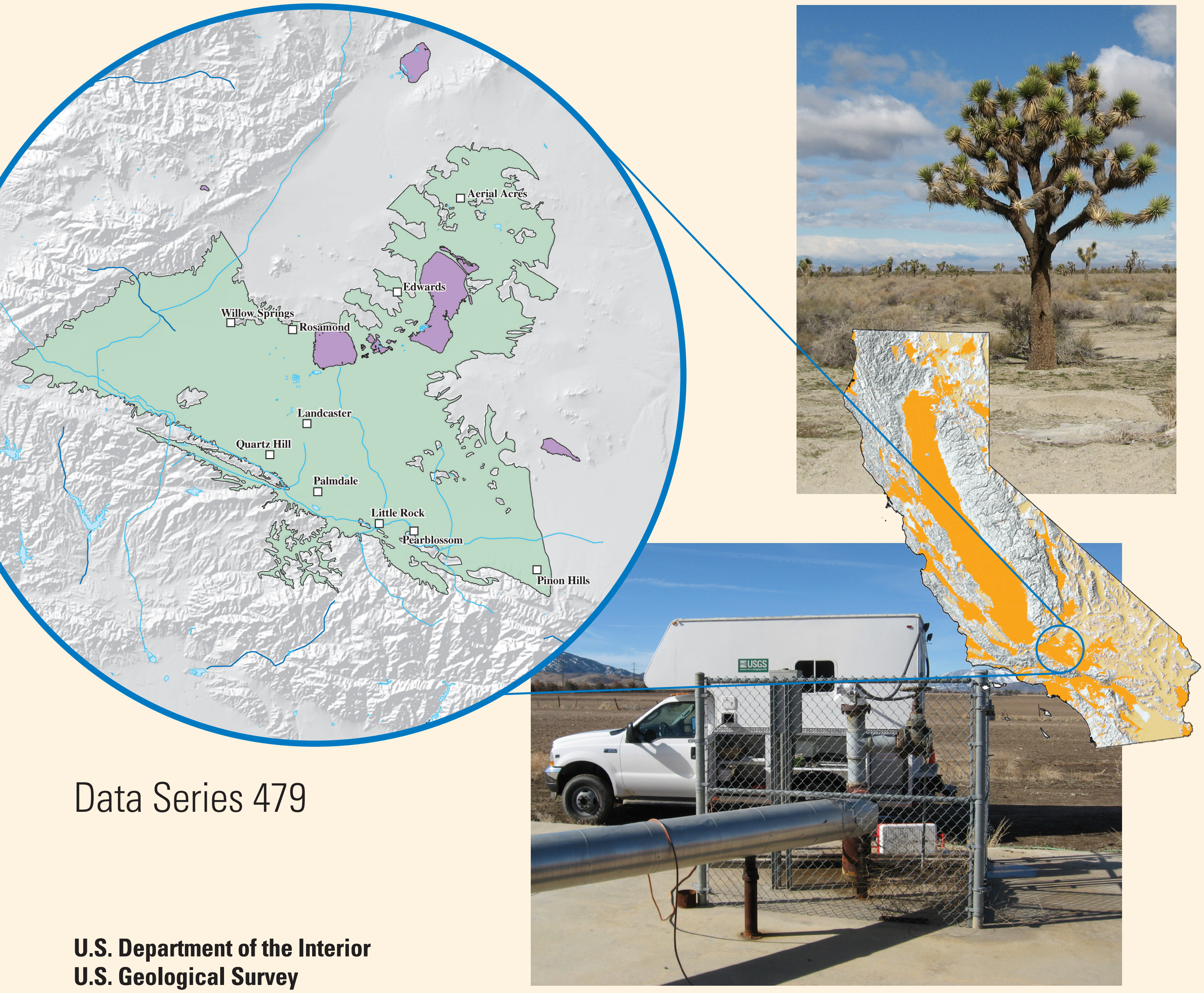
In cooperation with the California State Water Resources Control Board

Groundwater-Quality Data in the Antelope Valley Study Unit, 2008: Results from the California GAMA Program



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Cover Photographs:
Top: Joshua Tree located in Antelope Valley, California (photograph taken by Barbara J. Milby Dawson, U.S. Geological Survey).
Bottom: Well in Los Angeles County, California (photograph taken by Carmen Burton, U.S. Geological Survey).

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Contents

Figures

Tables

Appendix tables:

Abbreviations and Acronyms

AB	Assembly Bill (through the California State Assembly)
AL	action level
ANT	Antelope Valley study unit
CAS	Chemical Abstract Service (American Chemical Society)
CASRN	Chemical Abstract Service (American Chemical Society) Registry Number®
CSU	combined standard uncertainty
D	detected
E	estimated or having a higher degree of uncertainty
GAMA	Groundwater Ambient Monitoring and Assessment program
GPS	Global Positioning System
HAL-US	lifetime health advisory (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
NAWQA	National Water Quality Assessment (USGS)
nc	sample not collected
NL-CA	notification level (CDPH)
np	no preference
NWIS	National Water Information System (USGS)
PCFF	portable computer field forms software program
pK	logarithm of the reciprocal of the equilibrium constant for a special reaction under specific conditions
QC	quality control
RL	reporting level
RPD	relative percent difference
RSD	relative standard deviation
RSD5	risk-specific dose at 10-5 (USEPA)
SMCL	secondary maximum contaminant level
SMCL-CA	secondary maximum contaminant level (CDPH)
SMCL-US	secondary maximum contaminant level (USEPA)
SRL	study reporting level
ssL_C	sample-specific critical level
U.S.	United States
UV	ultraviolet
V	analyte detected in sample and an associated blank-thus data are not included in groundwater quality assessment
VPDB	Vienna Pee Dee Belemnite (the international reference standard for carbon isotopes)
VSMOW	Vienna Standard Mean Ocean Water (an isotopic water standard defined in 1968 by the International Atomic Energy Agency)
=	equal to
>	greater than
<	less than

≤	less than or equal to
—	not detected
*	value is above threshold or outside threshold range
**	value is above upper threshold level

Organizations

CDPH	California Department of Public Health
CDWR	California Department of Water Resources
LLNL	Lawrence Livermore National Laboratory
NELAP	National Environmental Laboratory Accreditation Program
NWQL	National Water Quality Laboratory (USGS)
NRP	National Research Program (USGS)
SWRCB	State Water Resources Control Board
TML	Trace Metal Laboratory (USGS)
USEPA	U.S. Environmental Protection Agency
USGS	U. S. Geological Survey

Selected chemical names

$CaCO_3$	calcium carbonate
CFC	chlorofluorocarbon
CO_3^{-2}	carbonate
HCl	hydrochloric acid
HCO_3^{-}	bicarbonate
MTBE	methyl tert-butyl ether
$Na_2S_2O_3$	sodium thiosulfate
NDMA	N-nitrosodimethylamine
PCE	perchloroethene
TCP	trichloropropane
TDS	total dissolved solids
THM	trihalomethane
VOC	volatile organic compound

Units of measurement

C	Celsius
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)
g	gram
in	inch
km	kilometer
L	liter
mg	milligram
mg/L	milligrams per liter (parts per million)
mi	mile
mL	milliliter
µg/L	micrograms per liter (parts per billion)
µL	microliter
µm	micrometer
NTU	nephelometric turbidity units
pCi/L	picocurie per liter
δ iE	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 as per mil

Notes

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

$$°F=(1.8\times °C)+32$$

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

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

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

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Groundwater-Quality Data in the Antelope Valley Study Unit, 2008: Results from the California GAMA Program

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

Abstract

Groundwater quality in the approximately 1,600 square-mile Antelope Valley study unit (ANT) was investigated from January to April 2008 as part of the Priority Basin Project of the Groundwater Ambient Monitoring and Assessment (GAMA) Program. The GAMA Priority Basin 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 study was designed to provide a spatially unbiased assessment of the quality of raw groundwater used for public water supplies within ANT, and to facilitate statistically consistent comparisons of groundwater quality throughout California. Samples were collected from 57 wells in Kern, Los Angeles, and San Bernardino Counties. Fifty-six of the wells were selected using a spatially distributed, randomized, grid-based method to provide statistical representation of the study area (grid wells), and one additional well was selected to aid in evaluation of specific water-quality issues (understanding well).

The groundwater samples were analyzed for a large number of organic constituents (volatile organic compounds [VOCs], gasoline additives and degradates, pesticides and pesticide degradates, fumigants, and pharmaceutical compounds), constituents of special interest (perchlorate, *N*-nitrosodimethylamine [NDMA], and 1,2,3-trichloropropane [1,2,3-TCP]), naturally occurring inorganic constituents (nutrients, major and minor ions, and trace elements), and radioactive constituents (gross alpha and gross beta radioactivity, radium isotopes, and radon-222). Naturally occurring isotopes (strontium, tritium, and carbon-14, and stable isotopes of hydrogen and oxygen in water), and dissolved noble gases also were measured to help identify the sources and ages of the sampled groundwater. In total, 239 constituents and water-quality indicators (field parameters) were investigated.

Quality-control samples (blanks, replicates, and samples for matrix spikes) were collected at 12 percent of the wells, and the results for these samples were used to evaluate the quality of the data for the groundwater samples. Field blanks rarely contained detectable concentrations of any constituent, suggesting that contamination was not a noticeable source of bias in the data for the groundwater samples. Differences between replicate samples generally were within acceptable ranges, indicating acceptably low variability. Matrix spike recoveries were within acceptable ranges for most compounds.

This study did not 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 water quality. Regulatory thresholds apply to water that is served to the consumer, not to raw groundwater. However, to provide some context for the results, concentrations of constituents measured in the raw groundwater were compared with regulatory and non-regulatory health-based thresholds established by the U.S. Environmental Protection Agency (USEPA) and California Department of Public Health (CDPH) and thresholds established for aesthetic concerns (secondary maximum contaminant levels, SMCL-CA) by CDPH. Comparisons between data collected for this study and drinking-water thresholds are for illustrative purposes only, and are not indicative of compliance or non-compliance with drinking water standards.

Most constituents that were detected in groundwater samples were found at concentrations below drinking-water thresholds. Volatile organic compounds (VOCs) were detected in about one-half of the samples and pesticides detected in about one-third of the samples; all detections of these constituents were below health-based thresholds. Most detections of trace elements and nutrients in samples from ANT wells were below health-based thresholds. Exceptions include: one detection of nitrite plus nitrate as nitrogen (NO_2+NO_3) above the USEPA maximum contaminant level (MCL-US: 10 mg/L), five detections of arsenic above the MCL-US (6 µg/L), one detection of boron above the CDPH notification level (NL-CA: 1,000 µg/L), and two detections of vanadium above the NL-CA (50 µg/L). Most detections of radioactive constituents were below health-based thresholds. Exceptions include two detections of gross alpha radioactivity (72-hour and 30-day counts) above the MCL-US (15 pCi/L). Also, radon-222 was detected above the proposed MCL-US (300 pCi/L) in 14 grid wells and the understanding well, but no wells had detections above the proposed alternative MCL-US (4,000 pCi/L). Most of the samples from ANT wells had concentrations of major elements, total dissolved solids (TDS), and trace elements below the non-enforceable thresholds set for aesthetic concerns. Three samples contained sulfate and four samples contained total dissolved solids at concentrations above the SMCL-CA thresholds (250 mg/L and 500 mg/L, respectively). Two of the total dissolved solids detections were above the upper SMCL-CA (1,000 mg/L). Samples from four wells had field pH values above the SMCL-US (>pH 8.5). Field-measured specific conductance values were above the SMCL-CA (900 µS/cm at 25°C) at eight wells with four of these measurements above the upper SMCL-CA threshold (1,600 µS/cm at 25°C).

Introduction

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

The SWRCB initiated the GAMA Priority Basin Project in response to Legislative mandates (Supplemental Report of the 1999 Budget Act 1999–00 Fiscal Year; and, the Groundwater Quality Monitoring Act of 2001 {Sections 10780–10782.3 of the California Water Code, Assembly Bill 599}) to assess and monitor the quality of groundwater used as public supply for municipalities in California. The GAMA Priority Basin Project is a comprehensive assessment of statewide groundwater quality designed to help better understand and identify risks to groundwater resources, and to increase the availability of information about groundwater quality to the public. For the Priority Basin Project, the USGS, in collaboration with the SWRCB, developed the monitoring plan to assess groundwater basins through direct and other statistically reliable sample approaches (Belitz and others, 2003; State Water Resources Control Board, 2003). Key aspects of the project are interagency collaboration, and cooperation with local water agencies and well owners. Local participation in the project is entirely voluntary.

The GAMA Priority Basin Project is unique in California because the data collected during the study include analyses for an extensive number of chemical constituents at very low concentrations, analyses that are not normally available. A broader understanding of groundwater 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 Project will analyze a broader suite of constituents than required by the California Department of Public Health (CDPH; formerly California Department of Health Services—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 groundwater resources.

The range of hydrologic, geologic, and climatic conditions that exist in California must be considered in an assessment of groundwater 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 groundwater basins within these hydrologic provinces. These groundwater basins, defined by the California Department of Water Resources, generally consist of relatively permeable, unconsolidated deposits of alluvial or volcanic origin (California Department of Water Resources, 2003). Groundwater basins were prioritized for sampling on the basis of the number of public-supply wells in the basin, with secondary consideration given to municipal groundwater use, agricultural pumping, the number of formerly leaking underground fuel tanks, and pesticide applications within the basins (Belitz and others, 2003). In addition, some groundwater 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 as part of the project. The 116 priority basins were grouped into 35 study units. Some areas not in the defined groundwater basins were included in several of the study units to achieve representation of the 20 percent of public-supply wells not located in the groundwater basins.

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

Provinces from Belitz and others, 2003

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

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 groundwater resource, (2) Trends: detection of changes in groundwater quality, and (3) Understanding: identification of the natural and human factors affecting groundwater 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; Fram and Belitz, 2007; Kulongoski and Belitz, 2007; Burton and Belitz, 2008; Dawson and others, 2008; Ferrari and others, 2008; Land and Belitz, 2008; Landon and Belitz, 2008; Mathany and others, 2008; Schmitt and others, 2008; Shelton and others, 2008; Fram and others, 2009; Goldrath and others, 2009; Kent and Belitz, 2009; Mathany and Belitz, 2009; Mathany and others, 2009; Montrella and Belitz, 2009; Ray and others, 2009). Subsequent reports will address the trends, and understanding aspects of the water-quality assessments.

The Antelope Valley GAMA study unit, hereafter referred to as ANT, contains one groundwater basin (the Antelope Valley Groundwater Basin) and also encompasses areas outside of the defined groundwater basin. ANT was considered high priority for sampling to provide adequate representation of the Desert hydrogeologic province (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 groundwater samples collected in ANT. Groundwater samples were analyzed for organic and inorganic constituents, field parameters, and chemical tracers. The chemical data presented in this report were evaluated by comparison to State and Federal drinking-water regulatory and other non-regulatory health-based standards that are applied to treated drinking water. Regulatory and non-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 groundwater 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 groundwater samples will be the subject of subsequent publications.

Hydrogeologic Setting

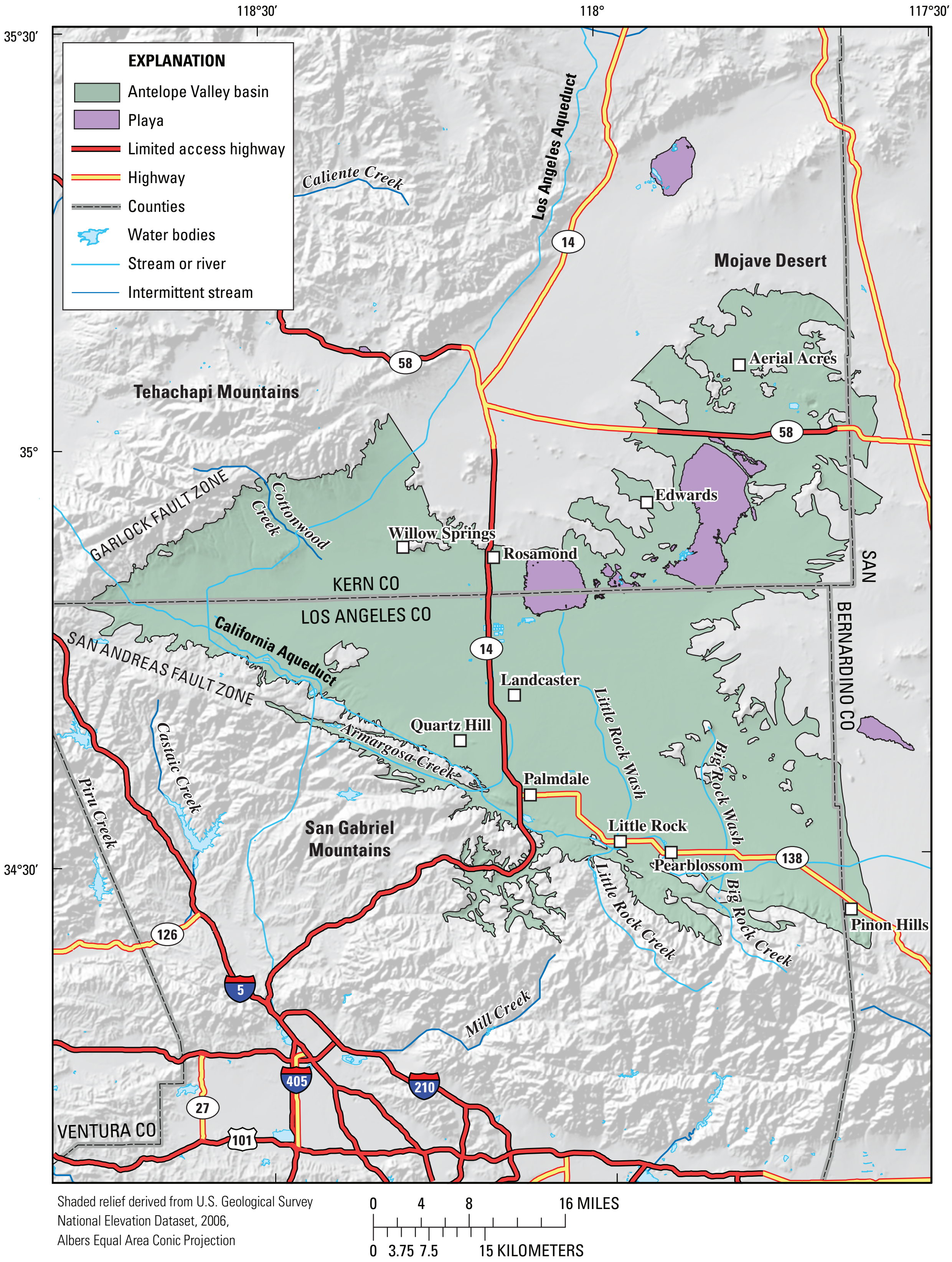
Knowledge of the hydrogeologic setting is important in the design of a groundwater-quality investigation. The Antelope Valley study unit (ANT) covers approximately 1,600 square miles (mi^2) in Kern, Los Angeles, and San Bernardino Counties, California, at the north-western part of the Desert hydrogeologic province (*fig. 1*). The study unit, located in the western portion of the Mojave Desert, includes one groundwater basin (the Antelope Valley Groundwater Basin), as defined by the California Department of Water Resources (California Department of Water Resources, 2003).

The Antelope Valley Groundwater Basin is a closed alluvial drainage basin that is bounded to the northwest by the Garlock fault zone at the base of the Tehachapi Mountains, to the southwest by the San Andreas fault zone at the base of the San Gabriel Mountains, and to the north and east by several fault systems and low-lying bedrock hills (Londquist and others, 1993; Rewis, 1995; California Department of Water Resources, 2004) (*fig.2*). The fault systems in Antelope Valley act as barriers to groundwater flow where displacement along the faults move the water-bearing deposits juxtaposed to less permeable lithologic units (Nishikawa and other, 2001).

Most of the study-unit land surface is flat; however, there is approximately 4,334 ft of topographic relief between the lowest and highest points of the study unit. The valley floor ranges in elevation from 2,270 to 3,500 ft above sea level, with the lowest point at Rogers Lake (Londquist and others, 1993; California Department of Water Resources, 2004).

Antelope Valley is in the rain shadow of the Tehachapi and San Gabriel Mountains, and averages less than 5 inches of annual rainfall (Londquist and others, 1993; Nishikawa and others, 2001). The basin climate is semiarid-to-arid, with hot, dry summers and cold winters. Winter precipitation commonly occurs as snow.

There are four main creeks and two closed playa, or dry lake, basins in the study unit. Armargosa, Little Rock, and Big Rock Creeks, flowing from the San Gabriel Mountains, and Cottonwood Creek, flowing from the Tehachapi Mountains, drain into the basin (Rewis, 1995). Rosamond and Rogers Lakes are closed playas in the northern portion of the study unit.



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

Figure 2. The Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study unit showing the major cities, hydrologic features, and roads. The area of the study unit is equivalent to the Antelope Valley Groundwater Basin defined by the California Department of Water Resources (California Department of Water Resources, 2003).

The aquifer system of Antelope Valley is underlain by pre-Cenozoic igneous and consolidated Tertiary sedimentary bedrock (Jennings and Strand, 1969; Londquist and others, 1993). The partly confined deep aquifer, or older alluvium, rests on top of the bedrock and is composed of silt, sand, and clay. In most places in the valley, the deep aquifer, which is late Pliocene to middle Pleistocene in age, is overlain by a lacustrine clay deposit (Nishikawa and others, 2001). This middle-to-late Pleistocene-aged deposit acts as an aquitard between the deep aquifer and the unconfined principal aquifer, or younger alluvium. The late-Pleistocene to Recent aged principal aquifer, composed of unconsolidated silt, sand, and gravel, supplies most of the groundwater pumped in the Antelope Valley. The aquifer system primarily is recharged by rainfall and runoff infiltration through the alluvial fans at the base of the San Gabriel and Tehachapi Mountains (Rewis, 1995; Nishikawa and others, 2001). Minor sources of groundwater recharge in Antelope Valley include irrigation and urban return flow (Duell, 1987). Prior to the initiation of extensive pumping from Antelope Valley groundwater systems, which began in the mid-1920's and peaked in the mid-1960's (Leighton and Phillips, 2003), the general pattern of groundwater movement was from the surrounding mountain-range fronts towards the north-central part of the valley, where groundwater discharged as springs and evapotranspiration. Extensive use of groundwater has caused the direction of groundwater movement to shift towards the major areas of groundwater withdrawal in the central part of the basin (Londquist and others, 1993).

Methods

Methods used for the GAMA program were selected to achieve the following objectives: (1) design a sampling plan suitable for statistical analysis on a statewide scale; (2) collect samples in a consistent manner; (3) analyze samples using proven and reliable laboratory methods; (4) assure the quality of the groundwater 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 plan, and the results of analyses of quality-control samples.

Study Design

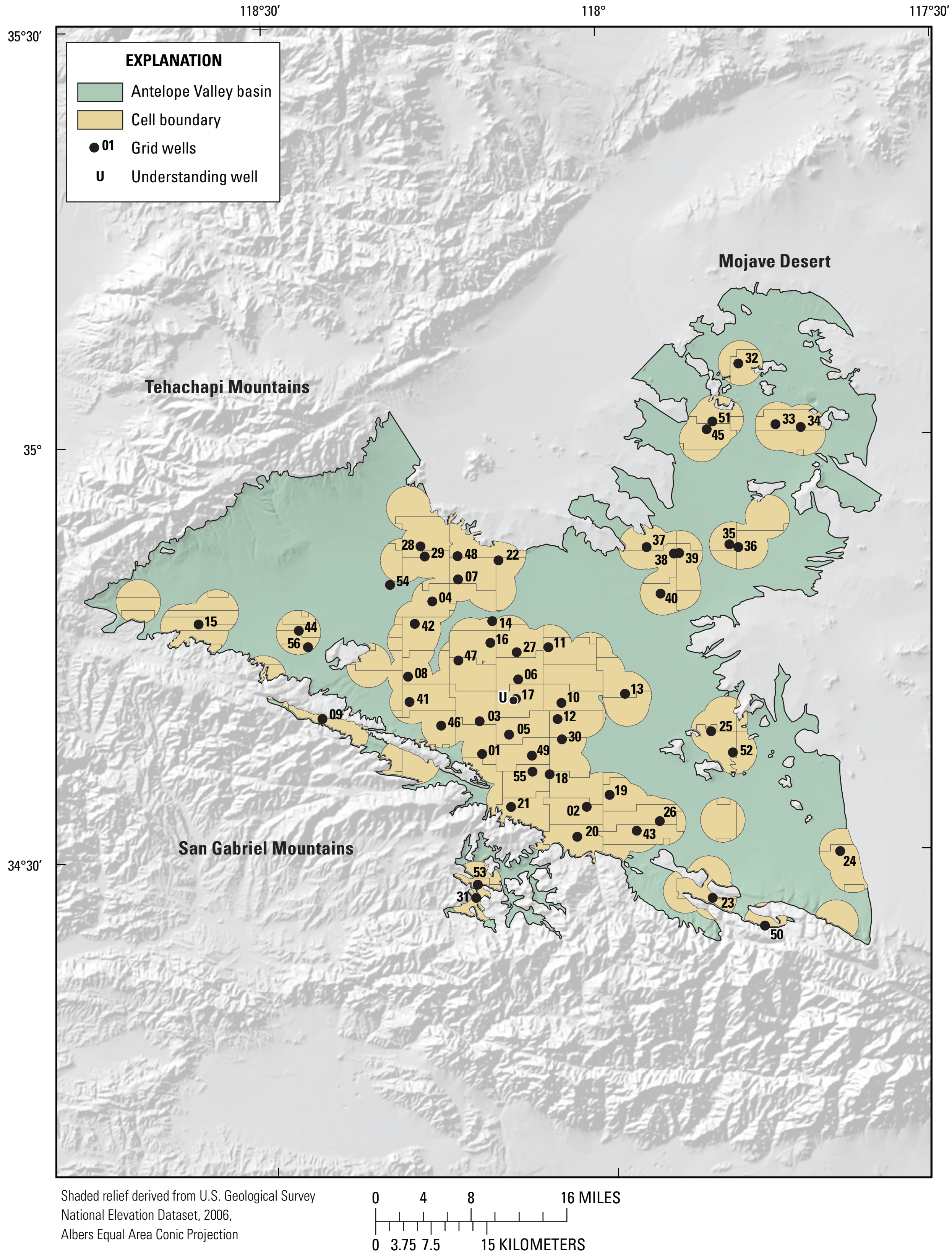
The wells selected for sampling in this study reflect the combination of two well-selection strategies. Fifty-six "grid" wells were selected to provide a statistically unbiased, spatially distributed assessment of the quality of groundwater resources used for public drinking-water supply, and one additional "understanding" well was selected to aid in understanding changes in arsenic concentrations and stable isotopes of hydrogen and oxygen ratios during pumping.

