron	1	102
MCPA (2-methyl-4-chlorophenoxyacetic acid)	1	80
MCPB [4-(2-methyl-4-chlorophenoxy) butyric acid]	1	77
Metalaxyl[1]	1	106
Methiocarb	1	104
Methomyl	1	6
Metsulfuron methyl	1	11
3-(4-Chlorophenyl)-1-methyl urea[1]	1	106
Neburon	1	102
Nicosulfuron	1	99
Norflurazon	1	110
Oryzalin	1	95
Oxamyl	1	102
Picloram	1	99
Propham	1	84
Propiconazole	1	95
Propoxur	1	91
Siduron	1	113
Sulfometuron-methyl[1]	1	85
Tebuthiuron[1]	1	114
Terbacil	1	119
Triclopyr	1	99

[1] Constituents detected in ground-water samples.

Table A5D. Quality-control summary for matrix-spike recoveries of constituents of special interest in samples collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.

[Acceptable recovery range is between 70 and 130 percent]

Constituent	Number of spiked samples	Recovery (percent)		
		Minimum	Maximum	Median
Perchlorate[1]	2	83	102	93
1,2,3-Trichloropropane (TCP)[1]	2	98	101	100
1,4-Dioxane	2	93	99	96
N-Nitrosdimethylamine (NDMA)[1]	2	81	98	90

[1] Constituents detected in ground-water samples.

Table A6. Quality-control summary for surrogate recoveries of volatile organic compounds, gasoline oxygenates and degradates, pesticides and pesticide degradates, and constituents of special interest in samples collected for the San Fernando–San Gabriel Groundwater Ambient Monitoring and Assessment (GAMA) study unit, California, May to July 2005.

[**Abbreviations:** MWH, Montgomery Watson Harza Laboratory; VOC, volatile organic compound]

Surrogate	Analytical schedule	Constituent or constituent class analyzed	Blank samples				Non-blank samples			
			Number of analyses	Median recovery (percent)	Number of surrogate recoveries		Number of analyses	Median recovery (percent)	Number of surrogate recoveries	
					Below 70 percent	Above 130 percent			Below 70 percent	Above 130 percent
1,2-Dichloroethane-*d*4	2020, 4024	VOCs, gasoline oxygenates	9	121	0	0	57	104	0	6
1-Bromo-4-fluorobenzene	2020, 4024	VOCs, gasoline oxygenates	9	83	2	0	57	93	4	0
Isobutyl alcohol-*d*6	4024	Gasoline oxygenates	2	92	0	0	19	92	0	0
Toluene-*d*8	2020, 4024	VOCs, gasoline oxygenates	9	99	0	0	57	100	0	0
alpha-HCH-*d*6	2003	Pesticides and degradates	5	98	0	0	56	96	0	0
Diazinon-*d*10	2003	Pesticides and degradates	5	92	0	0	55	95	0	0
2,4,5-T (2,4,5-trichlorophenoxyacetic acid)	2060	Polar pesticides and degradates	2	90	0	0	28	103	1	0
Barban	2060	Polar pesticides and degradates	2	85	0	0	28	95	0	2
Caffeine-^{13}C	2060	Polar pesticides and degradates	2	144	0	1	28	127	0	12
2-Fluorobiphenyl	MWH	1,4-Dioxane	4	92	0	0	27	87	1	0
NDMA-*d*6	MWH	NDMA	4	72	2	0	27	83	6	0
Nitrobenzene-*d*5	MWH	1,4-Dioxane	4	94	0	0	27	91	0	0
Terphenyl-*d*14	MWH	1,4-Dioxane	4	76	1	0	27	62	16	0
Toluene-*d*8	MWH	1,2,3-TCP	4	100	0	0	27	98	0	0