The spatially distributed wells were selected using a randomized grid-based method (Scott, 1990). The public-supply wells in ANT are not distributed evenly across the study area. To minimize the number of cells without any wells, only the portion of ANT in close proximity to a public-supply well was included in the gridded area. Locations of wells listed in the statewide database maintained by the CDPH were plotted and 1.86-mi (3-kilometer) radius circles were drawn around each well. The area encompassed by the circles then was divided into 66 10-mi^2 grid cells (*fig. 3*). The objective was to select one public-supply well per grid cell. Fifty-six of the 66 grid cells were sampled in ANT; the other 10 grid cells did not contain accessible wells. If a grid cell contained more than one public-supply well, each well was randomly assigned a rank. The highest ranking well that met basic sampling criteria (for example, the sampling point was located prior to treatment and had the capability to pump for several hours), and for which permission to sample could be obtained, was sampled. If a grid cell contained no accessible public-supply wells, domestic and irrigation wells were considered for sampling. Domestic and irrigation wells with depths and screened intervals similar to those in public-supply wells in the area were selected. Using these selection methods, 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, hereafter, are referred to as "grid wells." Grid wells in ANT were numbered in the order of sample collection with the prefix "ANT" (*fig. 3*).

An additional "understanding" well was sampled to evaluate changes in arsenic concentrations and ratios of stable isotopes of hydrogen and oxygen during pumping. This public supply well was not pumped for several months prior to sampling, and was not included in the statistical characterization of water quality in ANT because inclusion of this well would have caused overrepresentation of the associated grid-cell. This additional, non-randomized well was located near the center of the study unit in the same grid-cell as ANT-17 and was labeled "ANT-U" ("U" indicating "understanding") (*fig. 3*).

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 elevation, well type, and well-construction information. Groundwater samples were collected from 48 public-supply wells, 5 irrigations wells, 2 domestic wells, and 2 industrial-use wells from January to April 2008.

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. Driller's logs for wells were obtained when available. Well information was recorded on field sheets by hand and on field laptop computers by using specialized software (PCFF). Well owner information is confidential. Well location information and all chemical data currently are inaccessible from the NWIS public website.



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

Figure 3. The Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study unit showing the 1.86-mile (3 kilometer) buffer zones around all public-supply wells, the distribution of study area grid cells, and the location of sampled grid wells and the understanding well. Alphanumeric identification numbers for grid wells have the prefix "ANT", but only the numeric portions are shown on the map (the understanding well is labeled "U").

The wells in ANT were sampled using a tiered, analytical approach. All wells were sampled for a standard set of constituents, including VOCs, pesticides and pesticide degradates, perchlorate, stable isotopes of hydrogen and oxygen in water, and dissolved noble gases and tritium/helium age dates. The standard set of constituents was termed the "fast" schedule (*table 2*). Wells on the "intermediate" schedule were sampled for all the constituents on the fast schedule, plus 1,2,3-TCP, gasoline oxygenates, and fumigants. Wells on the "slow" schedule were sampled for all the constituents on the intermediate schedule, plus turbidity, DBCP, EDB, pharmaceutical compounds, NDMA, nutrients, major and minor ions, trace elements, arsenic, iron, and chromium speciation, stable isotopes of carbon and carbon-14 abundance, strontium isotope ratios, radium isotopes, gross alpha and gross beta radiation, and radon-222 (*table 2*). In ANT, 30 of the groundwater wells were sampled on the fast schedule, 8 wells were sampled on the intermediate schedule, and 19 wells were sampled on the slow schedule (*table 1*).

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), except as described in the Appendix. These sampling protocols ensure that a representative sample of groundwater 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."

Tables 3A–I list the compounds analyzed in each constituent class. Groundwater samples were analyzed for 85 VOCs (*table 3A*), 8 gasoline oxygenates and degradates (*table 3B*), 63 pesticides and pesticide degradates (*table 3C*), 2 fumigants (*table 3C*), 14 pharmaceutical compounds (*table 3D*), 3 constituents of special interest (*table 3E*), 5 nutrients (*table 3F*), 11 major and minor ions and total dissolved solids (TDS) (*table 3G*), 24 trace elements (*table 3G*), 6 arsenic, chromium, and iron species (*table 3H*), 4 stable isotope ratios, 7 radioactive constituents (*table 3I*). The methods used for sample analysis are described in the Appendix section "Sample Collection and Analysis" and in referenced publications.

Data Reporting

The methods and conventions used for reporting the data are described in the "Data Reporting" section of the *Appendix*. Fifteen constituents analyzed in this study were measured by more than one analytical schedule or more than one laboratory. Seven 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 preferred method are reported (see *Appendix* section "Constituents on Multiple Analytical Schedules"). Five other constituents—arsenic, chromium, iron, and 1,2,3-trichloropropane (1,2,3-TCP) concentrations and tritium activities—were measured by two different laboratories, and both sets of results are reported for these constituents. The water quality indicators, alkalinity, pH, and specific conductance, were measured in the field and at the USGS NWQL. Both sets of results are reported for these water quality indicators.

Quality Assurance

The quality-assurance and quality-control procedures 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). Quality-control (QC) samples collected in the ANT study included: source-solution blanks, field blanks, replicates, and matrix and surrogate spikes. QC samples were collected to evaluate sample contamination and data bias and variability that may have resulted from sample collection, processing, storage, transportation, or laboratory analysis. Quality-control procedures and quality-control sample results are described in the *Appendix* section "Quality Assurance."

Water-Quality Results

Quality-Control Results

Results of quality-control analyses (blanks, replicates, matrix spikes, and surrogates) were used to evaluate the quality of the data for the groundwater samples. On the basis of detections in field blanks collected for this and previous GAMA Priority Basins Project study units, all detections of toluene were removed from the set of groundwater-quality data presented in this report (see *table A3* and additional discussion in *Appendix*). Boron and silica were detected in field blanks, however, it was discovered that these major and minor constituents were present in blank water prior to collection of these field blank samples (U.S. Geological Survey, 2008). As a result, none of the detections of boron or silica were subject to V-coding. Radium-226 was detected in one of three field blanks at a concentration of 0.028 ± 0.012 (0.016) pCi/L [(result ± 1s-CSU (ssL$_c$)]. Five groundwater detections of radium-226 that were below this concentration were reported in the tables with a "less-than-or-equal-to" (≤) sign preceding the reported value. Results from the replicates confirm that the procedures used to collect and analyze the samples were consistent. Ninety-seven percent of the replicate pairs for constituents detected in samples had variability within acceptable limits. Median matrix-spike recoveries for 35 of the 150 organic constituents analyzed were lower than the acceptable limits, which may indicate that these constituents might not have been detected in some samples if they were present in the samples at concentrations near the laboratory reporting levels (LRLs). All 35 of these organic constituents were pesticide and pesticide degradates. Eighty-eight percent of the samples analyzed with surrogates had surrogate recoveries within acceptable limits of 70 to 130 percent. The quality-control results are described in the *Appendix* section "Quality-Control Sample Results."

Comparative Thresholds

To provide some context for the results, concentrations of constituents detected in raw groundwater samples were compared with CDPH and USEPA regulatory and non regulatory drinking-water health-based thresholds and thresholds established for aesthetic concerns (secondary maximum contaminant levels, SMCL-CA) by the CDPH (California Department of Public Health, 2008a,b; U.S. Environmental Protection Agency, 2008a,b,c). The chemical data presented in this report are meant to characterize the quality of the untreated groundwater resources within ANT, and are not intended to represent the treated drinking water delivered to consumers by water purveyors. The chemical composition of treated drinking water may differ from untreated groundwater 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. Comparisons of raw (untreated) groundwater to thresholds are for illustrative purposes only, and are not indicative of compliance or non-compliance with drinking-water regulations

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 greater than an MCL-US or MCL-CA thresholds in samples collected for the GAMA Priority Basin Project, but these detections do not constitute violations of CDPH regulations.

- AL—Action Level. Legally enforceable standards that apply to public water systems and are designed to protect public health by limiting the levels of copper and lead in drinking water. Detections of copper or lead above the action-level thresholds trigger requirements for mandatory water treatment to reduce the corrosiveness of water to water pipes. The action levels established by the USEPA and CDPH are the same, thus, the thresholds are labeled "AL-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 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 liters (2.1 quarts) of water per day over a 70-year lifetime by a 70-kilogram (154-pound) 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 ten (RSD5-US).

For constituents with MCLs, detections in groundwater samples were compared to the MCL-US or MCL-CA. Constituents with SMCLs were compared with the SMCL-CA. For chloride, sulfate, specific conductance, and total dissolved solids, CDPH defines a "recommended" and an "upper" SMCL-CA; detections of these constituents in groundwater samples were compared with both levels. The SMCL-US for these constituents corresponds to the recommended SMCL-CA. Detected concentrations of constituents that lack an MCL or 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 comparative thresholds used in this report are listed in *tables 3A–I* for all constituents and in *tables 4–13* for constituents detected in groundwater samples from ANT. Not all constituents analyzed for this study have established thresholds available. Detections of constituents at concentrations greater than the selected comparative threshold are marked with asterisks in *tables 4–13*, unless noted otherwise.

Groundwater-Quality Data

Results from analyses of raw (untreated) groundwater samples from ANT are presented in *tables 4–13*. Groundwater samples collected in ANT were analyzed for 239 constituents, and 146 of those constituents were not detected in any of the samples (*tables 3A–I*). The results tables present only the constituents that were 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 understanding well are presented in the tables, but these results were excluded from the detection frequency calculations to avoid statistically over-representing the area in the vicinity of this well.

Table 4 includes water-quality indicators measured in the field and at the USGS NWQL, and *tables 5–13* present the results of groundwater analyses organized by compound classes:

- Organic constituents
  - Volatile Organic Compounds (VOCs) and gasoline oxygenates and degradates (*table 5*)
  - Pesticides and pesticide degradates (*table 6*)
- Constituents of special interest (*table 7*)
- Inorganic constituents
  - Nutrients (*table 8*)
  - Major and minor ions and total dissolved solids (TDS) (*table 9*)
  - Trace elements (*table 10*)
  - Arsenic, chromium, and iron speciation (*table 11*)
- Isotopic tracers (*table 12*)
- Radioactive constituents (*tables 13A,B,C*)

Results for pharmaceutical compounds are not presented in the ANT Data Series report; they will be included in a subsequent publication. In addition, results for samples collected in ANT for helium isotope ratios, noble gases, and tritium were not received in time to be included in this report.

Water-Quality Indicators (Field Parameters)

Field and laboratory measurements of dissolved oxygen, pH, specific conductance, alkalinity, and associated parameters (turbidity, water temperature, bicarbonate, and carbonate) are presented in *table 4*. Alkalinity, bicarbonate, carbonate, and dissolved oxygen are used as indicators of natural processes that control water chemistry. Specific conductance is the unit of electrical conductivity of the water, and is proportional to the amount of total dissolved solids (TDS) in the water. The pH value indicates the acidity or basicity of the water. Eight grid wells had field specific-conductance values above the recommended SMCL-CA of 900 µS/cm, half of which also were above the upper threshold of 1,600 µS/cm. Four grid wells had field pH values outside of the SMCL-US range of 6.5 to 8.5 for pH.

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 groundwater than in surface water because groundwater is more isolated from the atmosphere.

Of the 85 VOCs analyzed, 20 were detected in groundwater samples; all detections were below health-based thresholds (*table 5*). Perchloroethene (PCE), a solvent used for dry-cleaning, was detected in more than 10 percent of the grid well samples. This compound is among the most commonly detected VOC in groundwater nationally (Zogorski and others, 2006). The disinfection by-products chloroform (trichloromethane), bromodichloromethane, and dibromochloromethane were also detected in more than 10 percent of the grid well samples. One or more VOCs were detected in 26 of the 56 grid wells sampled.

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 63 pesticides and pesticide degradates analyzed, 6 were detected in groundwater samples. Of these six constituents, four have health-based thresholds. All detections were below health-based thresholds, and all were less than one one-hundredth of the threshold values (*table 6*). In addition, the low-level fumigants, 1,2-dibromo-3-chloropropane (DBCP) and 1,2-dibromoethane (ECB), were not detected in this study. The herbicides simazine, deethylatrazine (a degradate of atrazine), and atrazine were detected in more than 10 percent of the grid well samples. These three compounds are among the most commonly detected pesticide compounds in groundwater nationally (Gilliom and others, 2006). One or more pesticide compounds were detected in 17 of the 56 grid wells.

Constituents of Special Interest

Perchlorate, NDMA, and 1,2,3-TCP are constituents of special interest in California because recently they have been found in water supplies (California Department of Public Health, 2008b). Perchlorate was detected in 49 of the groundwater samples, with one of these detections being the understanding well; 94 percent of these detections were less than one-third of the MCL-CA (*table 7*). NDMA and 1,2,3-TCP were not detected in any of the groundwater samples in ANT.

Inorganic Constituents

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

Nutrients (nitrogen and phosphorus compounds) present in groundwater can affect biological activity in aquifers and in surface-water bodies that receive groundwater discharge. Nitrogen may be present in the form of ammonia, nitrite, or nitrate, depending on the oxidation-reduction state of the groundwater. High concentrations of nitrate can affect human health adversely, particularly the health of infants. All concentrations of nutrients measured in samples from ANT wells were below health-based thresholds, with the exception of one nitrate concentration in well ANT-46 that was above the MCL-US of 10 mg/L (*table 8*).

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

The concentrations of chloride were below the recommended SMCL-CA of 250 mg/L for all but one ANT well (*table 9*). Three samples contained sulfate above the recommended SMCL-CA of 250 mg/L. Four samples contained TDS above the recommended SMCL-CA of 500 mg/L, with two of these samples above the upper SMCL-CA of 1,000 mg/L (*table 9*).

Iron and manganese are trace elements whose concentrations are affected by the oxidation-reduction state of the groundwater. Precipitation of minerals containing iron or manganese may cause orange, brown, or black staining of surfaces. Iron was detected in less than 20 percent of the samples, and none of the wells had concentrations above the SMCL-CA of 300 µg/L (*table 10*). Manganese was detected in 28 percent of the groundwater samples; all detections were below the SMCL-CA of 50 mg/L (*table 10*).

Seventeen of the 24 trace elements analyzed in this study have health-based thresholds. Of the 17 trace elements with health-based thresholds, one trace element (thallium) was not detected, and detections of the other 16 trace elements were below health-based thresholds, with the exceptions of arsenic, boron, and vanadium (*table 10*). Samples from five wells had arsenic concentrations above the MCL-US of 10 µg/L. One of these samples also had a boron concentration above the NL-CA of 1,000 µg/L. Samples from two wells had detections of vanadium above the NL-CA of 50 µg/L.

Arsenic, chromium, and iron occur as different species, depending on the oxidation-reduction state of the groundwater. The oxidized and reduced species have different solubilities in groundwater 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. Concentrations of total arsenic, total chromium, and total iron, and the concentrations of either the reduced or the oxidized species of each element, are reported in *table 11*. The concentration of the other species can be calculated by subtraction of the measured species from the total. The concentrations of arsenic, chromium, and iron reported in *table 11* are different than those reported in *table 10* because different analytical methods were used (see *Appendix*). The concentrations reported in *table 10* are considered to be more accurate than those reported in *table 11*.

Isotopic Tracers and Noble Gases

Isotopic ratios of strontium and of oxygen and hydrogen in water, tritium, and carbon-14 activities, and the concentration of dissolved noble gases are used as tracers in hydrologic processes. Isotopic ratios of strontium and of hydrogen and oxygen in water (*table 12*) aid in the interpretation of the sources of groundwater recharge. These stable isotope ratios reflect the altitude, latitude, and temperature of precipitation and also the extent of evaporation prior to infiltration into the aquifer. Concentrations of dissolved noble gases are used to estimate the conditions of groundwater recharge, particularly the temperature of the recharge water. Solubilities of noble gases, and of noble gas species dissolved in water that is in contact with the atmosphere, vary with temperature. Noble-gas analyses were not received in time for inclusion in this report; results will be presented in a subsequent publication.

Tritium and carbon-14 activities (*table 12*) and helium isotope ratios also provide information about the age (time since recharge) of the groundwater. Tritium is a short-lived radioactive isotope of hydrogen that is incorporated into water molecules. Low levels of tritium are produced continuously by interaction of cosmic radiation with the Earth's atmosphere, and a large amount of tritium was released into the environment as a result 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 are used in conjunction with tritium concentrations to estimate ages for young groundwater. Helium isotope ratio analyses were not received in time for inclusion in this report; results will be presented in a subsequent publication.

Carbon-14 (*table 12*) is a radioactive isotope of carbon. Low levels of carbon-14 are continuously produced by interaction of cosmic radiation with the Earth's atmosphere and incorporated into atmospheric carbon dioxide. The carbon dioxide dissolves in precipitation, surface water, and groundwater exposed to the atmosphere, thereby entering the hydrologic cycle. Because carbon-14 decays with a half-life of approximately 5,700 years, low activities of carbon-14, relative to modern values, generally indicate the presence of groundwater that is several thousand years old.

Of the isotopic tracer constituents analyzed for this study, tritium is the only constituent with a health-based threshold. All measured tritium activities in samples from ANT wells were less than 1/1000 of the MCL-CA (*table 12*).

Radioactive Constituents

Radioactivity is the release of energy or energetic particles during changes in the structure of the nucleus of an atom (Thatcher and others, 1977; McCurdy and others, 2008). Most of the radioactivity in groundwater comes from decay of naturally occurring isotopes of uranium and thorium that are present in mineral 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. During 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, thereby, 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 cancer.

Activity often is used instead of concentration for reporting the presence of radioactive constituents. Activity of radioactive constituents in groundwater is measured in units of picocuries per liter (pCi/L), and one picocurie is approximately equal to two atoms decaying per minute (McCurdy and others, 2008). The number of atoms decaying is equal to the number of alpha or beta particles emitted.

The 19 ANT well samples analyzed for radioactive constituents had activities of radium and of gross beta radioactivity at less-than-established health-based standards (*table 13A,B*). Gross alpha radioactivity (72-hr count and 30-day count) was detected above the MCL-US of 15 pCi/L in two wells (ANT-34 and ANT-48) (*table 13B*). Activities of radon-222 in samples from 15 wells (14 grid wells and 1 understanding well) were above the proposed MCL-US of 300 pCi/L, but none had an activity that was above the proposed alternative MCL-US of 4,000 pCi/L (*table 13C*). The proposed alternative MCL-US will apply if the State or local water agency has an approved multimedia mitigation program to address radon levels in indoor air (U.S. Environmental Protection Agency, 2008c).

Future Work

Subsequent reports will be focused on assessment of the data presented in this report using a variety of statistical, qualitative, and quantitative approaches to evaluate the natural and human factors affecting groundwater quality. Water-quality data contained in the CDPH 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; the results of these future efforts will appear in one or more subsequent reports.

Summary

Groundwater quality in the approximately 1,600-square-mile Antelope Valley study unit (ANT) was investigated from January to April 2008 as part of the Priority Basin 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 Project was designed by the SWRCB and the USGS in response to the Groundwater Quality Monitoring Act of 2001 (Belitz and others, 2003; State Water Resources Control Board, 2003). The project is a comprehensive assessment of statewide groundwater quality designed to identify and characterize risks to groundwater resources, and to increase the availability of information about groundwater quality to the public. ANT was the 22nd of 35 study units to be sampled as part of the GAMA program.

ANT is located in the north-western portion of the Desert hydrogeologic province and includes the entire Antelope Valley Groundwater basin defined by the California Department of Water Resources (California Department of Water Resources, 2004). The ANT study included assessment of the groundwater quality from 57 wells in Kern, Los Angeles, and San Bernardino Counties. Fifty-six of the wells were selected using a randomized grid approach to achieve statistically unbiased representation of groundwater used for public drinking-water supplies. An additional well was selected to aid in understanding processes affecting groundwater quality.

Groundwater samples were analyzed for volatile organic compounds (VOCs), pesticides and pesticide degradates, low-level fumigants, pharmaceutical compounds, nutrients, major and minor ions, trace elements, and radioactivity (radium isotopes, gross alpha and gross beta radiation, and radon-222). Naturally occurring isotopes (stable isotopes of hydrogen, oxygen, and carbon, and activities of tritium, strontium, 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 groundwater. In total, 239 constituents and 8 water-quality indicators (field parameters) were investigated for this study. This report describes the sampling, analytical, and quality-assurance methods used in the study and presents the results of the chemical analyses made of the groundwater samples collected from January to April 2008.

Quality-control samples (blanks, replicates, and samples for matrix spikes) were collected at 12 percent of the wells, and the results for these samples were used to evaluate the quality of the data for the groundwater samples. Field blanks rarely contained detectable concentrations of any constituent, suggesting that contamination was not a noticeable source of bias in the data for the groundwater samples. Differences between replicate samples generally were within acceptable ranges, indicating acceptably low variability. Matrix spike recoveries were within acceptable ranges for most compounds.

This study did not attempt to evaluate the quality of water delivered to consumers; after withdrawal from the ground, water typically is treated, disinfected, and blended with other waters to maintain acceptable water quality. Regulatory thresholds apply to treated water that is served to the consumer, not to raw groundwater. However, to provide some context for the results, concentrations of constituents measured in the raw groundwater were compared with regulatory and non-regulatory health-based thresholds established by the U.S. Environmental Protection Agency (USEPA) and California Department of Public Health (CDPH).

All detections of VOCs and pesticides were below health-based thresholds and most were less than one one-hundredth of the threshold values. All detections of perchlorate were below established thresholds. Nitrate plus Nitrite as nitrogen (NO_3+NO_2), arsenic, and activities of gross alpha radiation (72-hr and 30-day counts) were detected above a maximum contaminant level (MCL-US). Radon-222 was detected above the proposed MCL-US of 300 pCi/L, but not above the proposed alternative MCL-US of 4,000 pCi/L. Boron and vanadium concentrations were detected above the NL-CA. Sulfate, total dissolved solids (TDS), specific conductance, and pH were detected at concentrations above secondary maximum contaminant levels (SMCL-CAs), non-enforceable thresholds set for aesthetic concerns. Half of the TDS and specific conductance detections were above the secondary SMCL.

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Tables

Table 1. Well identification, sampling, and construction information for wells sampled for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.

[**GAMA well identification number:** ANT, Antelope Valley study area grid well; ANT-U, Antelope Valley study area understanding well. **Other abbreviations:** ft, foot; LSD, land surface datum; NAVD 88, North American Vertical Datum 1988; na, not available]

GAMA well identification number	Sampling information				Construction information		
	Date	Sampling schedule[1]	Elevation of LSD (ft above NAVD 88)[2]	Well type	Well depth (ft below LSD)	Top perforation (ft below LSD)	Bottom perforation (ft below LSD)
Grid wells							
ANT-01	01/28/2008	Fast	2,618	Production	na	na	na
ANT-02	01/28/2008	Slow	2,700	Production	400	190	400
ANT-03	01/28/2008	Intermediate	2,428	Production	570	390	560
ANT-04	01/29/2008	Slow	2,398	Production	765	350	765
ANT-05	01/29/2008	Fast	2,520	Production	770	350	762
ANT-06	01/29/2008	Fast	2,343	Production	1,000	240	980
ANT-07	01/29/2008	Slow	2,358	Production	527	260	527
ANT-08	01/29/2008	Fast	2,435	Production	500	na	na
ANT-09	01/30/2008	Slow	3,293	Production	213	93	213
ANT-10	01/30/2008	Fast	2,418	Production	1,200	360	1,200
ANT-11	01/30/2008	Fast	2,328	Production	125	80	102
ANT-12	01/30/2008	Slow	2,439	Production	800	317	800
ANT-13	01/30/2008	Fast	2,443	Production	600	350	600
ANT-14	01/31/2008	Fast	2,315	Production	470	270	470
ANT-15	01/31/2008	Slow	2,979	Production	680	na	na
ANT-16	01/31/2008	Intermediate	2,312	Production	300	120	300
ANT-17	01/31/2008	Slow	2,377	Production	552	192	552
ANT-18	02/04/2008	Fast	2,567	Production	920	570	900
ANT-19	02/04/2008	Intermediate	2,671	Production	410	200	410
ANT-20	02/05/2008	Fast	3,059	Production	350	80	350
ANT-21	02/05/2008	Fast	2,903	Production	na	na	na
ANT-22	02/05/2008	Fast	2,318	Production	365	na	na
ANT-23	02/06/2008	Fast	3,733	Production	150	0	150
ANT-24	02/06/2008	Fast	3,385	Production	795	545	785
ANT-25	02/06/2008	Fast	2,580	Production	360	na	na
ANT-26	02/07/2008	Slow	2,823	Production	320	160	300
ANT-27	02/11/2008	Fast	2,315	Production	220	na	na
ANT-28	02/11/2008	Fast	2,593	Production	na	na	na
ANT-29	02/11/2008	Fast	2,413	Production	na	na	na
ANT-30	02/12/2008	Fast	2,482	Production	736	400	700
ANT-31	02/12/2008	Fast	2,632	Production	260	60	210
ANT-32	02/13/2008	Fast	2,424	Production	715	na	na
ANT-33	02/13/2008	Fast	2,350	Production	530	281	530
ANT-34	02/14/2008	Slow	2,385	Production	606	96	606
ANT-35	02/26/2008	Intermediate	2,285	Production	534	155	505
ANT-36	02/26/2008	Intermediate	2,320	Production	548	148	548
ANT-37	02/27/2008	Intermediate	2,311	Production	700	270	690
ANT-38	02/27/2008	Intermediate	2,280	Production	700	290	690
ANT-39	02/27/2008	Intermediate	2,280	Production	750	238	738
ANT-40	02/28/2008	Slow	2,300	Production	843	583	833

Table 1. Well identification, sampling, and construction information for wells sampled for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.—Continued

[**GAMA well identification number:** ANT, Antelope Valley study area grid well; ANT-U, Antelope Valley study area understanding well. **Other abbreviations:** ft, foot; LSD, land surface datum; NAVD 88, North American Vertical Datum 1988; na, not available]

GAMA well identification number	Sampling information				Construction information		
	Date	Sampling schedule[1]	Elevation of LSD (ft above NAVD 88)[2]	Well type	Well depth (ft below LSD)	Top perforation (ft below LSD)	Bottom perforation (ft below LSD)
ANT-41	03/03/2008	Fast	2,429	Production	na	na	na
ANT-42	03/03/2008	Fast	2,434	Production	664	320	664
ANT-43	03/04/2008	Slow	2,892	Production	550	210	540
ANT-44	03/04/2008	Fast	2,757	Production	320	na	na
ANT-45	03/05/2008	Slow	2,289	Production	na	na	na
ANT-46	03/06/2008	Slow	2,436	Production	475	250	475
ANT-47	03/17/2008	Slow	2,341	Production	1,100	115	1,100
ANT-48	03/18/2008	Slow	2,394	Production	na	na	na
ANT-49	03/19/2008	Slow	2,563	Production	801	500	801
ANT-50	03/19/2008	Fast	5,278	Production	na	na	na
ANT-51	03/20/2008	Slow	2,294	Production	328	188	328
ANT-52	04/07/2008	Slow	2,658	Production	300	200	300
ANT-53	04/08/2008	Fast	2,701	Production	232	70	209
ANT-54	04/09/2008	Fast	2,465	Production	na	na	na
ANT-55	04/10/2008	Fast	2,591	Production	800	420	800
ANT-56	04/10/2008	Fast	2,795	Production	340	170	340
Understanding well							
ANT-U	02/25/2008	Slow	2,387	Production	700	235	693

[1] Sampling schedules are described in *table 2*.

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

Table 2. Classes of chemical and water-quality indicators (field parameters) collected for the slow, intermediate, and fast well sampling schedules in the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.

[X, analyte class collected; —, analyte class not collected or no table]

Analyte classes	Slow schedule	Intermediate schedule	Fast schedule	Analyte list table	Results table
Water-quality indicators					
Dissolved oxygen, temperature, specific conductance	X	X	X	—	*4*
pH, alkalinity, bicarbonate, and carbonate	X	X	X	—	*4*
Turbidity	X	—	—	—	*4*
Organic constituents					
Volatile organic compounds (VOC)	X	X	X	*3A*	*5*
Low-level 1,2-dibromo-3-chloropropane (DBCP) and 1,2-dibromoethane (EDB)	X	—	—	*3B*	None[1]
Gasoline additives and oxygenates	X	X	—	*3B*	*5*
Pesticides and pesticide degradates	X	X	X	*3C*	*6*
Pharmaceutical compounds	X	—	—	*3D*	None[2]
Constituents of special interest					
Perchlorate	X	X	X	*3E*	*7*
N-Nitrosodimethylamine (NDMA)	X	—	—	*3E*	*7*
1,2,3-Trichloropropane	X	X	—	*3E*	*7*
Inorganic constituents					
Nutrients	X	—	—	*3F*	*8*
Major and minor ions and trace elements	X	—	—	*3G*	*9, 10*
Arsenic, iron, and chromium abundance and speciation	X	—	—	*3H*	*11*
Stable isotopes					
Stable isotopes of hydrogen and oxygen in water	X	X	X	*3I*	*12*
Stable isotopes of carbon and carbon-14 abundance	X	—	—	*3I*	*12*
Strontium isotope ratios	X	—	—	*3I*	*12*
Radioactivity and noble gases					
Tritium	X	X	X	*3I*	*12*
Radium isotopes	X	—	—	*3I*	*13A*
Gross alpha and gross beta radiation (72-hour and 30-day counts)	X	—	—	*3I*	*13B*
Radon-222	X	—	—	*3I*	*13C*
Tritium and noble gases	X	X	X	*3J*	None[3]

[1] Low-level 1,2-dibromo-3-chloropropane (DBCP) and 1,2-dibromoethane (EDB) were not detected.

[2] Results for pharmaceutical compounds are not presented in the ANT data report; they will be included in a subsequent publication.

[3] Results for noble gases, tritium, and helium isotope ratios analyzed by Lawrence Livermore Laboratories are not presented in the ANT data report; they will be included in a subsequent publication.

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

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** 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 10^{-5}. **Other abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; THM, trihalomethane; D, detected in groundwater samples (*table 5*); µg/L, microgram per liter; na, not available; —, not detected]

Constituent	Primary use or source	USGS parameter code	CAS number[1]	LRL (µg/L)	Threshold type[2]	Threshold level (µg/L)	Detection
Acetone	Solvent	81552	67-64-1	4	na	na	—
Acrylonitrile	Organic synthesis	34215	107-13-1	0.4	RSD5-US	0.6	—
tert-Amyl methyl ether (TAME)	Gasoline oxygenate	50005	994-05-8	0.06	na	na	—
Benzene	Gasoline hydrocarbon	34030	71-43-2	0.016	MCL-CA	1	—
Bromobenzene	Solvent	81555	108-86-1	0.02	na	na	—
Bromochloromethane	Fire retardant	77297	74-97-5	0.06	HAL-US	90	D
Bromodichloromethane	Disinfection by-product (THM)	32101	75-27-4	0.04	MCL-US	[3] 80	D
Bromoform (Tribromomethane)	Disinfection by-product (THM)	32104	75-25-2	0.08	MCL-US	[3] 80	D
Bromomethane (Methyl bromide)	Fumigant	34413	74-83-9	0.4	HAL-US	10	—
n-Butylbenzene	Gasoline hydrocarbon	77342	104-51-8	0.14	NL-CA	260	—
sec-Butylbenzene	Gasoline hydrocarbon	77350	135-98-8	0.04	NL-CA	260	—
tert-Butylbenzene	Gasoline hydrocarbon	77353	98-06-6	0.06	NL-CA	260	—
Carbon disulfide	Organic synthesis	77041	75-15-0	0.06	NL-CA	160	—
Carbon tetrachloride (Tetrachloromethane)	Solvent	32102	56-23-5	0.08	MCL-CA	0.5	D
Chlorobenzene	Solvent	34301	108-90-7	0.02	MCL-CA	70	—
Chloroethane	Solvent	34311	75-00-3	0.10	na	na	D
Chloroform (Trichloromethane)	Disinfection by-product (THM)	32106	67-66-3	0.02	MCL-US	[3] 80	D
Chloromethane	Solvent	34418	74-87-3	0.10	HAL-US	30	D
3-Chloropropene	Organic synthesis	78109	107-05-1	0.08	na	na	—
2-Chlorotoluene	Solvent	77275	95-49-8	0.04	NL-CA	140	—
4-Chlorotoluene	Solvent	77277	106-43-4	0.04	NL-CA	140	—
Dibromochloromethane	Disinfection by-product (THM)	32105	124-48-1	0.12	MCL-US	[3] 80	D
1,2-Dibromo-3-chloropropane (DBCP)[4]	Fumigant	82625	96-12-8	0.5	MCL-US	0.2	—
1,2-Dibromoethane (EDB) [4]	Fumigant	77651	106-93-4	0.04	MCL-US	0.05	—
Dibromomethane	Solvent	30217	74-95-3	0.04	na	na	D
1,2-Dichlorobenzene	Solvent	34536	95-50-1	0.02	MCL-CA	600	D
1,3-Dichlorobenzene	Solvent	34566	541-73-1	0.04	HAL-US	600	D
1,4-Dichlorobenzene	Fumigant	34571	106-46-7	0.02	MCL-CA	5	D
trans-1,4-Dichloro-2-butene	Organic synthesis	73547	110-57-6	0.6	na	na	—
Dichlorodifluoromethane (CFC-12)	Refrigerant	34668	75-71-8	0.14	NL-CA	1,000	—
1,1-Dichloroethane (1,1-DCA)	Solvent	34496	75-34-3	0.04	MCL-CA	5	D
1,2-Dichloroethane (1,2-DCA)	Solvent	32103	107-06-2	0.5	MCL-CA	0.5	—
1,1-Dichloroethene (1,1-DCE)	Organic synthesis	34501	75-35-4	0.02	MCL-CA	6	D
cis-1,2-Dichloroethene (*cis*-1,2-DCE)	Solvent	77093	156-59-2	0.02	MCL-CA	6	—
trans-1,2-Dichloroethene (*trans*-1,2-DCE)	Solvent	34546	156-60-5	0.018	MCL-CA	10	—

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

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** 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 10^{-5}. **Other abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; THM, trihalomethane; D, detected in groundwater samples (*table 5*); µg/L, microgram per liter; na, not available; —, not detected]

Constituent	Primary use or source	USGS parameter code	CAS number[1]	LRL (µg/L)	Threshold type[2]	Threshold level (µg/L)	Detection
1,2-Dichloropropane	Fumigant	34541	78-87-5	0.02	MCL-US	5	—
1,3-Dichloropropane	Fumigant	77173	142-28-9	0.06	na	na	—
2,2-Dichloropropane	Fumigant	77170	594-20-7	0.06	na	na	—
1,1-Dichloropropene	Organic synthesis	77168	563-58-6	0.04	na	na	—
cis-1,3-Dichloropropene	Fumigant	34704	10061-01-5	0.1	RSD5-US	[5] 4	—
trans-1,3-Dichloropropene	Fumigant	34699	10061-02-6	0.10	RSD5-US	[5] 4	—
Diethyl ether	Solvent	81576	60-29-7	0.12	na	na	—
Diisopropyl ether (DIPE)	Gasoline oxygenate	81577	108-20-3	0.06	na	na	—
Ethylbenzene	Gasoline hydrocarbon	34371	100-41-4	0.04	MCL-CA	300	—
Ethyl *tert*-butyl ether (ETBE)	Gasoline oxygenate	50004	637-92-3	0.04	na	na	—
Ethyl methacrylate	Organic synthesis	73570	97-63-2	0.14	na	na	—
o-Ethyl toluene (1-Ethyl-2-methyl benzene)	Gasoline hydrocarbon	77220	611-14-3	0.04	na	na	—
Hexachlorobutadiene	Organic synthesis	39702	87-68-3	0.06	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	0.6	na	na	—
Iodomethane (Methyl iodide)	Organic synthesis	77424	74-88-4	0.4	na	na	—
Isopropylbenzene	Gasoline hydrocarbon	77223	98-82-8	0.04	NL-CA	770	—
4-Isopropyl-1-methyl benzene	Gasoline hydrocarbon	77356	99-87-6	0.08	na	na	—
Methyl acrylate	Organic synthesis	49991	96-33-3	0.6	na	na	—
Methyl acrylonitrile	Organic synthesis	81593	126-98-7	0.2	na	na	—
Methyl *tert*-butyl ether (MTBE)	Gasoline oxygenate	78032	1634-04-4	0.1	MCL-CA	13	D
Methyl iso-butyl ketone (MIBK)	Solvent	78133	108-10-1	0.4	NL-CA	120	—
Methylene chloride (Dichloromethane)	Solvent	34423	75-09-2	0.04	MCL-US	5	D
Methyl ethyl ketone (2-butanone, MEK)	Solvent	81595	78-93-3	1.6	HAL-US	4,000	—
Methyl methacrylate	Organic synthesis	81597	80-62-6	0.2	na	na	—
Naphthalene	Gasoline hydrocarbon	34696	91-20-3	0.2	NL-CA	17	—
Perchloroethene (Tetrachloroethene, PCE)	Solvent	34475	127-18-4	0.04	MCL-US	5	D
n-Propylbenzene	Solvent	77224	103-65-1	0.04	NL-CA	260	—
Styrene	Gasoline hydrocarbon	77128	100-42-5	0.04	MCL-US	100	D
1,1,1,2-Tetrachloroethane	Solvent	77562	630-20-6	0.04	HAL-US	70	—
1,1,2,2-Tetrachloroethane	Solvent	34516	79-34-5	0.10	MCL-CA	1	—
Tetrahydrofuran	Solvent	81607	109-99-9	1.4	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	0.12	na	na	—
Toluene	Gasoline hydrocarbon	34010	108-88-3	0.018	MCL-CA	150	—
1,2,3-Trichlorobenzene	Organic synthesis	77613	87-61-6	0.08	na	na	—
1,2,4-Trichlorobenzene	Solvent	34551	120-82-1	0.08	MCL-CA	5	—
1,1,1-Trichloroethane (TCA)	Solvent	34506	71-55-6	0.02	MCL-CA	200	—
1,1,2-Trichloroethane	Solvent	34511	79-00-5	0.06	MCL-CA	5	—
Trichloroethene (TCE)	Solvent	39180	79-01-6	0.02	MCL-US	5	D

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

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** 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 10^{-5}. **Other abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; THM, trihalomethane; D, detected in groundwater samples (*table 5*); µg/L, microgram per liter; na, not available; —, not detected]

Constituent	Primary use or source	USGS parameter code	CAS number[1]	LRL (µg/L)	Threshold type[2]	Threshold level (µg/L)	Detection
Trichlorofluoromethane (CFC-11)	Refrigerant	34488	75-69-4	0.08	MCL-CA	150	—
1,2,3-Trichloropropane (1,2,3-TCP)	Solvent/organic synthesis	77443	96-18-4	0.12	HAL-US [6]	40	—
Trichlorotrifluoroethane (CFC-113)	Refrigerant	77652	76-13-1	0.04	MCL-CA	1,200	
1,2,3-Trimethylbenzene	Gasoline hydrocarbon	77221	526-73-8	0.08	na	na	—
1,2,4-Trimethylbenzene	Gasoline hydrocarbon	77222	95-63-6	0.04	NL-CA	330	D
1,3,5-Trimethylbenzene	Organic synthesis	77226	108-67-8	0.04	NL-CA	330	—
Vinyl bromide (Bromoethene)	Fire retardant	50002	593-60-2	0.12	na	na	—
Vinyl chloride (Chloroethene)	Organic synthesis	39175	75-01-4	0.08	MCL-CA	0.5	—
m- and *p*-Xylene	Gasoline hydrocarbon	85795	108-38-3/ 106-42-3	0.08	MCL-CA	[7] 1,750	—
o-Xylene	Gasoline hydrocarbon	77135	95-47-6	0.04	MCL-CA	[7] 1,750	—

[1] This report contains CAS Registry Numbers®, which is a Registered Trademark of the American Chemical Society. CAS recommends the verification of the CASRNs through CAS Client Services℠.

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

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

[4] Constituent on both Schedules 2020 and 1306.

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

[6] In earlier reports in this series, the NL-CA (0.005 µg/L) was used as the comparison threshold for 1,2,3-TCP.

[7] The MCL-CA thresholds for *m* - and *p*-Xylene and *o*-Xylene is the sum of all three xylene compounds.

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

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** MCL-US, U.S. Environmental Protection Agency maximum contaminant level; NL-CA, California Department of Public Health notification level. **Other abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; D, detected in groundwater samples (*table 5*); µg/L, microgram per liter; na, not available; —, not detected]

Constituent	Primary use or source	USGS parameter code	CAS number	LRL (µg/L)	Threshold type[1]	Threshold level (µg/L)	Detection
Acetone	Degradate	81552	67-64-1	1.8	na	na	—
tert-Amyl alcohol	Oxygenate	77073	75-85-4	0.6	na	na	—
tert-Amyl methyl ether (TAME)	Oxygenate	50005	994-05-8	0.05	na	na	—
tert-Butyl alcohol (TBA)	Degradate	77035	75-65-0	1	NL-CA	12	—
Diisopropyl ether (DIPE)	Oxygenate	81577	108-20-3	0.04	na	na	—
Ethyl *tert*-butyl ether (ETBE)	Oxygenate	50004	637-92-3	0.02	na	na	—
Methyl acetate	Degradate	77032	79-20-9	0.4	na	na	—
Methyl *tert*-butyl ether (MTBE)	Oxygenate	78032	1634-04-4	0.04	MCL-US	13	D

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

Table 3C. Pesticides and pesticide degradates and fumigants, primary uses or sources, comparative thresholds, and reporting information for the U.S. Geological Survey (USGS) National Water Quality Laboratory Schedule 2003 and Schedule 1306.

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** 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 10^{-5}. **Other abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; D, detected in groundwater samples (*table 6*); na, not available; µg/L, microgram per liter; —, not detected]

Constituent	Primary use or source	USGS parameter code	CAS number	LRL (µg/L)	Threshold type[1]	Threshold level (µg/L)	Detection
Schedule 2003							
Acetochlor	Herbicide	49260	34256-82-1	0.006	na	na	—
Alachlor	Herbicide	46342	15972-60-8	0.006	MCL-US	2	—
Atrazine	Herbicide	39632	1912-24-9	0.007	MCL-CA	1	D
Azinphos-methyl	Insecticide	82686	86-50-0	0.12	na	na	—[2]
Azinphos-methyl-oxon	Insecticide degradate	61635	961-22-8	0.042	na	na	—[2]
Benfluralin	Herbicide	82673	1861-40-1	0.004	na	na	—[2]
Carbaryl	Insecticide	82680	63-25-2	0.06	RSD5-US	400	—
2-Chloro-2,6-diethylacetanilide	Herbicide degradate	61618	6967-29-9	0.01	na	na	—
4-Chloro-2-methylphenol	Herbicide degradate	61633	1570-64-5	0.0050	na	na	—[2]
Chlorpyrifos	Insecticide	38933	2921-88-2	0.005	HAL-US	2	—[2]
Chlorpyrifos oxon	Insecticide degradate	61636	5598-15-2	0.0562	na	na	—[2]
Cyfluthrin	Insecticide	61585	68359-37-5	0.016	na	na	—[2]
Cypermethrin	Insecticide	61586	52315-07-8	0.014	na	na	—[2]
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[2]
Desulfinylfipronil	Insecticide degradate	62170	na	0.012	na	na	—
Desulfinylfipronil amide	Insecticide degradate	62169	na	0.029	na	na	—
Diazinon	Insecticide	39572	333-41-5	0.005	HAL-US	1	—
3,4-Dichloroaniline	Herbicide degradate	61625	95-76-1	0.006	na	na	D
Dichlorvos	Insecticide	38775	62-73-7	0.013	na	na	—[2]
Dicrotophos	Insecticide	38454	141-66-2	0.0843	na	na	—[2]
Dieldrin	Insecticide	39381	60-57-1	0.009	RSD5-US	0.02	—
2,6-Diethylaniline	Herbicide degradate	82660	579-66-8	0.006	na	na	—
Dimethoate	Insecticide	82662	60-51-5	0.006	na	na	—[2]
Ethion	Insecticide	82346	563-12-2	0.006	na	na	—[2]
Ethion monoxon	Insecticide degradate	61644	17356-42-2	0.021	na	na	—[2]
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	—[2]
Fenamiphos sulfoxide [3]	Insecticide degradate	61646	31972-43-7	0.040	na	na	—
Fipronil	Insecticide	62166	120068-37-3	0.02	na	na	—[2]
Fipronil sulfide	Insecticide degradate	62167	120067-83-6	0.013	na	na	—[2]
Fipronil sulfone	Insecticide degradate	62168	120068-36-2	0.024	na	na	—[2]
Fonofos	Insecticide	04095	944-22-9	0.01	HAL-US	10	—
Hexazinone	Herbicide	04025	51235-04-2	0.008	HAL-US	400	—[2]
Iprodione	Fungicide	61593	36734-19-7	0.01	na	na	—[2]
Isofenphos	Insecticide	61594	25311-71-1	0.006	na	na	—
Malaoxon	Insecticide degradate	61652	1634-78-2	0.02	na	na	—[2]
Malathion	Insecticide	39532	121-75-5	0.016	HAL-US	100	—[2]
Metalaxyl	Fungicide	61596	57837-19-1	0.0069	na	na	—

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

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** 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 10^{-5}. **Other abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; D, detected in groundwater samples (*table 6*); na, not available; µg/L, microgram per liter; —, not detected]

Constituent	Primary use or source	USGS parameter code	CAS number	LRL (µg/L)	Threshold type[1]	Threshold level (µg/L)	Detection
Methidathion	Insecticide	61598	950-37-8	0.004	na	na	—
Metolachlor	Herbicide	39415	51218-45-2	0.01	HAL-US	700	D
Metribuzin	Herbicide	82630	21087-64-9	0.012	HAL-US	70	—
Myclobutanil	Fungicide	61599	88671-89-0	0.01	na	na	—
1-Naphthol	Insecticide degradate	49295	90-15-3	0.04	na	na	—[2]
Paraoxon-methyl	Insecticide degradate	61664	950-35-6	0.01	na	na	—[2]
Parathion-methyl	Insecticide	82667	298-00-0	0.008	HAL-US	1	—[2]
Pendimethalin	Herbicide	82683	40487-42-1	0.012	na	na	—[2]
cis-Permethrin	Insecticide	82687	54774-45-7	0.01	na	na	—[2]
Phorate	Insecticide	82664	298-02-2	0.04	na	na	—[2]
Phorate oxon	Insecticide degradate	61666	2600-69-3	0.027	na	na	—[2]
Phosmet	Insecticide	61601	732-11-6	0.0079	na	na	—[2]
Phosmet oxon [4]	Insecticide degradate	61668	3735-33-9	0.0511	na	na	—[2]
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	0.006	MCL-US	4	D
Tebuthiuron	Herbicide	82670	34014-18-1	0.016	HAL-US	500	—
Terbufos	Insecticide	82675	13071-79-9	0.018	HAL-US	0.4	—[2]
Terbufos oxon sulfone	Insecticide degradate	61674	56070-15-6	0.045	na	na	—[2]
Terbuthylazine	Herbicide	04022	5915-41-3	0.0083	na	na	—
Tribufos	Defoliant	61610	78-48-8	0.035	na	na	—[2]
Trifluralin	Herbicide	82661	1582-09-8	0.006	HAL-US	10	—[2]
Schedule 1306							
1,2-Dibromo-3-chloropropane (DBCP)[5]	Fumigant	82625	96-12-8	0.030	MCL-US	0.2	—
1,2-Dibromoethane (EDB) [5]	Fumigant	77651	106-93-4	0.020	MCL-US	0.05	—

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

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

[3] Constituent not spiked.

[4] Values for seven groundwater samples could not be determined because of matrix interference.

[5] Constituent on both Schedules 2020 and 1306.

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

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. Threshold types and threshold levels as of December 11, 2008. **Abbreviations:** CAS, Chemical Abstract Service; MDL, method detection limit; µg/L, microgram per liter; na, not available]

Constituent	Primary use or source	USGS parameter code	CAS number	MDL[1] (µg/L)	Threshold type	Threshold level (µg/L)
Acetaminophen	Analgesic	62000	103-90-2	0.024	na	na
Albuterol	Anti-inflammatory; bronchodilator	62020	18559-94-9	0.14	na	na
Caffeine	Stimulant	50305	58-08-2	0.0149	na	na
Carbamazapine	Anticonvulsant; analgesic; mood stabilizer	62793	298-46-4	0.018	na	na
Codeine	Opiod narcotic	62003	76-57-3	0.0223	na	na
Cotinine	Nicotine metabolite	62005	486-56-6	0.03	na	na
Dehydronifedipine	Antianginal metabolite	62004	67035-22-7	0.022	na	na
Diltiazem	Antianginal; antihypertensive	62008	42399-41-7	0.018	na	na
Diphenhydramine	Antihistamine	62796	58-73-1	0.023	na	na
Paraxanthine	Caffeine metabolite	62030	611-59-6	0.021	na	na
Sulfamethoxazole	Antibacterial, antiprotozoal	62021	723-46-6	0.024	na	na
Thiabendazole	Anthelmintic	62801	148-79-8	0.025	na	na
Trimethoprim	Antibacterial	62023	738-70-5	0.0203	na	na
Warfarin	Anticoagulant	62024	81-81-2	0.019	na	na

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

Table 3E. Constituents of special interest, primary uses or sources, comparative thresholds, and reporting information for Weck Laboratories, Inc., analyses.

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** MCL-CA, California Department of Public Health maximum contaminant level; HAL-US, U.S. Environmental Protection Agency lifetime health advisory**;** NL-CA, California Department of Public Health notification level. **Other abbreviations:** CAS, Chemical Abstract Service; MRL, minimum reporting level; D, detected in groundwater samples (*table 7*); µg/L, microgram per liter; —, not detected]

Constituent	Primary use or source	USGS parameter code	CAS number	MRL (µg/L)	Threshold type[1]	Threshold level (µg/L)	Detection
Perchlorate	Rocket fuel, fireworks, flares	63790	14797-73-0	0.10	MCL-CA	6	D
1,2,3-Trichloropropane (1,2,3-TCP)	Fumigant, solvent	77443	96-18-4	0.120	HAL-CA	40	—
N-Nitrosodimethylamine (NDMA)	Rocket fuel, plasticizer disinfection byproduct	34438	62-75-9	0.0020	NL-CA	0.010	—

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

Table 3F. Nutrients, comparative thresholds, and reporting information for the U.S. Geological Survey (USGS) National Water Quality Laboratory Schedule 2755.

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** HAL-US, U.S. Environmental Protection Agency lifetime health advisory level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level. **Other abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; D, detected in groundwater samples (*table 8*); mg/L, milligram per liter; na, not available; —, not detected]

Constituent	USGS parameter code	CAS number	LRL (mg/L)	Threshold type[1]	Threshold level (mg/L)	Detection
Ammonia, as nitrogen	00608	7664-41-7	0.020	HAL-US	[2]24.7	—
Nitrite, as nitrogen	00613	14797-65-0	0.002	MCL-US	1	D
Nitrate plus nitrite, as nitrogen	00631	na	0.040	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

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

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

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

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** 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. **Other abbreviations:** CAS, Chemical Abstract Service; LRL, laboratory reporting level; SRL, Study reporting limit; D, detected in groundwater samples (*tables 9, 10*); mg/L, milligram per liter; µg/L, microgram per liter; na, not available; —, not detected]

Constituent	USGS parameter code	CAS number	LRL/SRL	Threshold type[1]	Threshold level	Detection
Major and minor ions (mg/L)						
Bromide	71870	24959-67-9	0.02	na	na	D
Calcium	00915	7440-70-2	0.04	na	na	D
Chloride	00940	16887-00-6	0.12	SMCL-CA	[2]250 (500)	D
Fluoride	00950	16984-48-8	0.12	MCL-CA	2	D
Iodide	71865	7553-56-2	0.002	na	na	D
Magnesium	00925	7439-95-4	0.02	na	na	D
Potassium	00935	7440-09-7	0.02	na	na	D
Silica	00955	7631-86-9	0.018	na	na	D
Sodium	00930	7440-23-5	0.12	na	na	D
Sulfate	00945	14808-79-8	0.18	SMCL-CA	[2]250 (500)	D
Total dissolved solids (TDS)	70300	na	10	SMCL-US	[2]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	0.14	MCL-US	6	D
Arsenic	01000	7440-38-2	0.06	MCL-US	10	D
Barium	01005	7440-39-3	0.4	MCL-CA	1,000	D
Beryllium	01010	7440-41-7	0.008	MCL-US	4	D
Boron	01020	7440-42-8	6	NL-CA	1,000	D
Cadmium	01025	7440-43-9	0.04	MCL-US	5	D
Chromium	01030	7440-47-3	0.12	MCL-CA	50	D
Cobalt	01035	7440-48-4	0.02	na	na	D
Copper	01040	7440-50-8	1	AL-US	1,300	D
Iron	01046	7439-89-6	8	SMCL-CA	300	D
Lead	01049	7439-92-1	0.08	AL-US	15	D
Lithium	01130	7439-93-2	1	na	na	D
Manganese	01056	7439-96-5	0.2	SMCL-CA	50	D
Molybdenum	01060	7439-98-7	0.2	HAL-US	40	D
Nickel	01065	7440-02-0	0.2	MCL-CA	100	D
Selenium	01145	7782-49-2	0.04	MCL-US	50	D
Silver	01075	7440-22-4	0.1	SMCL-CA	100	D
Strontium	01080	7440-24-6	0.8	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	0.02	MCL-US	30	D
Vanadium	01085	7440-62-2	0.04	NL-CA	50	D
Zinc	01090	7440-66-6	1.8	SMCL-CA[3]	5,000	D

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

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

[3] The secondary maximum contaminant level for zinc is listed as SMCL-CA since SMCLs established by the California Department of Public Health are used in this report for all constituents that have SMCL-CA values.

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

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituents or property. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; SMCL-US, U.S. Environmental Protection Agency secondary maximum contaminant level. **Other abbreviations:** CAS, Chemical Abstract Service; MDL, method detection limit; na, not available; µg/L, microgram per liter; D, detected in groundwater samples *(table 11)*]

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

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

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

[The five-digit U.S. Geological Survey (USGS) parameter code is used to uniquely identify a specific constituent or property. Stable isotope ratios are reported in the standard delta notation (δ), the ratio of a heavier isotope to the more common lighter isotope of that element, relative to a standard reference material. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level. **Other abbreviations:** H, hydrogen; O, oxygen; C, carbon; Sr, strontium; CAS, Chemical Abstract Service; 2CSU, 2-sigma combined uncertainty; CSU, 1-sigma combined standard uncertainty; MRL, minimum reporting level; MU, method uncertainty; D, detected in groundwater samples (*tables 12* and *13*); ssL$_C$, sample-specific critical level; pCi/L, picocurie per liter; na, not available]

Constituent	USGS parameter code	CAS number	Reporting level type	Reporting level or uncertainty	Threshold type[1]	Threshold level	Detection
Stable isotope ratios (per mil)							
δ^{2}H of water[2]	82082	na	MU	2	na	na	D
δ^{18}O of water[2]	82085	na	MU	0.20	na	na	D
δ^{13}C of dissolved carbonates[3]	82081	na	1 sigma	0.05	na	na	D
Isotope ratios (atom ratio)							
Strontium isotope ratio (^{87}Sr/^{86}Sr)[4]	75978	na	MU	0.00005	na	na	D
Radioactive constituents (percent modern)							
Carbon-14[5]	49933	14762-75-5	1 sigma	0.0015	na	na	D
Radioactive constituents (pCi/L)							
Radon-222[6]	82303	14859-67-7	na	2CSU	Prop. MCL-US	[7]300 (4,000)	D
Tritium[8]	07000	10028-17-8	MRL	1	MCL-CA	20,000	D
Gross-alpha radioactivity, 72-hour and 30-day counts[9]	62636, 62639	12587-46-1	ssL$_C$	CSU	MCL-US	15	D
Gross-beta radioactivity, 72-hour and 30-day counts[9]	62642, 62645	12587-47-2	ssL$_C$	CSU	MCL-CA	50	D
Radium-226[9]	09511	13982-63-3	ssL$_C$	CSU	MCL-US	[10]5	D
Radium-228[9]	81366	15262-20-1	ssL$_C$	CSU	MCL-US	[10]5	D

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

[2] USGS Stable Isotope Laboratory, Reston, Virginia.

[3] University of Waterloo (contract laboratory).

[4] USGS Metals Isotope Research Laboratory, Menlo Park, California.

[5] University of Arizona, Accelerator Mass Spectrometry Laboratory (contract laboratory).

[6] USGS National Water Quality Laboratory.

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

[8] USGS Tritium Laboratory, Menlo Park, California.

[9] Eberline Analytical Services (contract laboratory).

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

Table 4. Water-quality indicators (field parameters) in samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.

[The five digit number below the constituent name is the U.S. Geological Survey (USGS) parameter code used to uniquely identify a specific constituent or property. **GAMA well identification number:** ANT, Antelope Valley study area grid well; ANT-U, Antelope Valley study area understanding well. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** SMCL-US, U.S. Environmental Protection Agency secondary maximum contaminant level; SMCL-CA, California Department of Public Health secondary maximum contaminant level. **Other abbreviations:** NTU, nephelometric turbidity unit; na, not available; RL, reporting limit; nc, sample not collected; A, average of two replicate values; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter; $CaCO_3$, calcium carbonate; <, less than; >, greater than; *, value above threshold level or outside threshold range; **, value above upper threshold level]

GAMA well identification number	Turbidity, field (NTU) (63676)	Dissolved oxygen, field (mg/L) (00300)	Water temperature, field (°C) (00010)	pH, lab (standard units) (00403)	pH, field (standard units) (00400)	Specific conductance, lab (µS/cm at 25°C) (90095)	Specific conductance, field (µS/cm at 25°C) (00095)
Threshold type	**na**	**na**	**na**	**SMCL-US**	**SMCL-US**	**SMCL-CA**	**SMCL-CA**
Threshold level	**na**	**na**	**na**	**<6.5 – >8.5**	**<6.5 – >8.5**	**[1]900 (1,600)**	**[1]900 (1,600)**
[RL]	**[0.1]**	**[0.2]**	**[0.0–38.5]**	**[0–14]**	**[0–14]**	**[5]**	**[5]**
Grid wells (56 wells sampled)							
ANT-01	0.2	7.3	24.5	nc	7.5	nc	*1,120
ANT-02	0.3	10.3	18.0	7.7	7.7	415	416
ANT-03	0.2	3.0	24.5	nc	7.8	nc	541
ANT-04	0.9	3.4	23.5	8.1	8.0	412	428
ANT-05	0.3	4.2	24.0	nc	7.9	nc	614
ANT-06	5.3	1.2	28.0	nc	*9.0	nc	623
ANT-07	0.3	2.1	23.0	8.0	8.0	372	372
ANT-08	0.3	6.0	22.0	nc	7.7	nc	402
ANT-09	1.0	9.8	16.5	7.3	7.0	**1,660	**1,640
ANT-10	0.2	7.1	21.5	nc	8.2	nc	298
ANT-11	0.1	5.0	19.5	nc	7.6	nc	282
ANT-12	0.9	7.0	21.0	8.0	8.0	410	401
ANT-13	0.2	6.4	20.5	nc	7.8	nc	404
ANT-14	0.1	0.8	22.0	nc	*8.6	nc	301
ANT-15	0.7	8.3	19.0	7.5	7.2	362	355
ANT-16	0.1	2.6	19.5	nc	7.8	nc	531
ANT-17	0.8	7.2	21.5	8.0	8.0	239	236
ANT-18	nc	7.6	25.0	nc	8.5	nc	243
ANT-19	nc	7.7	18.0	nc	7.9	nc	285
ANT-20	nc	4.2	17.5	nc	7.4	nc	619
ANT-21	nc	5.2	20.0	nc	7.3	nc	**1,720
ANT-22	nc	1.3	21.5	nc	7.6	nc	419
ANT-23	nc	7.8	17.5	nc	7.1	nc	464
ANT-24	nc	0.9	26.0	nc	7.8	nc	526
ANT-25	nc	6.2	22.0	nc	7.6	nc	401
ANT-26	nc	0.5	22.0	7.8	7.8	436	434
ANT-27	nc	2.1	20.0	nc	7.4	nc	551
ANT-28	nc	6.3	27.0	nc	7.1	nc	359
ANT-29	nc	1.4	30.0	nc	8.5	nc	635
ANT-30	nc	10.2	20.0	nc	7.7	nc	493

Table 4. Water-quality indicators (field parameters) in samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.—Continued

[The five digit number below the constituent name is the U.S. Geological Survey (USGS) parameter code used to uniquely identify a specific constituent or property. **GAMA well identification number:** ANT, Antelope Valley study area grid well; ANT-U, Antelope Valley study area understanding well. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** SMCL-US, U.S. Environmental Protection Agency secondary maximum contaminant level; SMCL-CA, California Department of Public Health secondary maximum contaminant level. **Other abbreviations:** NTU, nephelometric turbidity unit; na, not available; RL, reporting limit; nc, sample not collected; A, average of two replicate values; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter; $CaCO_3$, calcium carbonate; <, less than; >, greater than; *, value above threshold value or outside threshold range; **, value above upper threshold value]

GAMA well identification number	Turbidity, field (NTU) (63676)	Dissolved oxygen, field (mg/L) (00300)	Water temperature, field (°C) (00010)	pH, lab (standard units) (00403)	pH, field (standard units) (00400)	Specific conductance, lab (µS/cm at 25°C) (90095)	Specific conductance, field (µS/cm at 25°C) (00095)
Threshold type	**na**	**na**	**na**	**SMCL-US**	**SMCL-US**	**SMCL-CA**	**SMCL-CA**
Threshold level	**na**	**na**	**na**	**<6.5 – >8.5**	**<6.5 – >8.5**	**[1]900 (1,600)**	**[1]900 (1,600)**
[RL]	**[0.1]**	**[0.2]**	**[0.0–38.5]**	**[0–14]**	**[0–14]**	**[5]**	**[5]**
Grid wells (56 wells sampled)							
ANT-31	nc	7.1	16.0	nc	7.2	nc	489
ANT-32	nc	6.2	23.5	nc	7.6	nc	812
ANT-33	nc	5.3	25.0	nc	7.6	nc	**1,620
ANT-34	nc	7.6	20.5	7.5	7.4	**1,850	**1,840
ANT-35	nc	4.8	23.0	nc	8.1	nc	369
ANT-36	nc	4.0	21.5	nc	8.0	nc	409
ANT-37	nc	3.8	22.0	nc	7.9	nc	*1,070
ANT-38	nc	4.0	21.0	nc	8.1	nc	515
ANT-39	nc	8.7	20.0	nc	8.0	nc	650
ANT-40	0.4	4.0	24.0	8.0	7.9	387	382
ANT-41	nc	3.5	23.0	nc	7.4	nc	499
ANT-42	nc	7.4	23.5	nc	7.6	nc	532
ANT-43	0.7	5.9	23.5	8.0	7.9	512	519
ANT-44	nc	5.8	23.5	nc	8.0	nc	511
ANT-45	0.4	5.2	21.0	8.3	8.3	553	559
ANT-46	0.7	9.1	21.0	7.7	7.8	861	852
ANT-47	0.6	4.0	22.0	7.9	7.9	517	508
ANT-48	0.5	6.4	21.0	7.6	7.4	*1,450	*1,430
ANT-49	0.5	6.9	24.0	8.2	7.8	232	231
ANT-50	nc	1.8	16.5	nc	7.3	nc	*903
ANT-51	1.2	4.4	22.0	*8.7	*8.9	655	668
ANT-52	0.1	<0.2	22.5	8.1	*8.6	370	365
ANT-53	0.3	nc	18.5	nc	7.3	nc	810
ANT-54	0.6	3.6	24.5	nc	8.0	nc	354
ANT-55	0.2	4.8	28.5	nc	7.8	nc	460
ANT-56	nc	7.9	20.0	nc	7.6	nc	389
Understanding well (1 well sampled)							
ANT-U	0.5	5.6	21.0	8.1	8.2	271	266

Table 4. Water-quality indicators (field parameters) in samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.—Continued

[The five digit number below the constituent name is the U.S. Geological Survey (USGS) parameter code used to uniquely identify a specific constituent or property. **GAMA well identification number:** ANT, Antelope Valley study area grid well; ANT-U, Antelope Valley study area understanding well. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** SMCL-US, U.S. Environmental Protection Agency secondary maximum contaminant level; SMCL-CA, California Department of Public Health secondary maximum contaminant level. **Other abbreviations:** NTU, nephelometric turbidity unit; na, not available; RL, reporting limit; nc, sample not collected; A, average of two replicate values; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter; $CaCO_3$, calcium carbonate; <, less than; >, greater than; *, value above threshold value or outside threshold range; **, value above upper threshold value]

GAMA well identification number	Alkalinity, lab (mg/L as $CaCO_3$) (29801)	Alkalinity, field (mg/L as $CaCO_3$) (29802)	Bicarbonate[1] (mg/L)	Bicarbonate, field (mg/L) (63786)	Carbonate[1] (mg/L)	Carbonate, field (mg/L) (63788)
Threshold type	**na**	**na**	**na**	**na**	**na**	**na**
Threshold level	**na**	**na**	**na**	**na**	**na**	**na**
[RL]	**[1][3]**	**[1][3]**	**[1][3]**	**[1][3]**	**[1][3]**	**[1][3]**
Grid wells (56 wells sampled)						
ANT-01	nc	nc	nc	nc	nc	nc
ANT-02	128	123	155	149	<0.1	0.4
ANT-03	nc	nc	nc	nc	nc	nc
ANT-04	105	100	127	121	0.7	0.7
ANT-05	nc	nc	nc	nc	nc	nc
ANT-06	nc	nc	nc	nc	nc	nc
ANT-07	111	109	134	131	0.7	0.6
ANT-08	nc	nc	nc	nc	nc	nc
ANT-09	308	298	376	363	<0.1	0.3
ANT-10	nc	nc	nc	nc	nc	nc
ANT-11	nc	nc	nc	nc	nc	nc
ANT-12	92.0	88.4	111	106	0.6	0.6
ANT-13	nc	nc	nc	nc	nc	nc
ANT-14	nc	nc	nc	nc	nc	nc
ANT-15	133	128	162	156	<0.1	0.2
ANT-16	nc	nc	nc	nc	nc	nc
ANT-17	101	95.4	122	115	0.6	0.5
ANT-18	nc	nc	nc	nc	nc	nc
ANT-19	nc	nc	nc	nc	nc	nc
ANT-20	nc	nc	nc	nc	nc	nc
ANT-21	nc	nc	nc	nc	nc	nc
ANT-22	nc	nc	nc	nc	nc	nc
ANT-23	nc	nc	nc	nc	nc	nc
ANT-24	nc	nc	nc	nc	nc	nc
ANT-25	nc	nc	nc	nc	nc	nc
ANT-26	141	136	170	164	0.5	0.6
ANT-27	nc	nc	nc	nc	nc	nc
ANT-28	nc	nc	nc	nc	nc	nc
ANT-29	nc	nc	nc	nc	nc	nc
ANT-30	nc	nc	nc	nc	nc	nc

Table 4. Water-quality indicators (field parameters) in samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.—Continued

[The five digit number below the constituent name is the U.S. Geological Survey (USGS) parameter code used to uniquely identify a specific constituent or property. **GAMA well identification number:** ANT, Antelope Valley study area grid well; ANT-U, Antelope Valley study area understanding well. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** SMCL-US, U.S. Environmental Protection Agency secondary maximum contaminant level; SMCL-CA, California Department of Public Health secondary maximum contaminant level. **Other abbreviations:** NTU, nephelometric turbidity unit; na, not available; RL, reporting limit; nc, sample not collected; A, average of two replicate values; °C, degrees Celsius; mg/L, milligram per liter; µS/cm, microsiemens per centimeter; $CaCO_3$, calcium carbonate; <, less than; >, greater than; *, value above threshold value or outside threshold range; **, value above upper threshold value]

GAMA well identification number	Alkalinity, lab (mg/L as $CaCO_3$) (29801)	Alkalinity, field (mg/L as $CaCO_3$) (29802)	Bicarbonate[1] (mg/L)	Bicarbonate, field (mg/L) (63786)	Carbonate[1] (mg/L)	Carbonate, field (mg/L) (63788)
Threshold type	**na**	**na**	**na**	**na**	**na**	**na**
Threshold level	**na**	**na**	**na**	**na**	**na**	**na**
[RL]	**[1][3]**	**[1][3]**	**[1][3]**	**[1][3]**	**[1][3]**	**[1][3]**
Grid wells (56 wells sampled)						
ANT-31	nc	nc	nc	nc	nc	nc
ANT-32	nc	nc	nc	nc	nc	nc
ANT-33	nc	nc	nc	nc	nc	nc
ANT-34	197	A188	239	A228	<0.1	A0.5
ANT-35	nc	nc	nc	nc	nc	nc
ANT-36	nc	nc	nc	nc	nc	nc
ANT-37	nc	nc	nc	nc	nc	nc
ANT-38	nc	nc	nc	nc	nc	nc
ANT-39	nc	nc	nc	nc	nc	nc
ANT-40	118	113	142	136	0.7	0.7
ANT-41	nc	nc	nc	nc	nc	nc
ANT-42	nc	nc	nc	nc	nc	nc
ANT-43	121	114	146	139	0.7	0.3
ANT-44	nc	nc	nc	nc	nc	nc
ANT-45	165	157	197	188	2.0	1.6
ANT-46	141	134	171	162	<0.1	0.4
ANT-47	132	123	160	149	0.5	0.5
ANT-48	188	A180	229	A219	<0.1	A0.5
ANT-49	100	95.2	120	114	1.0	0.9
ANT-50	nc	nc	nc	nc	nc	nc
ANT-51	162	154	188	176	4.3	5.6
ANT-52	127	116	153	140	0.8	0.8
ANT-53	nc	nc	nc	nc	nc	nc
ANT-54	nc	nc	nc	nc	nc	nc
ANT-55	nc	nc	nc	nc	nc	nc
ANT-56	nc	nc	nc	nc	nc	nc
Understanding well (1 well sampled)						
ANT-U	101	96.6	121	117	0.7	0.5

[1] The SMCL-CA for specific conductance has recommended and upper threshold values. The upper value is shown in parentheses.

[2] Bicarbonate and carbonate concentrations were calculated from the laboratory alkalinity and pH values (table 4) using the advanced speciation method (http://or.water.usgs.gov/alk/methods.html) with $pK_1 = 6.35$, $pK_2 = 10.33$, and $pK_W = 14$.

[3] Alkalinity, bicarbonate, and carbonate values ≥100 mg/L are reported to whole numbers; however, to the tenths place if <100 mg/L.

Table 5. Volatile organic compounds (VOCs) and gasoline oxygenates and degradates detected in samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.

[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 57 wells were analyzed, but only samples with detections are listed. Analytes are grouped by constituent type and listed in order of decreasing detection frequency for the 56 grid wells. All analytes are listed in *tables 3A,B*. **GAMA well identification number:** ANT, Antelope Valley study area grid well; ANT-U, Antelope Valley study area understanding well. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** 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 Public Health notification level. **Other abbreviations:** LRL, laboratory reporting level; E, estimated or having a higher degree of uncertainty; V, analyte detected in sample and an associated blank; thus, data are not included in groundwater-quality assessment; µg/L, microgram per liter; —, not detected]

	Solvent									Refrigerant	Fumigant
GAMA well identification number	**Perchloroethene (Tetrachloro-ethene, PCE) (µg/L) (34475)**	**1,1-Dichloro-ethane (1, 1-DCA) (µg/L) (34496)**	**Trichloro-ethene (TCE) (µg/L) (39180)**	**Methylene chlo-ride (Dichloro-methane) (µg/L) (34423)**	**1,2-Dichloro-benzene (µg/L) (34536)**	**1,3-Dichloro-benzene (µg/L) (34566)**	**Chloro-eth-ane (µg/L) (34311)**	**Dibromo-methane (µg/L) (30217)**	**Carbon tetra-chloride (Tetra-chlorometane) (µg/L) (32102)**	**Chloro-meth-ane (µg/L) (34418)**	**1,4-Dichloro-benzene (µg/L) (34571)**
Threshold type[1]	**MCL-US**	**MCL-CA**	**MCL-US**	**MCL-US**	**MCL-US**	**HAL-US**	**na**	**na**	**MCL-CA**	**HAL-US**	**MCL-CA**
Threshold level	**5**	**5**	**5**	**5**	**600**	**600**	**na**	**na**	**0.5**	**30**	**5**
[LRL]	**[0.04]**	**[0.04]**	**[0.02]**	**[0.04]**	**[0.02]**	**[0.04]**	**[0.1]**	**[0.04]**	**[0.08]**	**[0.1]**	**[0.02]**
Grid wells (56 wells sampled)											
ANT-01	—	—	—	—	—	—	—	—	—	—	—
ANT-02	E0.02	—	—	—	—	—	—	—	—	—	—
ANT-03	—	—	—	—	—	—	—	—	—	—	—
ANT-05	—	—	—	E0.03	—	—	—	—	—	—	—
ANT-06	—	—	—	—	—	—	—	—	—	—	—
ANT-08	—	—	—	—	—	—	—	—	—	—	—
ANT-10	—	—	—	—	—	—	—	—	—	—	—
ANT-11	—	—	—	—	—	—	—	—	—	—	—
ANT-12	E0.01	—	—	—	—	—	—	—	—	—	—
ANT-13	—	—	—	—	—	—	—	—	—	—	—
ANT-14	—	—	—	—	—	—	—	—	—	—	—
ANT-15	—	—	—	—	—	—	—	—	—	—	—
ANT-17	—	—	—	—	—	—	—	—	—	—	—
ANT-18	E0.03	—	—	—	—	—	—	—	—	—	—
ANT-19	—	—	—	—	—	—	—	—	—	—	—
ANT-20	—	—	—	—	—	—	—	—	—	—	—
ANT-21	0.22	E0.06	—	—	—	—	—	—	—	—	—
ANT-22	—	—	—	—	—	—	—	—	—	—	—
ANT-23	—	—	—	—	—	—	—	—	—	—	—

Table 5. Volatile organic compounds (VOCs) and gasoline oxygenates and degradates detected in samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.—Continued

[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 57 wells were analyzed, but only samples with detections are listed. Analytes are grouped by constituent type and listed in order of decreasing detection frequency for the 56 grid wells. All analytes are listed in *tables 3A,B*. **GAMA well identification number:** ANT, Antelope Valley study area grid well; ANT-U, Antelope Valley study area understanding well. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** 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 Public Health notification level. **Other abbreviations:** LRL, laboratory reporting level; E, estimated or having a higher degree of uncertainty; V, analyte detected in sample and an associated blank; thus, data are not included in groundwater-quality assessment; µg/L, microgram per liter; —, not detected]

	Solvent									Refrigerant	Fumigant
GAMA well identification number	**Perchloroethene (Tetrachloro-ethene, PCE) (µg/L) (34475)**	**1,1-Dichloro-ethane (1, 1-DCA) (µg/L) (34496)**	**Trichloro-ethene (TCE) (µg/L) (39180)**	**Methylene chloride (Dichloro-methane) (µg/L) (34423)**	**1,2-Dichloro-benzene (µg/L) (34536)**	**1,3-Dichloro-benzene (µg/L) (34566)**	**Chloro-ethane (µg/L) (34311)**	**Dibromo-methane (µg/L) (30217)**	**Carbon tetra-chloride (Tetra-chlorometane) (µg/L) (32102)**	**Chloro-methane (µg/L) (34418)**	**1,4-Dichloro-benzene (µg/L) (34571)**
Threshold type[1]	**MCL-US**	**MCL-CA**	**MCL-US**	**MCL-US**	**MCL-US**	**HAL-US**	**na**	**na**	**MCL-CA**	**HAL-US**	**MCL-CA**
Threshold level	**5**	**5**	**5**	**5**	**600**	**600**	**na**	**na**	**0.5**	**30**	**5**
[LRL]	**[0.04]**	**[0.04]**	**[0.02]**	**[0.04]**	**[0.02]**	**[0.04]**	**[0.1]**	**[0.04]**	**[0.08]**	**[0.1]**	**[0.02]**
ANT-26	—	—	—	—	—	—	—	—	—	—	—
ANT-27	E0.08	E0.08	E0.04	—	E0.04	E0.03	—	—	—	—	E0.06
ANT-28	—	—	—	—	—	—	—	—	—	—	—
ANT-29	—	—	—	—	—	—	—	—	—	—	—
ANT-30	E0.07	—	—	—	—	—	—	—	—	—	—
ANT-33	—	—	—	E0.1	—	—	0.1	0.15	E0.02	E0.1	—
ANT-34	—	—	—	—	—	—	—	—	—	—	—
ANT-35	—	—	—	—	—	—	—	—	—	—	—
ANT-36	—	—	—	—	—	—	—	—	—	—	—
ANT-37	—	—	—	—	—	—	—	—	—	—	—
ANT-38	—	—	E0.03	—	—	—	—	—	—	—	—
ANT-39	—	—	—	—	—	—	—	—	—	—	—
ANT-41[2]	—	—	—	—	—	—	—	—	—	—	—
ANT-42	—	—	—	—	—	—	—	—	—	—	—
ANT-43	—	—	—	—	—	—	—	—	—	—	—
ANT-44	—	—	—	—	—	—	—	—	—	—	—
ANT-46	—	—	—	—	—	—	—	—	—	—	—
ANT-48	E0.03	E0.04	—	—	—	—	—	—	—	—	E0.01
ANT-50	—	—	—	—	—	—	—	—	—	—	—
ANT-52	—	—	—	—	—	—	—	—	—	—	—

Table 5. Volatile organic compounds (VOCs) and gasoline oxygenates and degradates detected in samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.—Continued

[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 57 wells were analyzed, but only samples with detections are listed. Analytes are grouped by constituent type and listed in order of decreasing detection frequency for the 56 grid wells. All analytes are listed in *tables 3A,B*. **GAMA well identification number:** ANT, Antelope Valley study area grid well; ANT-U, Antelope Valley study area understanding well. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** 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 Public Health notification level. **Other abbreviations:** LRL, laboratory reporting level; E, estimated or having a higher degree of uncertainty; V, analyte detected in sample and an associated blank; thus, data are not included in groundwater-quality assessment; µg/L, microgram per liter; —, not detected]

	Solvent									Refrigerant	Fumigant
GAMA well identification number	**Perchloroethene (Tetrachloro-ethene, PCE) (µg/L) (34475)**	**1,1-Dichloro-ethane (1,1-DCA) (µg/L) (34496)**	**Trichloro-ethene (TCE) (µg/L) (39180)**	**Methylene chloride (Dichloro-methane) (µg/L) (34423)**	**1,2-Dichloro-benzene (µg/L) (34536)**	**1,3-Dichloro-benzene (µg/L) (34566)**	**Chloro-ethane (µg/L) (34311)**	**Dibromo-methane (µg/L) (30217)**	**Carbon tetra-chloride (Tetra-chlorometane) (µg/L) (32102)**	**Chloro-methane (µg/L) (34418)**	**1,4-Dichloro-benzene (µg/L) (34571)**
Threshold type[1]	**MCL-US**	**MCL-CA**	**MCL-US**	**MCL-US**	**MCL-US**	**HAL-US**	**na**	**na**	**MCL-CA**	**HAL-US**	**MCL-CA**
Threshold level	**5**	**5**	**5**	**5**	**600**	**600**	**na**	**na**	**0.5**	**30**	**5**
[LRL]	**[0.04]**	**[0.04]**	**[0.02]**	**[0.04]**	**[0.02]**	**[0.04]**	**[0.1]**	**[0.04]**	**[0.08]**	**[0.1]**	**[0.02]**
ANT-53	E0.02	—	—	—	—	—	—	—	—	—	—
ANT-55	—	—	—	—	—	—	—	—	—	—	—
ANT-56	—	—	—	—	—	—	—	—	—	—	—
Number of detections	8	3	2	2	1	1	1	1	1	1	2
Detection frequency (percent)	14.3	5.4	3.6	3.6	1.8	1.8	1.8	1.8	1.8	1.8	3.6
	Understanding well (1 well sampled)[4]										
ANT-U	—	—	—	—	—	—	—	—	—	—	—

Table 5. Volatile organic compounds (VOCs) and gasoline oxygenates and degradates detected in samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.—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 all 57 wells were analyzed, but only samples with detections are listed. Analytes are grouped by constituent type and listed in order of decreasing detection frequency for the 56 grid wells. All analytes are listed in *tables 3A,B*. **GAMA identification number:** ANT, Antelope Valley study area grid well; ANT-U, Antelope Valley study area understanding well. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** 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 Public Health notification level. **Other abbreviations:** LRL, laboratory reporting level; E, estimated or having a higher degree of uncertainty; V, analyte detected in sample and an associated blank; thus, data are not included in groundwater quality assessment; µg/L, microgram per liter; —, not detected]

GAMA well identification number	Organic synthesis				Gasoline hydrocarbons and oxygenate		Disinfection by-product				VOC detections per well
	1,2,4-Trimethylbenzene (µg/L) (77222)	1,1-Dichloroethene (1,1-DCE) (µg/L) (34501)	Bromochloromethane (µg/L) (77297)	Styrene (µg/L) (77128)	Methyl *tert*-butyl ether (MTBE) (µg/L) (78032)	Toluene (µg/L) (34010)	Chloroform (Trichloromethane) (µg/L) (32106)	Bromodichloromethane (µg/L) (32101)	Dibromochloromethane (µg/L) (32105)	Bromoform (Tribromomethane) (µg/L) (32104)	
Threshold type[1]	**NL-CA**	**MCL-CA**	**HAL-US**	**MCL-US**	**MCL-CA**	**MCL-CA**	**MCL-US**	**MCL-US**	**MCL-US**	**MCL-US**	
Threshold level	**330**	**6**	**90**	**100**	**13**	**150**	**80**	**80**	**80**	**80**	
[LRL]	**[0.04]**	**[0.02]**	**[0.06]**	**[0.04]**	**[0.04]**	**[0.02]**	**[0.02]**	**[0.04]**	**[0.12]**	**[0.08]**	
Grid wells (56 wells sampled)											
ANT-01	—	—	—	—	—	V0.02	—	—	—	—	0
ANT-02	—	E0.03	—	—	0.1	—	0.18	E0.07	—	—	5
ANT-03	—	—	—	—	—	—	0.26	—	—	—	1
ANT-05	—	—	—	—	—	—	0.72	0.39	—	—	3
ANT-06	—	—	—	—	—	V0.01	E0.03	—	—	—	1
ANT-08	—	—	—	—	—	V0.02	—	—	—	—	0
ANT-10	—	—	—	—	—	V0.01	E0.01	—	—	—	1
ANT-11	—	—	—	—	—	V0.02	—	—	—	—	0
ANT-12	—	—	—	—	—	V0.04	0.15	—	—	—	2
ANT-13	—	—	—	—	—	V0.01	—	—	—	—	0
ANT-14	—	—	—	—	—	V0.01	—	—	—	—	0
ANT-15	—	—	—	—	—	V0.01	—	—	—	—	0
ANT-17	—	—	—	—	—	—	E0.02	E0.04	E0.1	—	3
ANT-18	—	—	—	—	—	—	—	—	—	—	1
ANT-19	—	—	—	—	0.3	V0.02	—	—	—	—	1
ANT-20	—	—	—	—	—	—	E0.09	0.13	0.2	0.27	4
ANT-21	—	—	—	—	—	V0.02	E0.03	—	—	—	3
ANT-22	—	—	—	—	—	V0.02	—	—	—	—	0

Table 5. Volatile organic compounds (VOCs) and gasoline oxygenates and degradates detected in samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.—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 all 57 wells were analyzed, but only samples with detections are listed. Analytes are grouped by constituent type and listed in order of decreasing detection frequency for the 56 grid wells. All analytes are listed in *tables 3A,B*. **GAMA identification number:** ANT, Antelope Valley study area grid well; ANT-U, Antelope Valley study area understanding well. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** 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 Public Health notification level. **Other abbreviations:** LRL, laboratory reporting level; E, estimated or having a higher degree of uncertainty; V, analyte detected in sample and an associated blank; thus, data are not included in groundwater quality assessment; µg/L, microgram per liter; —, not detected]

GAMA well identification number	Organic synthesis				Gasoline hydrocarbons and oxygenate		Disinfection by-product				VOC detections per well
	1,2,4-Trimethylbenzene (µg/L) (77222)	1,1-Dichloroethene (1,1-DCE) (µg/L) (34501)	Bromochloromethane (µg/L) (77297)	Styrene (µg/L) (77128)	Methyl *tert*-butyl ether (MTBE) (µg/L) (78032)	Toluene (µg/L) (34010)	Chloroform (Trichloromethane) (µg/L) (32106)	Bromodichloromethane (µg/L) (32101)	Dibromochloromethane (µg/L) (32105)	Bromoform (Tribromomethane) (µg/L) (32104)	
Threshold type[1]	**NL-CA**	**MCL-CA**	**HAL-US**	**MCL-US**	**MCL-CA**	**MCL-CA**	**MCL-US**	**MCL-US**	**MCL-US**	**MCL-US**	
Threshold level	**330**	**6**	**90**	**100**	**13**	**150**	**80**	**80**	**80**	**80**	
[LRL]	**[0.04]**	**[0.02]**	**[0.06]**	**[0.04]**	**[0.04]**	**[0.02]**	**[0.02]**	**[0.04]**	**[0.12]**	**[0.08]**	
Grid wells (56 wells sampled)											
ANT-23	—	—	—	—	—	V0.01	—	—	—	—	0
ANT-26	—	—	—	—	—	—	0.24	0.1	E0.1	—	3
ANT-27	—	—	—	—	—	V0.01	—	—	—	—	6
ANT-28	—	—	—	—	—	V0.01	—	—	—	—	0
ANT-29	—	—	—	—	—	V0.01	—	—	—	—	0
ANT-30	—	—	—	—	—	V0.01	E0.05	—	—	—	2
ANT-33	—	—	E0.03	—	—	—	13.1	6.85	6.6	6.89	10
ANT-34	—	—	—	—	—	V0.07	—	—	—	—	0
ANT-35	—	—	—	—	—	V0.01	—	—	—	—	0
ANT-36	—	—	—	—	—	V0.01	—	—	—	—	0
ANT-37	—	—	—	—	—	V0.01	—	—	—	—	0
ANT-38	—	—	—	—	—	—	—	—	—	—	1
ANT-39	—	—	—	—	—	V0.01	—	—	—	—	0
ANT-41[2]	—	—	—	—	—	—	0.19	0.18	0.2	0.13	4
ANT-42	—	—	—	—	—	V0.04	—	—	—	—	0
ANT-43	—	—	—	—	—	—	0.45	—	—	—	1
ANT-44	—	—	—	—	—	—	E0.02	—	—	0.12	2
ANT-46	—	—	—	—	—	—	E0.08	E0.04	—	—	2
ANT-48	E0.03	—	—	—	—	—	0.33	E0.07	E0.1	0.23	8

Table 5. Volatile organic compounds (VOCs) and gasoline oxygenates and degradates detected in samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.—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 all 57 wells were analyzed, but only samples with detections are listed. Analytes are grouped by constituent type and listed in order of decreasing detection frequency for the 56 grid wells. All analytes are listed in *tables 3A,B*. **GAMA identification number:** ANT, Antelope Valley study area grid well; ANT-U, Antelope Valley study area understanding well. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** 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 Public Health notification level. **Other abbreviations:** LRL, laboratory reporting level; E, estimated or having a higher degree of uncertainty; V, analyte detected in sample and an associated blank; thus, data are not included in groundwater quality assessment; µg/L, microgram per liter; —, not detected]

	Organic synthesis				Gasoline hydrocarbons and oxygenate		Disinfection by-product				
GAMA well identification number	**1,2,4-Trimethylbenzene (µg/L) (77222)**	**1,1-Dichloroethene (1, 1-DCE) (µg/L) (34501)**	**Bromochloromethane (µg/L) (77297)**	**Styrene (µg/L) (77128)**	**Methyl *tert*-butyl ether (MTBE) (µg/L) (78032)**	**Toluene (µg/L) (34010)**	**Chloroform (Trichloromethane) (µg/L) (32106)**	**Bromodichloromethane (µg/L) (32101)**	**Dibromochloromethane (µg/L) (32105)**	**Bromoform (Tribromomethane) (µg/L) (32104)**	**VOC detections per well**
Threshold type[1]	**NL-CA**	**MCL-CA**	**HAL-US**	**MCL-US**	**MCL-CA**	**MCL-CA**	**MCL-US**	**MCL-US**	**MCL-US**	**MCL-US**	
Threshold level	**330**	**6**	**90**	**100**	**13**	**150**	**80**	**80**	**80**	**80**	
[LRL]	**[0.04]**	**[0.02]**	**[0.06]**	**[0.04]**	**[0.04]**	**[0.02]**	**[0.02]**	**[0.04]**	**[0.12]**	**[0.08]**	
Grid wells (56 wells sampled)											
ANT-50	—	—	—	E0.02	—	—	—	—	—	—	1
ANT-52	E0.05	—	—	—	—	—	—	—	—	—	1
ANT-53	—	—	—	—	—	—	E0.02	—	—	—	2
ANT-55	—	—	—	—	—	—	E0.04	—	—	—	1
ANT-56	—	—	—	—	—	—	0.18	—	—	—	1
Number of detections	2	1	1	1	2	0	20	9	6	5	
Detection frequency (percent)	3.6	1.8	1.8	1.8	3.6	0	35.7	16.1	10.7	8.9	[3]46
Understanding well (1 well sampled)[4]											
ANT-U	—	—	—	—	—	—	0.13	0.31	0.6	0.43	4

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

[2] A calcium hypochloate injection system was shut off one hour before sampling. Free chlorine was measured onsite at a concentration of 1 mg/L. Therefore, the sample was collected in a container treated with a dechlorinating reagent. However, it is possible the disinfection by-products detected at this well are residual from the the calcium hypochlorite injection system.

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

[4] The understanding well was not included in statistical calculations.

Table 6. Pesticides and pesticide degradates detected in samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.

[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 57 wells were analyzed, but only samples with detections are listed. Analytes are listed in order of decreasing detection frequency in the 56 grid wells within each group. All analytes are listed in *table 3C*. **GAMA well identification number:** ANT, Antelope Valley study area grid well. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-CA; California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level. **Other abbreviations:** na, not available; LRL, laboratory reporting level; E, estimated or having a higher degree of uncertainty; µg/L, microgram per liter; —, not detected]

GAMA well identification number	Simazine (µg/L) (04035)	Deethylatrazine (2-Chloro-4-isopropylamino-6-amino-s-triazine) (µg/L) (04040)	Atrazine (µg/L) (39632)	3,4-Dichloro-aniline (µg/L) (61625)	Prometon (µg/L) (04037)	Metolachlor (µg/L) (39415)	Pesticide detections per well
Threshold type[1]	**MCL-US**	**na**	**MCL-CA**	**na**	**HAL-US**	**HAL-US**	
Threshold level	**4**	**na**	**1**	**na**	**100**	**700**	
[LRL]	**[0.006]**	**[0.014]**	**[0.007]**	**[0.006]**	**[0.01]**	**[0.01]**	
Grid wells (56 wells sampled)							
ANT-02	0.021	E0.004	—	—	E0.01	—	3
ANT-05	E0.005	—	—	E0.006	—	—	2
ANT-12	E0.005	E0.005	E0.004	—	—	—	3
ANT-18	—	E0.006	E0.007	—	—	—	2
ANT-19	E0.007	E0.006	—	—	—	—	2
ANT-20	0.008	—	—	—	—	—	1
ANT-21	0.008	E0.005	E0.007	—	E0.01	—	4
ANT-26	0.009	—	E0.007	—	—	—	2
ANT-27	—	—	—	E0.004	—	—	1
ANT-30	E0.007	E0.008	E0.008	—	—	—	3
ANT-31	0.01	E0.013	E0.007	—	E0.01	—	4
ANT-38	—	—	—	E0.005	—	—	1
ANT-42	—	—	—	—	—	E0.006	1
ANT-43	E0.006	—	—	—	—	—	1
ANT-46	—	E0.01	E0.005	—	—	—	2
ANT-48	—	—	—	E0.008	—	—	1
ANT-53	0.017	E0.045	0.008	—	—	—	3
Number of detections	11	9	8	4	3	1	
Detection frequency (percent)	19.6	16.1	14.3	7.1	5.4	1.8	[2]30

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

[2] Frequency of detecting at least one pesticide or pesticide degradate in the grid wells.

Table 7. Constituents of special interest (perchlorate, *N*-nitrosodimethylamine [NDMA], and 1,2,3-trichloropropane [1,2,3-TCP]) detected in samples collected in the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.

[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. Information about the analytes is given in *table 3E*. Samples from all 57 wells were analyzed for perchlorate, samples from the 27 intermediate and slow wells were sampled for 1,2,3-TCP, and samples from the 19 slow wells were sampled for NDMA. Only wells with at least one detection are listed. **GAMA well identification number:** ANT, Antelope Valley study area grid well; ANT-U, Antelope Valley study area understanding well. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** HAL-US, U.S. Environmental Protection Agency lifetime health advisory level; MCL-CA, California Department of Public Health maximum contaminant level; NL-CA, California Department of Public Health notification level. **Other abbreviations:** MRL, minimum reporting level; nc, sample not collected; µg/L, microgram per liter; —, not detected]

GAMA well identification number	Perchlorate (µg/L) (63790)	*N*-Nitroso-dimethylamine (NDMA) (µg/L) (34438)	1,2,3-Trichloropropane (µg/L) (77443)
Threshold type[1]	**MCL-CA**	**NL-CA**	**HAL-US**
Threshold level	**6**	**0.010**	**40**
[MRL]	**[0.10]**	**[0.0020]**	**[0.120]**
Grid wells (56 wells sampled for perchlorate)			
ANT-01	1.3	nc	nc
ANT-02	0.89	—	—
ANT-03	0.46	nc	—
ANT-04	0.53	—	—
ANT-05	0.11	nc	nc
ANT-07	0.47	—	—
ANT-08	0.61	nc	nc
ANT-10	0.25	nc	nc
ANT-12	0.22	—	—
ANT-13	0.13	nc	nc
ANT-14	0.35	nc	nc
ANT-15	0.47	—	—
ANT-16	0.31	nc	—
ANT-17	0.13	—	—
ANT-18	0.14	nc	nc
ANT-19	0.16	nc	—
ANT-20	0.86	nc	nc
ANT-21	5.2	nc	nc
ANT-22	0.17	nc	nc
ANT-23	0.19	nc	nc
ANT-24	0.21	nc	nc
ANT-25	0.21	nc	nc
ANT-26	0.55	—	—
ANT-28	0.33	nc	nc
ANT-30	0.26	nc	nc
ANT-31	0.77	nc	nc
ANT-32	0.72	nc	nc
ANT-33	1.7	nc	nc
ANT-34	1.9	—	—
ANT-35	0.21	nc	—

Table 7. Constituents of special interest [perchlorate, *N*-nitrosodimethylamine (NDMA), and 1,2,3-trichloropropane (1,2,3-TCP)] detected in samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.—Continued

[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. Information about the analytes given in *table 3E*. Samples from all 57 wells were analyzed for perchlorate, samples from the 27 intermediate and slow wells were sampled for 1,2,3-TCP, and samples from the 19 slow wells were sampled for NDMA. Only wells with at least one detection are listed. **GAMA well identification number:** ANT, Antelope Valley study area grid well; ANT-U, Antelope Valley study area understanding well. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** HAL-US, U.S. Environmental Protection Agency lifetime health advisory level; MCL-CA, California Department of Public Health maximum contaminant level; NL-CA, California Department of Public Health notification level. **Other abbreviations:** MRL, minimum reporting level; µg/L, microgram per liter; nc, sample not collected; —, not detected]

GAMA well identification number	Perchlorate (µg/L) (63790)	*N*-Nitroso-dimethylamine (NDMA) (µg/L) (34438)	1,2,3-Trichloropropane (µg/L) (77443)
Threshold type[1]	**MCL-CA**	**NL-CA**	**HAL-US**
Threshold level	**6**	**0.010**	**40**
[MRL]	**[0.10]**	**[0.0020]**	**[0.120]**
ANT-36	0.25	nc	—
ANT-37	0.37	nc	—
ANT-39	0.13	nc	—
ANT-40	0.15	—	—
ANT-41	0.73	nc	nc
ANT-42	0.80	nc	nc
ANT-43	0.99	—	—
ANT-44	1.8	nc	nc
ANT-45	0.18	—	—
ANT-46	3.7	—	—
ANT-47	0.43	—	—
ANT-48	0.67	—	—
ANT-51	0.19	—	—
ANT-52	0.32	—	—
ANT-53	2.0	nc	nc
ANT-54	0.49	nc	nc
ANT-55	0.14	nc	nc
ANT-56	0.37	nc	nc
Number of detections	48	—	—
Detection frequency (percent)	86	—	—
Understanding well (1 well sampled for perchlorate)[2]			
ANT-U	0.12	—	—

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

[2] The understanding well was not included in the statistical calculations.

Table 8. Nutrients detected in samples collected for the Antelope Valley Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.

[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 the 19 slow wells were analyzed. Information about the analytes is given in *table 3F*. **GAMA well identification number:** ANT, Antelope Valley study area grid well; ANT-U, Antelope Valley study area understanding well. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** HAL-US, U.S. Environmental Protection Agency lifetime health advisory level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level. **Other abbreviations:** E, estimated or having a higher degree of uncertainty; LRL, laboratory reporting level; mg/L, milligram per liter; na, not available; —, not detected; *, value above threshold level]

GAMA well identification number	Ammonia, as nitrogen (mg/L) (00608)	Nitrate plus nitrite, as nitrogen (mg/L) (00631)	Nitrite, as nitrogen (mg/L) (00613)	Total nitrogen (ammonia + nitrite + nitrate + organic-nitrogen), as nitrogen (mg/L) (62854)	Orthophosphate, as phosphorous (mg/L) (00671)
Threshold type[1]	**HAL-US**	**MCL-US**	**MCL-US**	**na**	**na**
Threshold level	**[2]24.7**	**10**	**1**	**na**	**na**
[LRL]	**[0.02]**	**[0.04]**	**[0.002]**	**[0.06]**	**[0.006]**
Grid wells (18 wells sampled)					
ANT-02	—	2.82	—	2.96	0.036
ANT-04	—	1.99	E0.001	2.04	0.013
ANT-07	—	1.34	E0.001	1.42	0.014
ANT-09	—	1.12	0.002	1.23	0.074
ANT-12	—	1.90	E0.001	2.03	0.011
ANT-15	—	4.29	E0.001	4.49	0.032
ANT-17	—	0.28	—	0.30	0.026
ANT-26	—	0.93	—	0.93	0.015
ANT-34	—	6.01	E0.001	6.07	0.022
ANT-40	—	0.32	—	0.33	0.024
ANT-43	—	3.20	—	3.26	0.024
ANT-45	—	0.42	—	0.44	0.040
ANT-46	—	*13.2	—	13.5	0.017
ANT-47	—	2.78	—	2.85	0.015
ANT-48	—	3.91	—	4.00	0.012
ANT-49	—	0.28	—	0.28	0.018
ANT-51	—	0.43	—	0.44	0.205
ANT-52[3]	—	0.69	—	0.70	0.014
Understanding well (1 well sampled)					
ANT-U	—	0.33	—	0.35	0.022

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

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

[3] NWQL storage refrigerator exceeded maximum allowable temperature before sample analysis.

Table 9. Major and minor ions and total dissolved solids (TDS) detected in samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.

[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 the 19 slow wells were analyzed. Information about the analytes is given *table 3G*. **GAMA well identification number:** ANT, Antelope Valley study area grid well; ANT-U, Antelope Valley study area understanding well. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** MCL-CA; California Department of Public Health maximum contaminant level; SMCL-CA, California Department of Public Health secondary maximum contaminant level. **Other abbreviations:** na; not available; LRL, laboratory reporting level; E, estimated or having a higher degree of uncertainty; mg/L, milligram per liter; —, not detected; *. value above threshold level; **, value above upper threshold level]

GAMA well identification number	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 (TDS) (mg/L) (70300)
Threshold type[1]	**na**	**na**	**na**	**na**	**na**	**SMCL-CA**	**MCL-CA**	**na**	**na**	**SMCL-CA**	**SMCL-CA**
Threshold level	**na**	**na**	**na**	**na**	**na**	**[2] 250 (500)**	**2**	**na**	**na**	**[2] 250 (500)**	**[2] 500 (1,000)**
LRL	**[0.04]**	**[0.02]**	**[0.02]**	**[0.12]**	**[0.02]**	**[0.12]**	**[0.12]**	**[0.002]**	**[0.018]**	**[0.18]**	**[10]**
Grid wells (18 wells sampled)											
ANT-02	50.1	9.14	2.59	19.7	0.08	23.9	0.2	—	22.8	34.2	265
ANT-04	35.2	4.79	1.84	42.9	0.11	28.8	0.3	—	21.9	44.4	255
ANT-07	27.1	5.72	1.84	44.9	0.07	19.1	0.5	—	25.5	40.1	240
ANT-09	151	59.9	2.85	138	0.79	185	0.6	0.042	26.2	*283	**1,110
ANT-12	35.2	1.76	1.64	47.2	0.08	41.5	0.2	E0.002	22.1	34.3	258
ANT-15	33.8	6.79	1.71	35.9	0.05	9.23	0.8	—	64.9	22.7	273
ANT-17	20.2	2.94	0.95	29.7	0.02	5.24	0.3	—	26.1	16.6	155
ANT-26	54.1	10.2	2.20	22.7	0.09	17.9	0.2	—	24.4	50.1	273
ANT-34	170	39.8	11.1	555	0.76	*266	0.7	0.012	148	*278	**1,190
ANT-40	16.0	3.12	2.01	61.5	0.03	10.7	0.5	E0.001	38.9	55.7	272
ANT-43	41.1	7.47	2.16	52.8	0.16	27.8	0.2	E0.001	22.1	77.6	332
ANT-45	10.8	2.66	1.33	103	0.07	25.9	1.1	E0.001	22.1	66.6	348
ANT-46	83.1	11.4	1.86	71.5	0.33	73.6	0.3	E0.001	25.6	121	*543
ANT-47	45.2	6.70	1.49	50.7	0.18	43.8	0.5	—	34.3	41.1	327
ANT-48	172	33.0	5.23	88.8	0.44	156	0.6	0.004	43.0	*317	*977
ANT-49	12.5	1.27	0.97	37.1	E0.01	2.74	0.3	—	20.3	16.6	156
ANT-51	2.91	0.64	1.02	135	0.13	49.1	0.8	E0.002	25.0	74.7	400
ANT-52	23.7	7.15	3.15	39.3	0.04	5.88	0.4	—	17.3	46.9	229
Understanding well (1 well sampled)											
ANT-U	21.7	2.76	0.95	29.9	0.04	11.2	0.4	—	24.6	20.2	184

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

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

Table 10. Trace elements detected in samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.

[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 the 19 slow wells were analyzed. All analytes are listed in *table 3G*. **GAMA well identification number:** ANT, Antelope Valley study area grid well; ANT-U, Antelope Valley study area understanding well. Threshold types and threshold levels as of December 11, 2008. **Threshold types:** AL-US, U.S. Environmental Protection Agency action level; HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; NL-CA, California Department of Public Health notification level; SMCL-CA, California Department of Public Health secondary maximum contaminant level. **Other abbreviations:** E, estimated or having a higher degree of uncertainty; LRL, laboratory reporting level; SRL, study reporting limit; na, not available; ≤, less than or equal to; µg/L, microgram per liter; —, not detected; *, value above threshold level]

GAMA well identification number	Aluminum (µg/L) (01106)	Antimony (µg/L) (01095)	Arsenic (µg/L) (01000)	Barium (µg/L) (01005)	Beryllium (µg/L) (01010)	Boron (µg/L) (01020)	Cadmium (µg/L) (01025)	Chromium (µg/L) (01030)	Cobalt (µg/L) (01035)	Copper (µg/L) (01040)	Iron (µg/L) (01046)	Lead (µg/L) (01049)
Threshold type[1]	**MCL-CA**	**MCL-US**	**MCL-US**	**MCL-CA**	**MCL-US**	**NL-CA**	**MCL-US**	**MCL-CA**	**na**	**AL-US**	**SMCL-CA**	**AL-US**
Threshold level	**1,000**	**6**	**10**	**1,000**	**4**	**1,000**	**5**	**50**	**na**	**1,300**	**300**	**15**
[LRL] or [SRL]	**[2] [1.6]**	**[0.14]**	**[0.06]**	**[2] [0.4]**	**[0.008]**	**[6]**	**[0.04]**	**[2] [0.12]**	**[0.02]**	**[2] [1]**	**[2] [8]**	**[2] [0.08]**
Grid wells (18 wells sampled)												
ANT-02	≤0.9	—	0.21	62	—	32	—	2.1	E0.01	≤1.5	—	≤0.23
ANT-04	3.2	0.15	5.3	56	—	68	—	11	E0.01	—	—	≤0.07
ANT-07	≤1.0	0.23	9.7	18	—	141	E0.04	11	—	3.1	≤4	≤0.55
ANT-09	—	—	0.15	57	—	15	E0.03	≤0.19	0.07	≤0.77	223	—
ANT-12	49.8	0.17	0.81	53	0.13	28	0.12	0.59	0.14	≤1.6	9	≤0.5
ANT-15	—	0.22	5.7	28	—	91	—	2.1	—	≤0.96	—	0.89
ANT-17	1.8	—	0.96	31	—	23	—	11	—	—	—	—
ANT-26	≤1.5	—	0.28	43	—	73	—	2.6	—	≤0.65	—	≤0.46
ANT-34[3]	—	0.47	*26.5	26	—	*1,050	0.04	2.1	0.04	≤0.99	154	≤0.21
ANT-40	10.2	—	0.16	9.0	E0.01	E6	—	≤0.13	0.04	—	10	≤0.05
ANT-43	2.0	—	0.22	39	—	43	—	3.1	0.02	—	E6	≤0.17
ANT-45	≤1.1	0.41	*82.4	11	E0.01	225	0.05	12	—	—	—	≤0.25
ANT-46	—	—	0.34	78	—	64	0.06	2.3	0.04	≤1.2	≤4	≤0.47
ANT-47	—	0.20	*11.3	53	—	373	—	6.6	0.02	—	8	≤0.15
ANT-48	≤1.4	0.23	*10.5	31	—	282	E0.02	8.4	0.10	—	24	≤0.07
ANT-49	≤1.3	E0.09	2.7	11	—	30	—	6.9	—	≤0.65	—	≤0.34
ANT-51	1.7	2.36	*278	3.0	—	265	0.04	8.9	—	—	32	—
ANT-52	≤1.5	E0.09	1.1	69	—	50	—	13	—	—	—	≤0.20
Understanding well (1 well sampled)												
ANT-U	2.3	—	1.7	42	—	31	—	11	0.01	—	13	—

Table 10. Trace elements detected in samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.—Continued

[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 the 19 slow wells were analyzed. All analytes are listed in table 3G. **GAMA well identification number:** ANT, Antelope Valley study area grid well; ANT-U, Antelope Valley study area understanding well. Threshold types and threshold levels as of December 11, 2008. **Threshold types:** AL-US, U.S. Environmental Protection Agency action level; HAL-US, U.S. Environmental Protection Agency Lifetime Health Advisory; MCL-CA, California Department of Public Health maximum contaminant level; MCL-US, U.S. Environmental Protection Agency maximum contaminant level; NL-CA, California Department of Public Health notification level; SMCL-CA, California Department of Public Health secondary maximum contaminant level. **Other abbreviations:** E, estimated or having a higher degree of uncertainty; LRL, laboratory reporting level; SRL; study reporting limit; na, not available; ≤, less than or equal to; µg/L, microgram per liter; —, not detected; *, value above threshold level]

GAMA identification umber	Lithium (µg/L) (01130)	Manganese (µg/L) (01056)	Molybdenum (µg/L) (01060)	Nickel (µg/L) (01065)	Selenium (µg/L) (01145)	Silver, dissolved (µg/L) (01075)	Strontium (µg/L) (01080)	Tungsten (µg/L) (01155)	Uranium (µg/L) (22703)	Vanadium (µg/L) (01085)	Zinc (µg/L) (01090)
Threshold type[1]	**na**	**SMCL-CA**	**HAL-US**	**MCL-CA**	**MCL-US**	**SMCL-CA**	**HAL-US**	**na**	**MCL-US**	**NL-CA**	**SMCL-CA[3]**
Threshold level	**na**	**50**	**40**	**100**	**50**	**100**	**4,000**	**na**	**30**	**50**	**5,000**
[LRL] or [SRL]	**[1]**	**[2][0.2]**	**[0.2]**	**[2][0.2]**	**[0.04]**	**[0.1]**	**[0.8]**	**[2][0.06]**	**[0.02]**	**[2][0.04]**	**[2][1.8]**
Grid wells (18 wells sampled)											
ANT-02	—	≤0.1	1.9	≤0.2	0.71	—	429	—	4.3	7.7	≤1.0
ANT-04	6.1	0.3	3.1	≤0.2	1.2	—	337	1.4	3.2	19.6	8.4
ANT-07	5.4	—	6.8	≤0.2	0.85	—	250	1.2	2.5	23.6	—
ANT-09	2.4	49.8	6.2	0.6	0.07	—	999	—	12.2	2.1	25.2
ANT-12	2.7	4.6	0.4	0.8	0.48	E0.1	19.2	—	0.65	0.75	10.5
ANT-15	24.8	1.5	3.5	≤0.1	0.44	—	140	≤0.09	4.2	7.2	19.7
ANT-17	2.2	0.5	2.7	—	0.20	—	197	≤0.04	0.75	11.8	≤3.0
ANT-26	2.2	E0.2	2.9	≤0.1	0.52	—	505	—	3.0	12.6	≤1.9
ANT-34	86.8	6.1	20.5	≤0.2	3.5	—	1,310	0.80	20.1	16.8	≤2.3
ANT-40	E0.6	2.7	E0.2	≤0.3	0.10	—	27.7	—	0.03	0.27	≤2.0
ANT-43	4.5	E0.2	2.4	≤0.2	1.1	—	439	—	1.2	10.7	≤1.0
ANT-45	26.4	0.3	23	≤0.1	0.80	—	114	0.96	7.4	*69.5	5.1
ANT-46	10.1	0.3	1.5	≤0.3	2.8	—	902	—	3.9	4.0	49.0
ANT-47	23.2	1.7	1.8	≤0.2	0.91	—	395	0.28	2.6	12.9	—
ANT-48	33.3	1.3	5.8	0.7	1.3	—	884	1.5	25.1	11.1	26.9
ANT-49	4.4	—	3.9	—	0.18	—	139	≤0.09	0.76	19.7	—
ANT-51	15.4	2.0	27.1	—	0.74	—	38.7	30.0	4.9	*126	—
ANT-52	4.2	—	2.8	—	0.64	—	463	≤0.09	1.7	11.6	≤1.8
Understanding well (1 well sampled)											
ANT-U	2.8	0.5	2.5	≤0.1	0.29	—	268	≤0.07	0.75	15.7	—

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

[2] Study reporting limit (SRL) defined based on examination of GAMA quality-control samples collected from May 2004 through January 2008 (Olsen and others, unpub. data, 2008). Values below SRL are reported as less than or equal to the value reported by the laboratory (<). In the USGS NWIS database, the result is accompanied with the following comment: Result is < or = reported value, based on QC data (may include: field blanks, source-solution blanks, trip blanks, NWQL set blanks, NWQL blank water certificates, and USGS BQS Blind Blank Program data).

[3] Sample diluted for analysis at the NWQL.

Table 11. Species of inorganic arsenic, chromium, and iron detected in samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.

[Data in this table were analyzed at U.S. Geological Survey (USGS) Trace Metal Laboratory in Boulder, Colorado, using research methods and are not stored in the USGS National Water Information System database. Samples from 19 slow wells were analyzed. Information about analytes is given in *table 3H*. **GAMA well identification number:** ANT, Antelope Valley study area grid well; ANT-U, Antelope Valley study area understanding well. Threshold types and threshold levels as of December 11, 2008.**Threshold type:** 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. **Other abbreviations:** MDL, method detection limit, na, not available; µg/L, microgram per liter; —, not detected; *, value above threshold value]

GAMA well identification number	Arsenic (total) (µg/L)	Arsenic(III) (µg/L)	Chromium (total) (µg/L)	Chromium(VI) (µg/L)	Iron (total) (µg/L)	Iron(II) (µg/L)
Threshold type[1]	**MCL-US**	**na**	**MCL-CA**	**na**	**SMCL-CA**	**na**
Threshold level	**10**	**na**	**50**	**na**	**300**	**na**
[MDL]	**[0.5]**	**[1]**	**[1]**	**[1]**	**[2]**	**[2]**
Grid wells (18 wells sampled)						
ANT-02	—	—	2	2	—	—
ANT-04	4.4	—	13	9	—	—
ANT-07	8.7	—	13	9	—	—
ANT-09	—	—	—	—	179	153
ANT-12	0.58	—	5	5	5	2
ANT-15	6.9	—	3	3	3	—
ANT-17	0.59	—	13	12	—	—
ANT-26	—	—	3	2	—	—
ANT-34	*18	—	4	2	125	89
ANT-40	*8.1	—	7	6	3	—
ANT-43	—	—	4	3	4	—
ANT-45	*68	—	12	11	3	—
ANT-46	—	—	2	2	—	—
ANT-47	6.2	—	7	7	7	—
ANT-48	6.1	—	9	8	19	3
ANT-49	1.5	—	8	7	—	—
ANT-51	*240	3	10	10	27	—
ANT-52	—	—	15	14	—	—
Understanding well (1 well sampled)						
ANT-U	0.88	—	15	12	—	—

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

Table 12. Results for analyses of stable isotope, tritium, carbon-14 activities, and strontium isotope ratios in samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.

[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 57 wells were analyzed for stable isotopes and tritium. Samples from the 19 slow wells were analyzed for strontium isotopes and carbon-14 activities. *Table 3I* contains additional information about the analytes. Stable isotope ratios are reported in the standard delta notation (δ), the ratio of a heavier isotope to the more common lighter isotope of that element, relative to a standard reference material. **GAMA well identification number:** ANT, Antelope Valley study area grid well; ANT-U, Antelope Valley study area understanding well. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** MCL-CA; California Department of Public Health maximum contaminant level. 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.100-percent modern carbon is referenced to atmospheric carbon-14 production rates in 1950. Values of percent modern carbon can be greater than 100 percent because the atmospheric production rate was much higher during the period of above−ground nuclear testing in the 1950s and 1960s. **Other abbreviations:** H, hydrogen; O, oxygen; C, carbon; Sr, strontium; 2SCU, 2-sigma combined uncertainty; nc, sample not collected; pCi/L, picocurie per liter; <, less than]

GAMA well identification number	δ^{2}H (per mil) (82082)	δ^{18}O (per mil) (82085)	Tritium (pCi/L) (07000)	δ^{13}C (per mil) (82081)	Carbon-14 (percent modern) (49933)	^{87}Sr/^{86}Sr (atom ratio) (75978)
Threshold type	**na**	**na**	**MCL–CA**	**na**	**na**	**na**
Threshold level	**na**	**na**	**20,000**	**na**	**na**	**na**
Grid wells (56 wells sampled, result ± 2SCU)						
ANT-01	−71.30	−9.60	<1	nc	nc	nc
ANT-02	−68.30	−9.84	2.6 ± 1	-11.05	97.23	0.70946
ANT-03	−71.90	−10.29	<1	nc	nc	nc
ANT-04	−69.90	−9.93	<1	-11.49	42.51	0.70852
ANT-05	−70.30	−9.92	1.3 ± 0.6	nc	nc	nc
ANT-06	−75.20	−10.85	<1	nc	nc	nc
ANT-07	−69.50	−9.99	<1	-12.33	47.23	0.70780
ANT-08	−69.60	−9.69	<1	nc	nc	nc
ANT-09	−44.10	−5.87	6.7 ± 0.6	-12.13	100.4	0.71079
ANT-10	−72.20	−10.53	<1	nc	nc	nc
ANT-11	−73.00	−10.57	<1	nc	nc	nc
ANT-12	−72.10	−10.46	<1	-9.55	64.59	0.71034
ANT-13	−76.40	−10.79	<1	nc	nc	nc
ANT-14	−70.00	−9.97	<1	nc	nc	nc
ANT-15	−69.40	−9.55	1 ± 0.6	-12.67	71.10	0.70804
ANT-16	−68.40	−9.52	<1	nc	nc	nc
ANT-17	−72.70	−10.53	<1	-9.05	58.23	0.71008
ANT-18	−72.40	−10.40	<1	nc	nc	nc
ANT-19	−71.50	−10.01	3.2 ± 0.6	nc	nc	nc
ANT-20	−67.70	−9.27	8 ± 1	nc	nc	nc
ANT-21	−70.60	−9.53	1.6 ± 0.6	nc	nc	nc
ANT-22	−73.20	−10.32	<1	nc	nc	nc
ANT-23	−73.40	−10.66	9 ± 1	nc	nc	nc
ANT-24	−83.10	−11.80	<1	nc	nc	nc
ANT-25	−75.70	−10.77	<1	nc	nc	nc
ANT-26	−75.80	−10.80	<1	-9.71	80.61	0.70944
ANT-27	−74.70	−10.61	<1	nc	nc	nc
ANT-28	−88.60	−11.89	<1	nc	nc	nc
ANT-29	−84.40	−10.80	<1	nc	nc	nc
ANT-30	−72.20	−9.72	1.3 ± 0.6	nc	nc	nc

Table 12. Results for analyses of stable isotope, tritium, carbon-14 activities, and strontium isotope ratios in samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.—Continued

[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 57 wells were analyzed for stable isotopes and tritium. Samples from the 19 slow wells were analyzed for strontium isotopes and carbon-14 activities. *Table 31* contains additional information about the analytes. Stable isotope ratios are reported in the standard delta notation (δ), the ratio of a heavier isotope to the more common lighter isotope of that element, relative to a standard reference material. **GAMA well identification number:** ANT, Antelope Valley study area grid well; ANT-U, Antelope Valley study area understanding well. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** MCL-CA; California Department of Public Health maximum contaminant level. 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.100-percent modern carbon is referenced to atmospheric carbon-14 production rates in 1950. Values of percent modern carbon can be greater than 100 percent because the atmospheric production rate was much higher during the period of above−ground nuclear testing in the 1950s and 1960s**. Other abbreviations:** H, hydrogen; O, oxygen; C, carbon; Sr, strontium; 2SCU, 2-sigma combined uncertainty; nc, sample not collected; pCi/L, picocurie per liter; <, less than]

GAMA well identification number	δ^{2}H (per mil) (82082)	δ^{18}O (per mil) (82085)	Tritium (pCi/L) (07000)	δ^{13}C (per mil) (82081)	Carbon-14 (percent modern) (49933)	^{87}Sr/^{86}Sr (atom ratio) (75978)
Threshold type	**na**	**na**	**MCL–CA**	**na**	**na**	**na**
Threshold level	**na**	**na**	**20,000**	**na**	**na**	**na**
ANT-31	−67.70	−9.45	6.4 ± 1.3	nc	nc	nc
ANT-32	−91.70	−11.48	<1	nc	nc	nc
ANT-33	−105.00	−13.00	<1	nc	nc	nc
ANT-34	−98.30	−12.17	<1	nc	nc	0.70843
ANT-35	−78.00	−11.08	<1	nc	nc	nc
ANT-36	−79.10	−11.10	<1	nc	nc	nc
ANT-37	−84.50	−11.33	<1	nc	nc	nc
ANT-38	−77.60	−10.75	<1	nc	nc	nc
ANT-39	−77.20	−10.88	<1	nc	nc	nc
ANT-40	−82.50	−11.50	<1	−9.53	28.46	0.70992
ANT-41	−66.90	−9.42	<1	nc	nc	nc
ANT-42	−70.30	−9.79	<1	nc	nc	nc
ANT-43	−75.80	−10.49	<1	−9.29	70.62	0.70960
ANT-44	−72.10	−10.03	1 ± 0.6	nc	nc	nc
ANT-45	−77.10	−10.82	<1	−7.9	25.11	0.70823
ANT-46	−68.20	−9.44	1.9 ± 0.6	−12.41	59.90	0.70948
ANT-47	−70.30	−9.80	<1	−11.51	38.36	0.70966
ANT-48	−71.00	−9.99	1 ± 0.6	−13.90	78.73	0.70810
ANT-49	−73.20	−10.46	<1	−9.34	63.84	0.70996
ANT-50	−84.30	−11.57	<1	nc	nc	nc
ANT-51	−79.20	−10.94	<1	−7.96	32.17	0.70818
ANT-52	−78.20	−11.03	<1	−10.61	53.19	0.71118
ANT-53	−66.40	−9.02	4.1 ± 0.9	nc	nc	nc
ANT-54	−67.70	−9.91	<1	nc	nc	nc
ANT-55	−70.80	−10.07	<1	nc	nc	nc
ANT-56	−64.30	−9.41	4.7 ± 0.6	nc	nc	nc
Understanding well (1 well sampled)						
ANT-U	−74.90	−10.50	<1	−8.71	48.33	0.71020

Table 13A. Radium isotopes detected in samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.

[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 the 19 slow wells were analyzed. *Table 3I* contains additional information about the analytes. Measured values less than the sample-specific critical level (ssL_C) are reported as nondetections (—). **GAMA well identification number:** ANT, Antelope Valley study area grid well; ANT-U, Antelope Valley study area understanding well. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** MCL-US, U.S. Environmental Protection Agency maximum contaminant level. **Other abbreviations:** CSU, combined standard uncertainty; pCi/L, picocurie per liter; —, not detected; ≤, less than or equal to]

GAMA identification number	Radium-226 (pCi/L) (09511)		Radium-228 (pCi/L) (81366)	
Threshold type[1]	**MCL-US**		**MCL-US**	
Threshold level	[2]**5**		[2]**5**	
Reporting level method	**Result ± CSU**	**ssL_c**	**Result ± CSU**	**ssL_c**
Grid wells (18 wells sampled)				
ANT-2	≤ 0.024 ± 0.011	0.015	—	0.20
ANT-4	0.036 ± 0.012	0.015	—	0.21
ANT-7	≤ 0.026 ± 0.012	0.015	—	0.21
ANT-9	0.034 ± 0.011	0.014	—	0.19
ANT-12	—	0.015	0.34 ± 0.12	0.25
ANT-15	0.045 ± 0.013	0.015	—	0.19
ANT-17	0.041 ± 0.013	0.016	0.202 ± 0.085	0.18
ANT-26	0.046 ± 0.013	0.014	0.27 ± 0.13	0.26
ANT-34	0.178 ± 0.022	0.015	—	0.30
ANT-40	0.078 ± 0.018	0.015	—	0.21
ANT-43	≤ 0.026 ± 0.011	0.014	0.356 ± 0.092	0.21
ANT-45	≤ 0.021 ± 0.011	0.015	—	0.23
ANT-46	0.080 ± 0.016	0.015	0.254 ± 0.076	0.18
ANT-47	0.063 ± 0.014	0.016	—	0.22
ANT-48	0.072 ± 0.015	0.014	—	0.21
ANT-49	≤ 0.021 ± 0.011	0.015	—	0.20
ANT-51	0.312 ± 0.036	0.016	—	0.20
ANT-52	0.050 ± 0.013	0.016	—	0.26
Understanding well (1 well sampled)				
ANT-U	0.035 ± 0.012	0.015	—	0.19

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

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

Table 13B. Gross alpha and gross beta radioactivity detected in samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.

[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 the 19 slow wells were analyzed. *Table 31* contains additional information about the analytes. The reference nuclide for measurement of gross alpha is thorium-230 and the reference nuclide for measurement of gross beta is cesium-137. Measured values less than the sample-specific critical level (ssL_C) are reported as nondetections (—). **GAMA well identification number:** ANT, Antelope Valley study area grid well; ANT-U, Antelope Valley study area understanding well. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** MCL-US, U.S. Environmental Protection Agency maximum contaminant level; MCL-CA, California Department of Public Health maximum contaminant level. **Other abbreviations:** CSU, combined standard uncertainty; pCi/L, picocurie per liter; *, value above threshold level; —, not detected]

GAMA well identification number	Gross alpha radioactivity, 72-hour count (pCi/L) (62636)		Gross alpha radioactivity, 30-day count (pCi/L) (62639)		Gross beta radioactivity 72-hour count (pCi/L) (62642)		Gross beta radioactivity, 30-day count (pCi/L) (62645)	
Threshold type[1]	**MCL-US**		**MCL-US**		**MCL-CA**		**MCL-CA**	
Threshold value	**15**		**15**		**50**		**50**	
Threshold level	**Result ± CSU**	**ssL_C**	**Result ± CSU**	**ssL_C**	**Result ± CSU**	**ssL_C**	**Result ± CSU**	**ssL_C**
Grid wells (18 wells sampled)								
ANT-02	3.61 ± 0.83	0.52	2.53 ± 0.84	0.74	2.39 ± 0.74	1.1	3.29 ± 0.58	0.66
ANT-04	3.00 ± 0.81	0.49	3.73 ± 0.93	0.78	1.56 ± 0.46	0.66	1.87 ± 0.48	0.65
ANT-07	2.11 ± 0.68	0.60	3.25 ± 0.82	0.63	1.44 ± 0.45	0.66	2.08 ± 0.52	0.70
ANT-09	10.5 ± 2.2	1.6	5.9 ± 1.8	1.8	3.32 ± 0.60	0.74	5.34 ± 0.73	0.70
ANT-12	1.86 ± 0.77	0.92	0.78 ± 0.56	0.65	1.84 ± 0.47	0.65	1.32 ± 0.44	0.62
ANT-15	[2] 6.1 ± 1.1	0.61	4.5 ± 1.0	0.65	[2] 2.59 ± 0.56	0.71	3.03 ± 0.55	0.62
ANT-17	[2] 1.16 ± 0.49	0	0.75 ± 0.49	0.59	— [2]	1.0	1.42 ± 0.49	0.72
ANT-26	2.14 ± 0.78	0.85	0.76 ± 0.60	0.74	2.40 ± 0.74	1.1	3.42 ± 0.61	0.74
ANT-34	* 18.3 ± 3.3	2.0	* 20.7 ± 3.5	2.2	5.01 ± 0.66	0.81	9.76 ± 0.84	0.81
ANT-40	[2] 4.01 ± 0.99	0.71	3.45 ± 0.88	0.67	[2] 2.11 ± 0.46	0.62	3.42 ± 0.53	0.71
ANT-43	2.03 ± 0.83	0.88	2.10 ± 0.73	0.59	2.46 ± 0.76	1.1	2.94 ± 0.72	1.1
ANT-45	12.0 ± 2.0	0.93	11.0 ± 2.0	1.2	—	0.87	5.22 ± 0.71	0.87
ANT-46	[2] 6.8 ± 1.3	0.89	4.8 ± 1.2	0.98	[2] 1.23 ± 0.55	0.87	1.99 ± 0.56	0.89
ANT-47	4.4 ± 1.2	1.1	4.0 ± 1.0	0.61	1.50 ± 0.61	0.88	3.36 ± 0.68	0.88
ANT-48	* 31.8 ± 4.7	2.9	* 22.0 ± 3.7	2.4	[2] 6.41 ± 0.60	0.61	12.2 0± 0.90	0.68
ANT-49	1.67 ± 0.44	0.42	1.19 ± 0.35	0.31	1.08 ± 0.32	0.48	0.71 ± 0.27	0.42
ANT-51	6.3 ± 1.2	0.67	6.3 ± 1.2	0.65	—	0.66	2.21 ± 0.50	0.71
ANT-52	2.22 ± 0.64	0.41	1.80 ± 0.58	0.43	2.72 ± 0.47	0.62	3.73 ± 0.51	0.61
Understanding well (1 well sampled)								
ANT-U	1.70 ± 0.62	0.60	—	1.0	1.07 ± 0.41	0.61	—	0.67

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

[2] 72-hour holding time exceeded by 2 days.

Table 13C. Radon-222 detected in samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.

[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 the 19 slow wells were analyzed. *Table 31* contains additional information about the analytes. **GAMA well identification number:** ANT, Antelope Valley study area grid well; ANT-U, Antelope Valley study area understanding well. Threshold types and threshold levels as of December 11, 2008. **Threshold type:** MCL-US, U.S. Environmental Protection Agency maximum contaminant level. **Other abbreviations:** 2SCU, 2-sigma combined standard uncertainty; pCi/L, picocurie per liter; *, result above threshold value]

GAMA well identification number	Radon-222 (pCi/L) (82303)
Threshold type[1]	**Proposed MCL-US**
Threshold level	**[2]300 (4,000)**
Threshold level method	**Result ± 2SCU**
Grid wells (18 wells sampled)	
ANT-02	290 ± 22
ANT-04	* 400 ± 25
ANT-07	* 460 ± 26
ANT-09	240 ± 21
ANT-12	220 ± 20
ANT-15[3]	* 1,280 ± 44
ANT-17	230 ± 27
ANT-26	* 580 ± 24
ANT-34	* 910 ± 27
ANT-40	* 700 ± 25
ANT-43	* 500 ± 22
ANT-45	* 420 ± 22
ANT-46	* 970 ± 25
ANT-47	* 380 ± 21
ANT-48	* 550 ± 27
ANT-49	* 350 ± 21
ANT-51	* 430 ± 21
ANT-52	* 400 ± 22
Understanding well (1 well sampled)	
ANT-U	* 310 ± 21

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

[2] Two MCLs have been proposed for Radon-222; the proposed Alternative MCL is in parentheses.

[3] Sample analyzed after radon half life of 3.92 days (collected 01/31/08, analyzed 2/4/08). Thus the result may be biased low.

Appendix

This appendix includes discussions of the methods used to collect and analyze groundwater samples and report the resulting water-quality data. These methods were selected to obtain representative samples of the groundwater from each well, and to minimize the potential for contamination of the samples or for bias in 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

Groundwater samples were collected using standard and modified USGS protocols from the USGS NAWQA program (Koterba and others, 1995), the USGS National Field Manual (U.S. Geological Survey, variously dated), and protocols described by Weiss (1968), Shelton and others (2001), Ball and McClesky (2003a,b), and Wright and others (2005).

Prior to sampling, each well was pumped continuously to purge at least three casing-volumes of water from the well (U.S. Geological Survey, 2006). 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 wellhead as possible. All wells were sampled from points upstream of any water storage tanks. Of the 57 wells sampled, 32 had no water treatment near the wellhead, 17 had water treatment injection points downstream of sampling points. Of these 17 wells, 8 wells had water-treatment systems that were shut off prior to sampling. Prior to sampling, wells were tested for free chlorine if it was suspected residual disinfection by-products could be present after a water-treatment system had been shut off. In one case, free chlorine was measured at a concentration of 1 mg/L and the sample collected for VOC analysis at this site was placed in a container treated with a dechlorinating reagent (*table 5*). For the fast and intermediate schedules, samples were collected at the well head using a foot-long length of Teflon tubing. After use, these foot-long lengths of tubing were returned to a GAMA base of operations for cleaning prior to being re-used for sampling. For the slow schedule, the samples were collected inside an enclosed chamber located inside a mobile laboratory and connected to the well head by a 10- to 50-ft length of the Teflon tubing (Lane and others, 2003). All fittings and lengths of tubing were cleaned between samples in a mobile laboratory following procedures described in Wilde (2004).

For field measurements, groundwater was pumped through a flow-through chamber fitted with a multi-probe meter that simultaneously measures water temperature, dissolved oxygen, pH, and specific conductance. Turbidity was measured in the field with a calibrated turbidity meter. Field measurements were made in accordance with protocols in the USGS National Field Manual (Radtke and others, 2005; Lewis, 2006; Ritz and Collins, 2008; Wilde, 2006, 2008). All sensors on the multi-probe meter were calibrated daily and checked at each well. Temperature, dissolved oxygen, pH, specific conductance, and turbidity values were recorded at 3- to 10-minute intervals for at least 30 minutes, and when these values remained stable for 25 minutes, samples were collected.

Field measurements and instrument calibrations were recorded by hand on field record sheets and, along with other sample information were entered in PCFF, a software package designed by the USGS with support from the GAMA program. Analytical service request forms for the USGS NWQL also were produced by PCFF. Information from PCFF was uploaded directly into NWIS at the end of every week of sample collection.

For analyses requiring filtered water, groundwater was filtered in-line through a 0.45-µm pore-sized vented capsule filter, a disk filter, or a baked glass-fiber filter, depending on the protocol for the analysis (U.S. Geological Survey, 2006; Wilde and others, 2004). Both perchlorate and chromium (abundance and speciation) samples required filtering using a small, 0.45-µm pore-sized disk filter attached to a syringe.

Prior to sample collection, polyethylene sample bottles were pre-rinsed two times using deionized water, and then 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 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 speciation, strontium isotopes, and stable isotopes of hydrogen and oxygen in water were shipped monthly, while volatile organic compounds (VOCs), pesticides, perchlorate, *N*-nitrosodimethylamine (NDMA), 1,2,3-trichloropropane (1,2,3-TCP), radium isotopes, gross alpha and gross beta radioactivity, and radon-222 samples were shipped daily. The temperature-sensitive samples for arsenic and iron speciation were stored on ice, archived in a laboratory refrigerator, and shipped to the USGS Trace Metal Laboratory (TML) after results for the metal concentrations were received from the NWQL.

Volatile organic compounds (VOCs), gasoline oxygenates and degradates, 1,2,3-trichloropropane (1,2,3-TCP), 1,2-dibromo-3-chloropropane (DBCP), and 1,2-dibromoethane (EDB) samples were collected in 40-mL sample vials that were purged with three vial volumes of sample water before bottom filling to eliminate atmospheric contamination. Six normal (6 N) hydrochloric acid (HCl) was added as a preservative to the VOC samples but not to the gasoline oxygenate and degradate samples. The 1,2,3-TCP sample containers were treated with 0.5 mL 6N 1:1 HCL acid as a preservative. For perchlorate samples, groundwater was collected in a polyethylene bottle. A 40-mL portion of this water was drawn into a syringe and passed through a 0.20-µm filter into a 125-mL polystyrene bottle.

Tritium samples were collected by bottom filling 1-L polyethylene bottles with unfiltered groundwater. While bottom filling, the sample bottle was flushed with 3 L of groundwater. The sample bottle then was sealed with a conical cap that was secured with electrical tape to prevent leakage and evaporation.

Unfiltered water samples for analysis of stable isotopes of hydrogen and oxygen in water were collected in 60-mL clear glass bottles, sealed with a conical cap to prevent leakage and evaporation, and the cap secured with electrical tape.

Pesticides and pesticide degradation products, pharmaceutical compounds, and *N*-nitrosodimethylamine (NDMA) samples were collected in 1-L baked amber bottles. Pesticide and pharmaceutical samples were passed through 0.7-µm glass fiber filters and collected in 1-L baked amber glass containers, whereas the NDMA samples were collected in 0.5-L baked amber glass containers and filtered at Weck Laboratories, Inc. NDMA sample containers, treated with 0.05 g of sodium thiosulfate ($Na_2S_2O_3$), were provided by Weck Laboratories, Inc.

Unless stated otherwise, samples of groundwater constituents described below were filtered through a 0.45 µm Whatman capsule filter. Major and minor ions, trace elements, alkalinity, and total dissolved solids analyses (TDS) groundwater samples required filling one 250-mL plain polyethylene bottle with raw groundwater, and one 500-mL plain polyethylene and one 250-mL acid rinsed polyethylene bottle with filtered groundwater (Wilde and others, 2004). The 250-mL filtered sample then was preserved with 7.5 N nitric acid. Arsenic and iron speciation samples were filtered into a 250-mL polyethylene bottle that was covered with opaque plastic and tape to prevent light exposure, and preserved with 6 N hydrochloric acid. The nutrient sample was filtered into a 125-mL brown polyethylene bottle. Radium isotopes and gross alpha and gross beta radiation samples were filtered into 1-L polyethylene bottles and acidified with nitric acid. Carbon isotope samples were filtered and bottom filled into 500-mL glass bottles that first were overfilled with three bottle volumes of groundwater. These samples had no headspace and were sealed with a conical cap to avoid atmospheric contamination. Samples for alkalinity titrations were collected by filtering groundwater into a 500-mL polyethylene bottles.

Chromium, radon-222, and dissolved gases were collected from the nearest sampling point to the well head, regardless of the sampling schedule (fast, intermediate, or slow). Chromium speciation samples were collected using a 10-mL syringe with an attached 0.45-µm disk filter. After the syringe was rinsed thoroughly and filled with groundwater, 4 mL was forced through the disk filter; the next 2 mL of the groundwater were filtered slowly into a small centrifuge vial for analysis of total chromium. Hexavalent chromium, Cr (VI), then was 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 were 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 point (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 partially filled 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.-diameter copper tubes using reinforced nylon tubing connected to the hose bib at the wellhead. Groundwater was flushed through the tubing to dislodge bubbles before flow was restricted with a back pressure valve. Clamps on either side of the copper tube then were tightened, trapping a sample of groundwater for analyses of noble gases (Weiss, 1968).

Alkalinities of filtered samples were measured in the mobile laboratory at the well site by titration method (Gran, 1952). Titration data were entered directly into PCFF and the concentrations of bicarbonate (HCO_3^-) and carbonate (CO_3^{2-}) were calculated automatically from the titration data using the advanced-speciation method. Concentrations of HCO_3^- and CO_3^{2-} also were calculated from the alkalinity and pH measurements made at the NWQL. Calculations were made in a spreadsheet using the advanced speciation method (*http://or.water.usgs.gov/alk/methods.html*) with $pK_1 = 6.35$, $pK_2 = 10.33$, and $pK_W = 14$.

Nine laboratories performed chemical analyses for this study (*table A1*), although most of the analyses were performed at the NWQL or by labs 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 are updated accordingly. NWQL maintains National Environmental Laboratory Accreditation Program (NEPLAP) 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://qadata.cr.usgs.gov/nfqa/*). Results for analyses made at the NWQL or by laboratories contracted by the NWQL are uploaded directly into NWIS by the NWQL.

Data Reporting

The following section details the laboratory reporting conventions and the constituents that are determined by multiple methods or by multiple laboratories.

Reporting Limits

The USGS NWQL uses laboratory reporting levels (LRLs) and minimum reporting levels (MRLs) as thresholds for reporting analytical results. Weck Laboratories uses MRLs and the National Research Program Trace Metals Laboratory uses method detection levels (MDLs) as thresholds for reporting analytical results. The LRL is set to minimize the reporting of false negatives (not detecting a compound when it is actually present in a sample) to less than 1 percent (Childress and others, 1999) and 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 method detection limit (MDL) determinations made over an extended period of time. LT-MDLs are monitored and updated continually. The MDL is the minimum concentration of a substance that can be measured and reported with 99-percent confidence that the concentration is greater than zero (at the MDL there is less than a 1-percent chance of a false positive) (Childress and others, 1999; U.S. Environmental Protection Agency, 2002). The USGS NWQL updates LRL values regularly and the values listed in this report were in effect during the period analyses of groundwater samples from the ANT study (January to April 2008) were made.

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 LT-MDL have high certainty of detection, but the precise concentration is uncertain. Information-rich methods are those that utilize gas chromatography or high-performance liquid chromatography (HPLC) with mass spectrometry detection (VOCs, gasoline oxygenates and degradates, pesticides, and the low-level fumigants; 1,2-dibromo-3-chloropropane [DBCP] and 1,2-dibromoethane [EDB]). E-values also may result from detections outside the range of calibration standards, for detections that did not meet all laboratory quality-control criteria, and for samples that were diluted prior to analysis (Childress and others, 1999).

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

Results for most constituents are presented using the LRL or MRL values provided by the analyzing laboratories. Results for some constituents are presented using raised study reporting levels (SRL). The SRLs were determined by statistical assessment of results from the field blanks collected during the first 21 GAMA study units (May 2004 through January 2008) (Olsen and others, in press). The statistical analysis used order statistics and binomial probabilities to construct an upper confidence limit for the amount of contamination potentially present in field blanks and, by inference, groundwater samples (Hahn and Meeker, 1991). Olsen and others (in press) set the upper confidence limit as the maximum amount of potential contamination that has a 90-percent confidence level of being present in 90 percent of the samples. In other words, there is a 90-percent confidence level that no more than 10 percent of the samples might have a greater amount of contamination. For most constituents, this maximum amount of potential contamination was far below the LRL or MRL for the constituent. Data for such constituents are reported with the LRL or MRL. For some constituents, the maximum amount of potential contamination was greater than the LRL or MRL. For those constituents, SRLs were defined at the maximum amount of potential contamination. Detections of those constituents reported by the laboratory with concentrations less than the SRLs are considered non-detections in this report and are reported with a “less-than-or-equal-to” (≤) sign preceding the reported value.

The methods used for analysis of radiochemical constituents (gross-alpha radioactivity, gross-beta radioactivity, radium isotopes, and uranium isotopes) measure activities using counting techniques (*table A1*). The reporting limits for radiochemical constituents are based on sample-specific critical levels (ssL_C) (McCurdy and others, 2008). The critical level is analogous to the LT-MDL used for reporting analytical results for organic and non-radioactive inorganic constituents. Here, the critical level is defined as the minimum measured activity that indicates a positive detection of the radionuclide in the sample with less than a 5-percent probability of a false-positive detection. Sample-specific critical levels are used for radiochemical measurements because the critical level is sensitive to sample size and sample yield during analytical processing, as well as being dependent on instrument background, counting times for the sample and background, and the characteristics of the instrument being used and the nuclide being measured. An ssL_C is calculated for each sample, and the measured activity in the sample is compared to the ssL_C associated with that sample. Measured activities less than the ssL_C are reported as non-detections.

The analytical uncertainties associated with measurement of activities also are sensitive to sample-specific parameters, including sample size, sample yield during analytical processing, and time elapsed between sample collection and various steps in the analytical procedure, as well as parameters associated with the instrumentation. Therefore, measured activities of radium isotopes and gross alpha and gross beta radiation are reported with sample-specific combined standard uncertainties (CSU). The CSUs are reported at the 68-percent confidence level (1-σ). Radon activities are measured by a different laboratory than the other radioactive constituents; the laboratory reports radon activity results with 2-σ (95-percent confidence level) standard combined uncertainties (*tables 13A,B,C*).

Notation

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):

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

where

i is the atomic mass of the heavier isotope of the element;

E is the element (O for oxygen, C for carbon, or H for hydrogen);

R_{sample} is the ratio of the abundance of the heavier isotope of the element (^{18}O, ^{13}C, or ^{2}H) to the lighter isotope of the element, (^{16}O, ^{12}C, or ^{1}H) in the sample; and,

$R_{\text{reference}}$ is the ratio of the abundance of the heavier isotope of the element to the lighter isotope of the element in the reference material.

The reference material for oxygen and hydrogen is Vienna Standard Mean Ocean Water (VSMOW), which is assigned δ^{18}O and δ^{2}H values of 0 per mil (note that δ^{2}H also is written as δD because the common name of the heavier isotope of hydrogen, hydrogen-2, is deuterium). The reference material for carbon is Vienna Pee Dee Belemnite (VPDB), which is assigned a δ^{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 this study are measured by more than one analytical schedule or more than one laboratory (*table A2*). The preferred methods for these constituents were selected, based on the procedure recommended by the NWQL. 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 generally is preferred. However, the method with higher LRLs may be selected as the preferred method to provide consistency with historical data analyzed by the same method.

Seven of the constituents each appear on two of the following NWQL analytical schedules (*table A2*): VOCs (Schedule 2020; *table 3A*), low-level VOCs (DBCP and EDB) (Schedule 1306; *table 3C*), and gasoline oxygenates and degradates (Schedule 4024; *table 3B*). For constituents collected on Schedules 2020 and 1306, the preferred method was Schedule 1306 (Schedule 1306 was collected at intermediate and slow wells). For constituents on Schedules 2020 and 4024, the preferred method was Schedule 2020 to provide consistency (all samples collected for the GAMA Priority Basin Project are analyzed using Schedule 2020).

Some of the water-quality indicators (field parameters)—pH, specific conductance, and alkalinity—were measured in the field and at the NWQL. The field measurements are the preferred method for all three constituents; however, both are reported for comparison.

1,2,3-Trichloropropane (1,2,3-TCP) was measured at the NWQL and Weck Laboratories, Inc. Both sets of results are reported for this constituent.

Tritium was measured at two laboratories: Lawrence Livermore National Laboratory (LLNL) and U.S. Geological Survey Stable Isotope and Tritium Laboratory (SITL), but only the data from SITL were available for reporting at the time of this publication.

For arsenic, chromium, and iron concentrations, the approved method, Schedule 1948, used by the NWQL are preferred over the research methods used by the USGS Trace Metal Laboratory (*table A2*). The concentrations measured by the Trace Metal Laboratory are used only to calculate the ratios of redox species for each element, $\frac{\text{As(V)}}{\text{As(III)}}$ for arsenic, $\frac{\text{Cr(VI)}}{\text{Cr(III)}}$ for chromium, and $\frac{\text{Fe(III)}}{\text{Fe(II)}}$ for iron. For example:

$$\frac{\text{Fe(III)}}{\text{Fe(II)}} = \frac{\text{Fe(T) - Fe(II)}}{\text{Fe(II)}}$$

where

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

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

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

Quality Assurance

The purpose of quality assurance is to identify which data are representative of environmental conditions and which data 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 performed 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 organic constituents in groundwater samples that may have resulted from contamination were assigned a "V" remark code, and were not considered detections for calculations of detection frequencies in water-quality assessments. Detections of inorganic constituents in groundwater samples that may have resulted from contamination were reported in tables with a "less-than-or-equal-to" (≤) sign before the value. The evaluation of QC data presented in this report was based on results for QC samples collected for the ANT study unit and on results for QC samples for the 21 GAMA study units sampled from May 2004 through January 2008.

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). It should be noted that due to results from the USGS Branch of Quality Systems quality-assurance program, it has been discovered recently that iron and manganese have negative analytical biases (of 16 and 6 percent, respectively), uranium and zinc have positive analytical biases (of "slight" and 11 percent, respectively) during the time that ANT samples were analyzed at the NWQL (U.S. Geological Survey Branch of Quality Systems, 2008).

Blanks

The primary purposes of collecting blanks are to evaluate the magnitude of potential contamination of samples with analytes of interest during sample handling or analysis and to identify and mitigate these sources of sample contamination.

Collection of Blanks

Two types of blanks were collected: source-solution and field blanks. Source-solution blanks were collected to assess potential contamination of samples during transport and analysis, and potential contamination of the certified blank water obtained from the USGS NWQL. Field blanks were collected to assess potential contamination of samples during collection, processing, transport, and analysis. Both source-solution and field blanks were collected prior to collecting groundwater samples. Blanks were collected using blank water certified by the NWQL to contain less than the LRL or MRL of the analytes investigated in the study (*http://wwwnwql.cr.usgs.gov/USGS/OBW/obw.html*). Nitrogen-purged, organic-free blank water was used for field blanks of organic constituents, and inorganic-free blank water was used for field blanks of other constituents. For ANT, blanks were collected at 12 percent of the wells sampled. Field blanks were analyzed for VOCs; gasoline oxygenates and degradates; pesticides; the low-level fumigants, 1,2-dibromo-3-chloropropane (DBCP) and 1,2-dibromoethane (EDB); pharmaceuticals; perchlorate; NDMA; nutrients; major and minor ions; trace elements; arsenic, chromium, and iron speciation; and radioactive constituents. Certified blank water was not available for tritium, stable isotopes, or noble gases, thus field blanks were not collected for these constituents.

Source-solution blanks were collected at the sampling site by pouring blank water directly into sample containers. Theses samples were preserved, stored, shipped, and analyzed in the same manner as the groundwater samples. For field blanks, blank water either was pumped or poured through the sampling equipment (fittings and tubing) used to collect groundwater, then processed and transported using the same protocols used for the groundwater samples. Approximately 12 liters of blank water were pumped or poured through the sampling equipment before the field blank was collected.

Analysis of Blanks

Contamination in blanks may originate from several different types of sources that require different strategies for assessment of potential contamination of groundwater samples. Three primary sources of contamination are assessed in the event of a field-blank or unusual groundwater detection: (1) contamination from a known source, (2) carry-over contamination from the previously collected samples, and, (3) systematic and random contamination from field and laboratory equipment and processes. The third source of contamination (systematic and random) is being addressed using a larger set of field-blank results from multiple studies, in addition to the results from field blanks collected during the ANT study. The development of this approach and its methods are described by Olsen and others (in press).

The first potential source evaluated is contamination from identifiable, known sources present at a specific field site. Contamination from specific sources may produce distinctive patterns of detections in field blanks and groundwater samples, particularly for the VOCs. Substances that may be encountered at the field site, such as lubricants (for example, WD-40), cements used on PVC-piping, exhaust fumes from pump engines, and the methanol used to clean sample lines, contain recognizable associations of VOC constituents. For example, cements used on PVC-piping primarily are composed of tetrahydrofuran, acetone, methyl ethyl ketone (MEK), and cyclohexanone (not analyzed in this study). However, detection of these recognizable associations of VOC constituents in groundwater samples does not necessarily indicate contamination during sample collection because these VOC constituents also may occur together in groundwater.

If a recognizable association of VOC constituents was detected in a field blank or in a groundwater sample, then the field notes and photographs from the site at which the sample was collected were examined for evidence of the probable contaminant source. If the constituents were present in the field blank and groundwater sample from the same site at similar concentrations and the field notes or photographs indicated that the probable contaminant source was present, then the detections of that constituent in the groundwater sample was V-coded and all other groundwater samples collected at sites where the same condition may have occurred were considered for V-coding. If the constituents were present in a groundwater sample and not in the associated field blank or a groundwater sample from a site where no blanks were collected, and the field notes or photographs indicated that the probable contaminant source was present, then the data were considered for V-coding. If no probable contaminant sources were identified in the field notes or photographs, then V-codes were not applied on this basis.

The second potential source of contamination evaluated was carry-over from the previous sample collected with the same equipment. Carry-over between samples is very rare because the procedures used to clean the equipment between samples have been developed and tested extensively 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 groundwater sample or field blank collected with the same equipment. If non-detections were reported in field blanks or groundwater samples collected after groundwater samples containing high concentrations of the constituent and prior to collection of a suspected contaminated sample, then carry-over was ruled out as a source of contamination.

The third potential source of contamination that was evaluated was random or systematic contamination from field or laboratory equipment or processes. All detections in field blanks that could not be accounted for by source-solution contamination, specific known conditions at field sites, or carry-over contamination were evaluated for random contamination. Random contamination has an equal chance of affecting each groundwater sample, thus, strategies for identifying detections of constituents subject to random contamination must be applied to all groundwater samples. Different notation was used for identifying detections of organic and inorganic constituents that may have been subject to random contamination.

For organic constituents, V-codes were applied. The V-coding level was defined as the highest concentration of the constituent detected in a blank (field or source solution) plus the LT-MDL (equal to one-half the LRL) for that constituent. Detections of the constituent in groundwater samples at concentrations less than this V-coding level were identified with a “V” in front of the reported value in the data tables. The highest concentration measured in a blank was assumed to represent the highest potential amount of contamination. Thus, the V-code results could have changed from a non-detection to a detection, relative to the LT-MDL due to contamination. Results with V-codes were not considered detections of the constituent for this study and were not included in calculations of detection frequencies for organic constituents.

Inorganic constituents are present naturally in groundwater, and the concerns about inorganic constituents generally are related to concentration, rather than to detection (presence or absence). In contrast, concerns about organic constituents generally are related to both detection and concentration. For inorganic constituents, a ≤ symbol was applied to low-concentration detections of constituents that may have been affected by contamination. The ≤ symbol means that the concentration of the constituent in the groundwater sample is less than or equal to the measured concentration (including the possibility that it may be less than the LT-MDL and, therefore, a non-detection). For trace elements, the concentration threshold for applying the ≤ symbol was determined from a statistical assessment of results for 86 field blanks collected between May 2004 and January 2008 (Olsen and others, in press). For all other inorganic constituents, the concentration threshold for applying the ≤ symbol was determined from assessment of the field blanks collected at ANT sites only. Future reports in this series will use the approach of Olsen and others (in press) for all inorganic constituents.

For trace elements, the concentration threshold for applying the ≤ symbol was equal to the concentration of the field blank ranked at the 90-percent confidence level for the 90th percentile of the binomial distribution of the 86 field blanks. For all other inorganic constituents, concentration threshold for applying the ≤ symbol was equal to the highest concentration measured in the seven field blanks collected at ANT sites. In the data tables, a ≤ symbol was put in front of measured values that were less than the threshold concentration.

Replicates

Sequential replicate samples were collected to assess variability resulting 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 (*tables A4A–D*). The RSD is defined as 100 times the standard deviation divided by the mean concentration for each replicate pair of samples. If one value in a sample pair was reported as a non-detection and the other value was reported as an estimate below the LRL or MRL, the RSD was set to zero because the values are analytically identical. If one value in a sample pair was reported as a non-detection and the other value was greater than the LRL or MRL, then the non-detection value was set equal to one-quarter of the LRL and the RSD was calculated (Hamlin and others, 2002). Values of RSD less than 20 percent are considered acceptable in this study. An RSD value of 20 percent corresponds to a relative-percent difference (RPD) value of 29 percent. High RSD values for a compound may indicate analytical uncertainty at low concentrations, particularly for concentrations within an order of magnitude of LT-MDL or MDL. Sequential replicate samples were collected at 12 percent of the wells sampled.

Matrix Spikes

Addition of a known concentration of a constituent (‘spike’) to a replicate environmental sample enables the analyzing laboratory to determine the effect of the matrix, in this case—groundwater, 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 groundwater sample is close to the MCL: a low recovery could result in a falsely measured concentration below the MCL, whereas, a high recovery could result in a falsely measured concentration above the MCL.

Acceptable ranges for matrix-spike recoveries are based on the acceptable ranges established for laboratory “set” spike recoveries. Laboratory set spikes are aliquots of laboratory blank water to which the same spike solution used for the matrix spikes has been added. One set spike is analyzed with each set of samples. Acceptable ranges for set spike recoveries are 70 to 130 percent for NWQL Schedules 2020, 4024, and 1306 (Connor and others, 1998; Rose and Sandstrom, 2003), 60 to 120 percent for NWQL Schedule 2003 (Sandstrom and others, 2001), and 60 to 130 percent for NWQL Schedule 2080 (Kolpin and others, 2002). Based on these ranges, 70 to 130 percent was defined as the acceptable range for matrix-spike recoveries for organic compounds in this study.

Matrix spikes were performed for VOCs, gasoline oxygenates and degradates, pesticides, the low-level fumigants, 1,2-dibromo-3-chloropropane (DBCP) and 1,2-dibromoethane (EDB), pharmaceuticals, NDMA, and 1,2,3-TCP because the analytical methods for these constituents are chromatographic methods that may be susceptible to matrix interferences. Replicate samples for matrix-spike additions were collected at 12 percent of the wells sampled, although not all analyte classes were tested at every well (*tables A5A–C*).

Surrogates

Surrogate compounds are added to environmental samples in the laboratory prior to analysis in order to evaluate the recovery of similar constituents. Surrogate compounds were added to all groundwater and quality-control samples that were analyzed for VOCs, gasoline oxygenates and degradates, and pesticides (*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- to 130-percent recovery of surrogates is generally considered acceptable; values outside this range indicate possible problems with the processing and analysis of samples (Connor and others, 1998; Sandstrom and others, 2001).

Quality-Control Results

Detections in Field and Source-Solution Blanks

Field and source solution blanks were collected at 12 percent of the sites sampled in ANT. Source solution blanks were analyzed only if there were detections in the field blanks. *Table A3* presents a summary of detections in field blanks (Note, two types of lines were used to collect samples; twenty-five foot lines for slow schedule samples and foot-long lines for fast and intermediate schedule samples. In order to examine the possible effects of these two different types of field equipment on blank detection results, *table A3* was divided to present slow schedule field blank detections first followed by fast and intermediate field blank detections.).

The only VOCs detected in field blanks were acetone, ethyl methyl ketone (2-butanone, MEK), and toluene. Acetone was detected in three of seven field blanks and in two associated source-solution blanks at a maximum concentration of E1.32 µg/L. Ethyl methyl ketone (2-butanone, MEK) was detected in two of seven field blanks and in one associated source-solution blank with a maximum concentration of E0.61 µg/L. Neither acetone nor ethyl methyl ketone (2-butanone, MEK) were detected in ANT groundwater samples. Toluene was detected in five of the seven field blanks at a maximum concentration of E0.02 µg/L and in six of the seven associated source-solution blank samples at a maximum concentration of E0.07 µg/L (*table A3*). Since the ranges of groundwater and source solution detections were similar, the maximum source solution blank detection of toluene was used to establish the V-code criteria. Detections of toluene in groundwater samples below 0.08 µg/L (0.07 µg/L plus one-half the LRL of 0.02 µg/L) were V-coded (*table 5*).

Field blanks were collected at 3 of 19 sites sampled for analysis of major and minor ions and trace elements (*tables 9*, *10* and *A3*). Boron and Silica were the only major or minor ions detected in lone field blanks at a concentration of 19.4 µg/L and 0.045 mg/L, respectively. However, it was discovered that a batch of blank water contaminated with boron and silica was used in the ANT study, therefore, none of the groundwater detections of boron or silica were subjected to V-coding (U.S. Geological Survey, 2008).

Three field blanks were collected for analysis of radioactive constituents. Radium-226 was detected in a single field blank at an activity of 0.028 pCi/L. Five groundwater samples had detections of radium-226 less than 0.028 pCi/L, therefore, these results were reported with a “less-than-or-equal-to” (≤) sign prior to the values to indicate they may have been affected by contamination (*tables 13A* and *A3*). No other radioactive constituents were detected in the field blank.

No compounds were detected in field blanks for the following analyte groups: pesticides and pesticide degradates (six field blanks), the low-level fumigants, 1,2-dibromo-3-chloropropane (DBCP) and 1,2-dibromoethane (EDB) (seven field blanks), perchlorate (seven field blanks), NDMA (three field blanks), 1,2,3-TCP (five field blanks), species of arsenic, chromium, and iron (three field blanks), and nutrients (three field blanks).

Variability in Replicate Samples

Tables A4A–D summarize the results of replicate analyses for constituents detected in groundwater samples collected in the ANT study. Nearly 400 replicate analyses were made for constituents detected in at least one groundwater sample. Concentrations or activities in the environmental and replicate samples are reported for all replicate analyses with RSD values greater than zero. Most replicate analyses had RSD values less than 5 percent and only 26 had RSD values greater than the acceptable limit of 20 percent. Constituents with replicate analyses with RSD values greater than 20 percent include styrene (*table A4A*), aluminum (*table A4C*), cadmium (*table A4C*), copper (*table A4C*), lead (*table A4C*), zinc (*table A4C*), chromium (VI) (*table A4C*), perchlorate (*table A4D*), radium-226 (*table A4D*), and tritium (*table A4D*). However, with the exception of one zinc replicate analysis and four perchlorate analyses, the magnitudes of the concentrations of the replicate sample pairs with RSD values greater than 20 percent were all within a factor of five of the LRLs for the respective analytes. At these low concentrations, small deviations in measured values result in large RSDs. The tritium replicate analyses were within laboratory analytical uncertainty of one another. Only four replicate analyses included one detection and one non-detection (aluminum, cadmium, copper, and tritium) and the detected concentrations were equal to or less than twice the LRLs.

Matrix-Spike Recoveries

A summary of matrix-spike recoveries for the ANT study are presented in *tables A5A–C*. Seven environmental samples were spiked with VOCs to calculate matrix-spike recoveries (*table A5A*). All 85 VOC spike compounds had recoveries within the acceptable range of 70 and 130 percent.

Six groundwater samples were spiked with pesticide and pesticide-degradate compounds in order to calculate matrix-spike recoveries. Twenty-seven of the 62 spike compounds had recoveries within the acceptable range of 70 and 130 percent (*table A5B*). Five of the six compounds detected in groundwater samples had spike recoveries within the acceptable range. Deethylatrazine (2-Chloro-4-isopropyl-amino-6-amino-*s*-triazine) had a median spike recovery of 52 percent. All of the spike compound recoveries were less than 130 percent. Thirty-five spike compounds had median recovery below 70 percent. (NOTE—low recoveries may indicate that the compound might not have been detected in some samples if it was present at very low concentrations). For samples analyzed at NWQL from approximately February 12, 2008, to August 6, 2008, for schedule 2003 a new calibration standard solution was used. Although this calibration standard was within acceptable criteria for calibration solutions, its higher-than-expected concentration resulted in lower recoveries of laboratory reagent spikes and groundwater concentrations for most compounds (*http://bqs.usgs.gov/OBSP/Quarterly_Reports_June2008/LS2033_Quarterly_Report_June2008.xls*).

Five groundwater samples were spiked with 1,2,3-trichloropropane (1,2,3-TCP) and two groundwater samples were spiked with *N*-nitrosodimethylamine (NDMA) at Weck Laboratories, Inc. All spike recoveries were within the acceptable range of 70 to 130 percent (*table A5C*).

Results for pharmaceutical compounds are not presented in this report; they will be included in subsequent publications.

Surrogate-Compound Recoveries

Surrogate compounds were added to environmental samples in the laboratory and analyzed to evaluate the recovery of similar constituents. *Table A6* lists the surrogate, analytical schedule on which it was applied, the number of analyses for blank and environmental samples, the number of surrogate recoveries below 70 percent, and the number of surrogate recoveries above 130 percent for the blank and non-blank 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.

In ANT, most surrogate recoveries were within the acceptable range of 70 to 130 percent recovery. In total, 97 percent of the surrogate recoveries for VOC and gasoline oxygenate and degradate analyses, and 98 percent of the surrogate recoveries for pesticide analyses were within the acceptable range.

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

[Laboratory entity codes in the USGS National Water Information System (NWIS) for laboratories other than the USGS National Water Quality Laboratory (NWQL) are given in parentheses after the laboratory names. VOC, volatile organic compound; HPLC, high-performance liquid chromatography]

Analyte	Analytical method	Laboratory and analytical schedule	Citation(s)
		Water-quality indicators	
Field parameters	Calibrated field meters and test kits	USGS field measurement	U.S. Geological Survey, variously dated
		Organic constituents	
VOCs	Purge and trap capillary gas chromatography/mass spectrometry	NWQL, Schedule 2020	Connor and others, 1998
Pesticides and degradates	Solid-phase extraction and gas chromatography/mass spectrometry	NWQL, Schedule 2003	Zaugg and others, 1995; Lindley and others, 1996; Madsen and others, 2003; Sandstrom and others, 2001
Gasoline oxygenates	Heated purge and trap/gas chromatography/mass spectrometry	NWQL, Schedule 4024	Rose and Sandstrom, 2003
Fumigants	Micro-extraction and gas chromatography/electron-capture detection	NWQL, Schedule 1306	Munch, 1995 (USEPA method 504.1)
Pharmaceuticals	Solid-phase extraction and HPLC/mass spectrometry	NWQL, Schedule 2080	Kolpin and others, 2002; Furlong and others, 2008
		Constituents of special interest	
Perchlorate	Chromatography/mass spectrometry	Weck Laboratories, Inc., standard operating procedure ORG099.R01	U.S. Environmental Protection Agency, 2005
N-Nitrosodimethylamine (NDMA)	Isotopic dilution chromatography/chemical ionization mass spectrometry	Weck Laboratories, Inc., standard operating procedure ORG065.R10	U.S. Environmental Protection Agency, 1989; Plomley and others, 1994
1,2,3-Trichloropropane	Isotopic dilution purge and trap/gas chromatography/mass spectrometry	Weck Laboratories, Inc., standard operating procedure ORG083	Okamoto and others, 2002
		Inorganic constituents	
Nutrients	Alkaline persulfate digestion, Kjedahl digestion	NWQL, Schedule 2755	Fishman, 1993; Patton and Kryskalla, 2003
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
Arsenic, chromium, and iron speciation	Various techniques of ultraviolet visible (UV-VIS) spectrophotometry and atomic absorbance spectroscopy	USGS Trace Metal Laboratory, Boulder, Colorado (USGST-MCO)	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 and inorganic constituents by the U.S. Geological Survey (USGS) National Water Quality Laboratory (NWQL) and additional contract laboratories.—Continued

[Laboratory entity codes in the USGS National Water Information System (NWIS) for laboratories other than the USGS National Water Quality Laboratory (NWQL) are given in parentheses after the laboratory names. VOC, volatile organic compound; HPLC, high-performance liquid chromatography]

Analyte	Analytical method	Laboratory and analytical schedule	Citation(s)
Stable isotopes			
Stable isotopes of hydrogen and oxygen in water	Gaseous hydrogen and carbon dioxide-water equilibration and stable-isotope mass spectrometry	USGS Stable Isotope Laboratory, Reston, Virginia (USGSSIVA), NWQL Schedule 1142	Epstein and Mayeda, 1953; Coplen and others, 1991; Coplen, 1994
Strontium isotopes	Chemical separations and thermal-ionization mass spectrometry	USGS Radiogenic Isotope Laboratory, Menlo Park, California	Bullen and others, 1996
Carbon isotopes	Accelerator mass spectrometry	University of Waterloo, Environmental Isotope Laboratory (CAN-UWIL); University of Arizona Accelerator Mass Spectrometry Laboratory (AZ-UAMSL), NWQL Schedule 2015	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 (USGSH3CA)	Thatcher and others, 1977
Tritium and noble gases	Helium-3 in-growth and mass spectrometry	Lawrence Livermore National Laboratory (CA-LLNL)	Moran and others, 2002; Eaton and others, 2004
Radon-222	Liquid scintillation counting	NWQL, Schedule 1369	American Society for Testing and Materials, 1998
Radium isotopes	Alpha activity counting	Eberline Analytical Services (CA-EBERL), NWQL Schedule 1262	Kreiger and Whittaker, 1980 (USEPA methods 903 and 903)
Gross alpha and gross beta radioactivity	Alpha and beta activity counting	Eberline Analytical Services, NWQL Schedule 1792	Kreiger and Whittaker, 1980 (USEPA method 900.0)

Table A2. Preferred analytical schedules for constituents appearing on multiple schedules for samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.

[Preferred analytical schedules are generally the methods of analysis with the greatest accuracy and precision out of the ones used for the compound in question except in cases where consistency with historic data analyzed using the same method is preferred. **Abbreviations:** VOC, volatile organic compound; TML, U.S. Geological Survey Trace Metal Laboratory, Boulder, Colorado; Weck, Weck Laboratories, Inc.; LLNL, Lawrence Livermore National Laboratory; SITL, U.S. Geological Survey Stable Isotope and Tritium Laboratory; np, no preference]

Constituent	Primary constituent classification	Analytical schedules	Preferred analytical schedule
Results from preferred method reported			
Acetone	VOC, gasoline additive degradate	2020, 4024	2020
tert-Amyl methyl ether (TAME)	VOC, gasoline oxygenate	2020, 4024	2020
DBCP (1,2-Dibromo-3-chloropropane)	VOC, fumigant	1306, 2020	1306
EDB (1,2-Dibromoethane)	VOC, fumigant	1306, 2020	1306
Diisopropyl ether (DIPE)	VOC, gasoline oxygenate	2020, 4024	2020
Ethyl *tert*-butyl ether (ETBE)	VOC, gasoline oxygenate	2020, 4024	2020
Methyl *tert*-butyl ether (MTBE)	VOC, gasoline oxygenate	2020, 4024	2020
Results from both methods reported			
Alkalinity	Water-quality indicator	Field, 1948	Field
Arsenic, total	Trace element	1948, TML	1948
Chromium, total	Trace element	1948, TML	1948
Iron, total	Trace element	1948, TML	1948
pH	Water-quality indicator	Field, 1948	Field
Specific conductance	Water-quality indicator	Field, 1948	Field
1,2,3-Trichloropropane (1,2,3-TCP)	VOC	Weck, 2020	Weck
Tritium	Inorganic tracer	LLNL, SITL	np

Table A3. Constituents detected in field blanks collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.

[V-coded data for groundwater samples are excluded from the dataset of groundwater quality results because the constituents were detected in blanks at similar concentrations or were determined to be a result of contamination during sample collection. **Abbreviations:** 1σ-CSU, 1-sigma combined standard uncertainty; E, estimated or having a high degree of uncertainty; nc, not collected; µg/L, microgram per liter; mg/L, milligram per liter; pCi/L, picocurie per liter; —, not detected]

Constituent	Number of field blank detections/analyses	Concentrations detected in field blanks	Number of groundwater samples V-coded or ≤-coded
Slow Schedule[1]			
Organic constituents (µg/L)			
Acetone	2/3	E1.32, E1.00	0
Ethyl methyl ketone (2-Butanone, MEK)	2/3	E0.47, E0.61	0
Toluene[2]	2/3	E0.01, E0.01	3
Inorganic constitutents			
Boron (µg/L)[3]	1/3	19.4	0
Silica (mg/L) [3]	1/3	0.045	0
Radioactive constituents (pCi/L)			
Radium-226[4]	1/3	0.028 ± 0.012 (0.016)	5
Fast and Intermediate Schedules[1]			
Organic constituents (µg/L)			
Acetone	1/4	E1.00	0
Ethyl methyl ketone (2-Butanone, MEK)	0/4	—	0
Toluene[2]	3/4	E0.02, E0.02, E0.02	23
Inorganic constitutents			
Boron (µg/L)[3]	nc	nc	nc
Silica (mg/L) [3]	nc	nc	nc
Radioactive constituents (pCi/L)			
Radium-226[4]	nc	nc	nc

[1] Twenty-five-foot lines were used to collect samples for the slow schedule while foot-long lines were used to collect samples for the fast and intermediate schedules. The summaries of the blank analyses for these two types of sampling methods are presented in this table.

[2] Toluene was detected in 6 out of 7 source solution blank samples at a maximum concentration of 0.07 µg/L. The certificate of analysis for the blank water indicated it was toluene-free. Since the range of groundwater and source solution detections were similar, the maximum source solution blank detection of toluene was used to establish the V-code criteria. This resulted in all groundwater detections of toluene being V-coded.

[3] Blank water was contaminated with boron and silica. Therefore, the boron and silica blank detections were not used to V-code groundwater detections.

[4] Radium-226 concentration is reported as the result ± 1σ-CSU (ssL_C).

Table A4A. Quality-control summary of replicate analyses of organic constituents detected in samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.

[RSD, relative standard deviation in percent; µg/L, microgram per liter]

Constituent	Number of RSDs greater than zero/ number of replicates	Maximum RSD (percent)	Median RSD (percent)	Concentrations for replicates with RSD greater than zero (environmental/replicate) (µg/L)
Volatile organic compounds and gasoline oxygenates (Schedules 2020 and 4204)[1]				
Bromochloromethane	0/7	0	0	
Bromodichloromethane	2/7	8.9	0	(E0.066, E0.075), (E0.072, E0.070)
Bromoform (tribromomethane)	0/7	0	0	
Carbon tetrachloride (tetrachloromethane)	0/7	0	0	
Chloroethane	0/7	0	0	
Chloroform (trichloromethane)	3/7	1.6	0	(0.177, 0.181), (0.241, 0.238), (0.333, 0.328)
Chloromethane	0/7	0	0	
Dibromochloromethane	1/7	10.9	0	(E0.109, E0.108)
Dibromomethane	0/7	0	0	
1,2-Dichlorobenzene	0/7	0	0	
1,3-Dichlorobenzene	0/7	0	0	
1,4-Dichlorobenzene	1/7	9.6	0	(E0.015, E0.017)
1,1-Dichloroethane (1,1-DCA)	1/7	4.5	0	(E0.044, E0.041)
1,1-Dichloroethene (1,1-DCE)	1/7	1.6	0	(E0.029, E0.030)
Methyl *tert*-butyl ether (MTBE)	0/7	0	0	
Methylene chloride (dichloromethane)	0/7	0	0	
Styrene	1/7	26.7	0	(E0.024, 0.016)
Perchloroethene (tetrachloroethene, PCE)	1/7	6.1	0	(E0.019, E0.020), (E0.028, E0.031)
Trichloroethene (TCE)	0/7	0	0	
1,2,4-Trimethylbenzene	1/7	19.5	0	(E0.027, E0.035)
Pesticides and pesticide degradates and fumigants (Schedules 2003 and 1306)[1]				
Atrazine	0/7	0	0	
Deethylatrazine (2-chloro-4-isopropyl-amino-6-amino-s-triazine)	0/7	0	0	
3,4-Dichloroaniline	0/7	0	0	
Metolachlor	0/7	0	0	
Prometon	0/7	0	0	
Simazine	2/7	6.5	0	(0.021, 0.023), (0.009, 0.010)

[1] Only detected constituents are shown.

Table A4B. Quality-control summary of replicate analyses of major and minor ions and nutrients detected in samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.

[RSD, relative standard deviation in percent; mg/L, milligram per liter]

Constituent	Number of RSDs greater than zero/ number of replicates	Maximum RSD (percent)	Median RSD (percent)	Concentrations for replicates with RSD greater than zero (environmental/replicate) (mg/L)
Major and minor ions				
Calcium	3/3	0.6	0.6	(50.2, 50.5), (54.1, 54.6), (171.7, 173.2)
Magnesium	3/3	0.8	0.6	(9.14, 9.20), (10.16, 10.24), (32.97, 32.58)
Potassium	3/3	0.8	0.7	(2.59, 2.56), (2.20, 2.22), (5.23, 5.25)
Sodium	3/3	0.4	0.3	(19.7, 19.8), (22.7, 22.8), (88.8, 89.3)
Bromide	2/3	4.5	3.0	(0.09, 0.10), (0.44, 0.43)
Chloride	1/3	0.2	0	(23.8, 23.9)
Fluoride	0/3	0	0	
Iodide	0/3	0	0	
Sulfate	1/3	0.2	0	(50.1, 50.0)
Silica	3/3	0.9	0.7	(22.8, 22.7), (24.4, 24.7), (43.1, 42.6)
Total dissolved solids (TDS)	2/3	0.9	0.7	(250, 253), (942, 949)
Nutrients and dissolved organic carbon				
Phosphorus	0/3	0	0	
Total nitrogen	2/3	3.4	1.8	(0.93, 0.98), (4.00, 3.99)
Nitrate plus nitrite	3/3	1.1	1.1	(2.82, 2.77), (0.93, 0.94), (3.91, 3.96)
Ammonia	0/3	0	0	
Nitrite	0/3	0	0	

Table A4C. Quality-control summary of replicate analyses of trace elements detected in samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.

[RSD, relative standard deviation in percent; USGS, U.S. Geological Survey; E, estimated; µg/L, microgram per liter; —, not detected]

Constituent	Number of RSDs greater than zero/ number of replicates	Maximum RSD (percent)	Median RSD (percent)	Concentrations for replicates with RSD greater than zero (environmental/replicate) (µg/L)
USGS National Water Quality Laboratory (Schedule 1948)				
Aluminum	3/3	40.2	14.6	(E0.9, —), (E1.5, 1.8), (E1.4, —)
Antimony	1/3	3.5	0	(0.23, 0.22)
Arsenic	2/3	5.2	4.2	(0.21, 0.19), (0.28, 0.27)
Barium	1/3	0.7	0.7	(62, 63)
Beryllium	0/3	0	0	
Boron	3/3	2.8	2.5	(32, 30), (73, 74), (282, 272)
Cadmium	1/3	38.4	0.0	(E0.02, —)
Chromium	2/3	1.9	1.7	(2.6, 2.5), (8.3, 8.2)
Cobalt	1/3	2.4	2.4	(E0.015, E0.014)
Copper	1/3	30.2	30	(E0.65, —)
Iron	1/3	0.6	0	(E1, —)
Lead	3/3	21.1	4.9	(0.23, 0.22), (0.46, 0.34), (E0.07, E0.06)
Lithium	2/3	5.0	3.8	(2.2, 2.4), (33.3, 31.5)
Manganese	0/3	0	0	
Molybdenum	1/3	2.5	2.5	(1.9, 1.8)
Nickel	2/3	15.9	9	(0.20, 0.26), (0.65, 0.68)
Selenium	1/3	0.4	0.4	(0.52, 0.53)
Silver	0/3	0.0	0	
Strontium	3/3	1.1	0.4	(429, 435), (505, 503), (884, 878)
Thallium	0/3	0	0	
Tungsten	1/3	2.1	2.1	(1.52, 1.56)
Uranium	2/3	0.9	0.7	(2.95, 2.93), (25.1, 24.8)
Vanadium	3/3	1.4	1.4	(7.7, 7.5), (12.6, 12.4), (11.0, 10.8)
Zinc	2/3	27.7	14.0	(1.9, 1.3), (26.9, 27.0)
USGS Trace Metals Laboratory				
Iron, total	0/3	0	0	
Iron(II)	0/3	0	0	
Arsenic, total	1/3	1	0	(6.1, 6.2)
Arsenic(III)	0/3	0	0	
Chromium, total	0/3	0	0	
Chromium(VI)	2/3	28.3	8.3	(2, 3), (8, 9)

Table A4D. Quality-control summary of replicate analyses of constituents of special interest and radioactive constituents detected in samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.

[Stable isotope ratios are reported in the standard delta notation (δ), the ratio of the abundance of a heavier isotope to the more common lighter isotope of that element, relative to a standard reference material. RSD, relative standard deviation in percent; H, hydrogen: O, oxygen; C, carbon; Sr, strontium; μg/L, microgram per liter; pCi/L, picocurie per liter; per mil, per thousand; —, not detected; <, less than]

Constituent	Number of RSDs greater than zero/number of replicates	Maximum RSD (percent)	Median RSD (percent)	Concentrations for replicates with RSD greater than zero (environmental/replicate)
Constituents of special interest (μg/L)				
Perchlorate	5/7	29.3	2.4	(0.89, 0.85), (0.55, 0.54), (0.72, 0.47), (0.25, 0.27), (0.67, 0.62)
1,2,3-Trichloropropane (1,2,3-TCP)	0/5	0	0	
N-nitrosodimethylamine (NDMA)	0/3	0	0	
Radioactive constituents (pCi/L)				
Radium-226[1]	2/3	41.6	28.3	(0.024 ± 0.011, 0.044 ± 0.012), (0.072 ± 0.015, 0.048 ± 0.014)
Radon-222	0/3	9.1	2.5	
δ^{2}H (per mil)	0/7	2.0	1.2	
δ^{18}O (per mil)	0/7	0.4	0.1	
δ^{13}C (per mil)	0/3	3.2	0.8	
Carbon-14 (percent modern)	0/3	0.6	0.1	
^{87}Sr/^{86}Sr (atom ratio)	0/3	0	0	
Tritium[2]	2/7	84.8	84.8	(1, <1), (<1, 1)

[1] Radium-226 concentrations are reported as the result ± CSU (combined standard uncertainty).

[2] Tritium concentrations <1 were assigned a value of 0.25 to facilitate RSD calculations.

Table A5A. Quality-control summary of matrix-spike recoveries of volatile organic compounds (VOCs) and gasoline oxygenates and degradates in samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.

[Acceptable recovery range is between 70 and 130 percent]

Constituent	Number of spike samples	Minimum recovery (percent)	Maximum recovery (percent)	Median recovery (percent)
Acetone [1]	7	70	105	90
Acrylonitrile	7	101	108	101
tert-Amyl methyl ether (TAME) [1]	7	93	106	99
Benzene	7	100	108	101
Bromobenzene	7	98	114	104
Bromochloromethane [2]	7	101	115	102
Bromodichloromethane [2]	7	101	113	106
Bromoform (Tribromomethane) [2]	7	93	109	100
Bromomethane (Methyl bromide)	7	104	140	119
n-Butylbenzene	7	85	105	90
sec-Butylbenzene	7	98	113	100
tert-Butylbenzene	7	100	120	104
Carbon disulfide	7	68	88	76
Carbon tetrachloride (Tetrachloromethane) [2]	7	97	114	105
Chlorobenzene	7	101	111	103
Chloroethane [2]	7	90	124	94
Chloroform (Trichloromethane) [2]	7	102	131	110
Chloromethane [2]	7	96	120	108
3-Chloropropene	7	105	129	112
2-Chlorotoluene	7	99	109	103
4-Chlorotoluene	7	98	108	102
Dibromochloromethane [2]	7	92	108	97
1,2-Dibromo-3-chloropropane (DBCP) [3]	5	90	117	99
1,2-Dibromoethane (EDB) [3]	5	94	109	103
Dibromomethane [2]	7	96	118	105
1,2-Dichlorobenzene [2]	7	97	112	105
1,3-Dichlorobenzene [2]	7	98	110	104
1,4-Dichlorobenzene [2]	7	96	111	99
trans-1,4-Dichloro-2-butene	7	98	114	104
Dichlorodifluoromethane (CFC-12)	7	70	96	76
1,1-Dichloroethane (1,1-DCA) [2]	7	102	114	105
1,2-Dichloroethane (1,2-DCA)	7	98	121	103
1,1-Dichloroethene (1,1-DCE) [2]	7	95	108	99
cis-1,2-Dichloroethene (*cis*-1,2-DCE)	7	100	119	105
trans-1,2-Dichloroethene (*trans*-1,2-DCE)	7	99	117	105
1,3-Dichloropropane	7	103	112	106
1,2-Dichloropropane	7	99	111	102
2,2-Dichloropropane	7	83	110	91
1,1-Dichloropropene	7	95	110	96
cis-1,3-Dichloropropene	7	87	108	98
trans-1,3-Dichloropropene	7	88	109	94
Diethyl ether	7	103	118	110
Diisopropyl ether (DIPE) [1]	7	100	110	106
Ethylbenzene	7	100	116	103
Ethyl *tert*-butyl ether (ETBE) [1]	7	92	115	110
Ethyl methacrylate	7	94	107	100
o-Ethyl toluene (1-Ethyl-2-methyl benzene)	7	96	109	98
Hexachlorobutadiene	7	73	94	82
Hexachloroethane	7	93	113	97
2-Hexanone (*n*-Butyl methyl ketone)	7	91	114	98
Iodomethane (Methyl iodide)	7	67	119	107

Table A5A. Quality-control summary of matrix-spike recoveries of volatile organic compounds (VOCs) and gasoline oxygenates and degradates in samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.—Continued

[Acceptable recovery range is between 70 and 130 percent]

Constituent	Number of spike samples	Minimum recovery (percent)	Maximum recovery (percent)	Median recovery (percent)
Isopropylbenzene	7	97	114	102
4-Isopropyl-1-methyl benzene	7	95	113	97
Methyl acrylate	7	99	108	104
Methyl acrylonitrile	7	103	109	107
Methyl *tert*-butyl ether (MTBE)[1,2]	7	102	114	106
Methyl iso-butyl ketone (MIBK)	7	93	114	102
Methylene chloride (Dichloromethane) [2]	7	96	107	101
Methyl ethyl ketone (2-Butanone, MEK)	7	88	107	95
Methyl methacrylate	7	93	106	99
Naphthalene	7	100	117	105
n-Propylbenzene	7	93	103	98
Styrene [2]	7	49	103	95
1,1,1,2-Tetrachloroethane	7	100	117	106
1,1,2,2-Tetrachloroethane	7	94	109	103
Perchloroehtene (Tetrachloroethene, PCE) [2]	7	96	113	105
Tetrahydrofuran	7	104	114	105
1,2,3,4-Tetramethylbenzene	7	98	121	105
1,2,3,5-Tetramethylbenzene	7	105	125	109
Toluene [2]	7	99	107	103
1,2,3-Trichlorobenzene	7	100	114	104
1,2,4-Trichlorobenzene	7	93	109	96
1,1,1-Trichloroethane (TCA)	7	98	115	107
1,1,2-Trichloroethane	7	98	112	107
Trichloroethene (TCE) [2]	7	98	108	100
Trichlorofluoromethane (CFC-11)	7	92	131	106
1,2,3-Trichloropropane (1,2,3-TCP)	7	97	116	103
Trichlorotrifluoroethane (CFC-113)	7	86	102	87
1,2,3-Trimethylbenzene	7	103	119	109
1,2,4-Trimethylbenzene [2]	7	100	114	103
1,3,5-Trimethylbenzene	7	98	110	99
Vinyl bromide (Bromoethene)	7	97	111	101
Vinyl chloride (Chloroethene)	7	102	116	107
m- and *p*-Xylene	7	99	113	101
o-Xylene	7	98	114	103

[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 groundwater samples.

[3] Constituents on schedules 2020 and 1306; only values from schedule 1306 are reported because it is the preferred analytical schedule.

Table A5B. Quality-control summary of matrix-spike recoveries of pesticides and pesticide degradates in samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.

[Acceptable recovery range is between 70 and 130 percent; *, median recovery percent outside of acceptable recovery range]

Constituent	Number of spike samples	Minimum recovery (percent)	Maximum recovery (percent)	Median recovery (percent)
Acetochlor	6	68	100	81
Alachlor	6	71	103	84
Atrazine [1]	6	78	104	84
Azinphos-methyl	6	55	85	*58
Azinphos-methyl-oxon	6	25	58	*37
Benfluralin	6	40	67	*47
Carbaryl	6	69	102	74
2-Chloro-2,6-diethylacetanilide	6	69	101	80
4-Chloro-2-methylphenol	6	49	90	*69
Chlorpyrifos	6	58	71	*60
Chlorpyrifos oxon	6	9	53	*12
Cyfluthrin	6	43	52	*44
Cypermethrin	6	39	50	*44
Dacthal (DCPA)	6	84	105	91
Deethylatrazine (2-Chloro-4-isopropylamino-6-amino-*s*-triazine) [1]	6	38	86	*52
Desulfinylfipronil	6	64	89	83
Desulfinylfipronil amide	6	69	93	76
Diazinon	6	69	93	80
3,4-Dichloroaniline [1]	6	69	100	84
Dichlorvos	6	49	77	*57
Dicrotophos	6	12	39	*25
Dieldrin	6	71	145	96
2,6-Diethylaniline	6	73	108	87
Dimethoate	6	31	66	*36
Ethion	6	55	82	*62
Ethion monoxon	6	57	85	*63
2-Ethyl-6-methylaniline	6	73	108	89
Fenamiphos	6	66	98	79
Fenamiphos sulfone	6	62	80	*68
Fenamiphos sulfoxide [2]	6	—	—	—
Fipronil	6	60	83	*62
Fipronil sulfide	6	50	75	*67
Fipronil sulfone	6	42	65	*61
Fonofos	6	62	92	74
Hexazinone	6	36	77	*53
Iprodione	6	30	66	*48
Isofenphos	6	69	98	71
Malaoxon	6	34	58	*47
Malathion	6	59	90	*68
Metalaxyl	6	71	102	79
Methidathion	6	69	109	83
Metolachlor [1]	6	74	95	81
Metribuzin	6	59	97	73
Myclobutanil	6	66	96	75
1-Naphthol	6	14	31	*20
Paraoxon-methyl	6	21	41	*32
Parathion-methyl	6	52	80	*58
Pendimethalin	6	61	86	*66
cis-Permethrin	6	38	57	*42
Phorate	6	46	79	*62
Phorate oxon	6	63	97	*68

Table A5B. Quality-control summary of matrix-spike recoveries of pesticides and pesticide degradates in samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.—Continued

[Acceptable recovery range is between 70 and 130 percent; *, median recovery percent outside of acceptable recovery range; —, not detected]

Constituent	Number of spike samples	Minimum recovery (percent)	Maximum recovery (percent)	Median recovery (percent)
Phosmet	6	7	24	*10
Phosmet oxon	5	3	20	*6
Prometon [1]	6	61	102	74
Prometryn	6	71	95	82
Propyzamide	6	66	101	78
Simazine [1]	6	71	112	77
Tebuthiuron	6	75	123	81
Terbufos	6	53	92	*64
Terbufos oxon sulfone	6	37	60	*44
Terbuthylazine	6	78	105	88
Tribufos	6	43	59	*46
Trifluralin	6	49	77	*57

[1] Constituents detected in groundwater samples.

[2] Constituent not spiked.

Table A5C. Quality-control summary of matrix-spike recoveries of *N*-nitrosodimethylamine (NDMA) and 1,2,3-trichloropropane (1,2,3-TCP) in groundwater samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.

[Acceptable recovery range is between 70 and 130 percent]

Constituent	Number of spike samples	Minimum recovery (percent)	Maximum recovery (percent)	Median recovery (percent)
1,2,3-Trichloropropane (1,2,3-TCP)	5	108	119	114
N-nitrosodimethylamine (NDMA)	2	100	106	103

Table A6. Quality-control summary for surrogate recoveries of volatile organic compounds (VOCs), gasoline oxygenates and degradates, pesticides and pesticide degradates in samples collected for the Antelope Valley Groundwater Ambient Monitoring and Assessment (GAMA) study, California, January to April 2008.

[VOC, volatile organic compound]

Surrogate	Analytical schedule	Constituent or constituent class analyzed	Number of analyses	Median recovery (percent)	Number of surrogate recoveries below 70 percent	Number of surrogate recoveries above 130 percent
		Blanks				
1-Bromo-4-fluorobenzene	2020, 4024	VOC, gasoline oxygenate	14	91	0	0
1,2-Dichloroethane-*d*4	2020, 4024	VOC, gasoline oxygenate	14	111	0	0
Isobutyl alcohol-*d*6	4024	Gasoline oxygenate	10	97	0	0
Toluene-*d*8	2020, 4024	VOC, gasoline oxygenate	14	98	0	0
Diazinon-*d*10	2003	Pesticide	6	60	4	0
α-HCH-*d*6	2003	Pesticide	6	79	0	0
		Groundwater, replicate, and matrix-spike test samples				
1-Bromo-4-fluorobenzene	2020, 4024	VOC, gasoline oxygenate	90	92	0	0
1,2-Dichloroethane-*d*4	2020, 4024	VOC, gasoline oxygenate	90	114	0	12
Isobutyl alcohol-*d*6	4024	Gasoline oxygenate	46	98	0	0
Toluene-*d*8	2020, 4024	VOC, gasoline oxygenate	90	98	0	0
Diazinon-*d*10	2003	Pesticide	76	65	45	0
α-HCH-*d*6	2003	Pesticide	76	80	1	0

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