Ground-Water Ambient Monitoring and Assessment Program

What is the Ground-Water Ambient Monitoring and Assessment Program (GAMA)?

The GAMA program is a comprehensive assessment of statewide ground-water quality. The program is designed to help better understand and identify risks to ground-water resources. Ground water will be sampled at many locations across California in order to characterize its constituents and identify trends in ground-water quality. The results of these tests will provide information for water agencies to address a variety of issues ranging in scale from local water supply to statewide resource management.

The GAMA program was developed in response to the Ground-Water Quality Monitoring Act of 2001 (Sections 10780-10782.3 of the Water Code): a public mandate to assess and monitor the quality of ground water used as public supply for municipalities in California. The goal of the act was to improve statewide ground-water monitoring and facilitate the availability of information about ground-water quality to the public. The State Water Resources Control Board is implementing the GAMA Program in coordination with the U.S. Geological Survey and Lawrence Livermore National Laboratory.

Who is GAMA?

Stewardship of the State's ground-water resources is a shared responsibility between all levels of the government and community. Participants include representatives from California Water Boards, Department of Water Resources, Department of Health Services (DHS), U.S. Geological Survey (USGS), Lawrence Livermore National Laboratory (LLNL), and county and local water management authorities. A key aspect of the GAMA program is interagency collaboration and cooperation with local water agencies and well owners. Local participation in the GAMA program is entirely voluntary.

Why is GAMA Important?

The GAMA program is important because the data collected during the study include analyses for chemical constituents that are not normally available; these data will be especially useful for providing an early awareness of changes in water-quality. The data also will be used to identify the natural and human factors affecting ground-water quality. An understanding of these factors is important for the long-term management and protection of California's ground-water resources.

Radon sampling in Temecula, California.

What Will Participants Gain from the GAMA Program?

The GAMA program will provide many benefits to State, local, and community participants. The program will

- provide agencies with knowledge of ground-water trends that may be useful in long-term water-quality management, and planning for municipal growth;
- improve the understanding of local, regional, and statewide hydrogeology;
- establish baseline ground-water conditions for comparison with future ground-water analyses;
- identify emergent constituents in ground water;
- determine ground-water age and recharge conditions to aid in ground-water recharge characterization;
- produce summary data reports and interpretive reports of ground-water quality for each study unit;
- create a secure ground-water database as an archive and a tool for completing ground-water assessments;
- provide agencies with better information to respond to concerns of consumers and consumer-advocate groups;
- help agencies evaluate basin-wide or regional ground-water management objectives;
- unite local, regional, and statewide ground-water programs in a common effort to understand and manage ground-water resources effectively; and
- facilitate communication between Federal, State, and local agencies.

Study Approach

For the purposes of this study, the 476 identified ground-water basins and subbasins in California were ranked in order of sampling priority on the basis of the number of public-supply wells, ground-water usage, and potential sources of ground-water contamination (for example leaking underground fuel tanks, and pesticide applications) in each basin (Belitz and others, 2003). The GAMA program combines the highest priority basins into 35 study units. In each study unit, 60 to 120 public-supply wells will be sampled to provide a spatially-unbiased assessment of raw ground-water quality within the study unit, as well as a statistically-consistent basis for comparing water quality in different study units.

Three types of water-quality assessments will be conducted for each study unit:

(1) Status: the assessment of current ground-water quality;

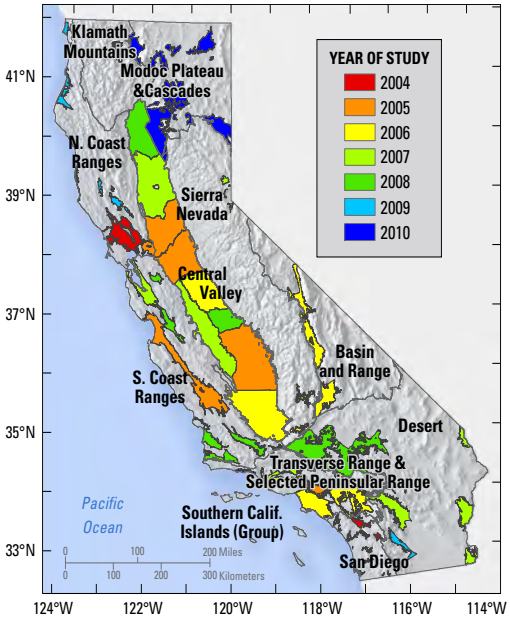
(2) Trends: the detection of changes in water quality; and

(3) Understanding: the assessment of natural and human factors that affect ground-water quality.

These assessments will integrate existing water-quality data (such as DHS public-supply well water-quality data), with data collected specifically as part of this study. In addition, the GAMA program will monitor a much broader suite of constituents, at much lower detection limits, than required by DHS. Samples will be analyzed for chemical constituents that include major ions, trace elements, nutrients, volatile organic compounds, pesticides, and pharmaceuticals, to define the quality of water in the ground-water basins (table 1). Naturally occurring isotopes (tritium, carbon-14, and helium-4) also will be measured in these samples to help identify the source and age of the sampled ground water (table 1). A tiered analytical approach will be used to balance spatial coverage and analytical intensity (number of constituents analyzed).

GAMA Program Results Reporting

The GAMA program is committed to facilitating interagency communication and data sharing. Informational meetings will be held for each study unit. Preliminary results will be discussed with participants at local ground-water assessment "Wrap-Up" meetings. The State Water Board and USGS will post summary data reports and ground-water interpretive reports on the program internet web-sites. Prior to the public release of any data or reports, the State Water Board and the USGS will consult with local water agencies and well owners to ensure that information is communicated in an appropriate manner.



For more information

Technical reports and hydrologic data collected for the GAMA program may be obtained from:

GAMA Project Chief
U.S. Geological Survey
California Water Science Center
4165 Spruance Road, Suite 200
San Diego, CA 92101
Telephone number: (619) 225-6100

GAMA Program Unit
State Water Resources Control Board
Division of Water Quality
PO Box 2231
Sacramento, CA 95812
Telephone number: (916) 341-5250

SWB: www.waterboards.ca.gov/gama/
USGS: http://ca.water.usgs.gov/gama/

References:

Belitz, Kenneth, Dubrovsky, Neil M., Burow, Karen, Jurgens, Bryant, and Johnson, Tyler, 2003, Framework for a ground-water quality monitoring and assessment program for California: U.S. Geological Survey Water-Resources Investigations Report 03-4166, 78 p.

California State Water Resources Control Board, 2003, Report to the Governor and Legislature: A Comprehensive Ground-water Quality Monitoring Program in California, 100 p.

Table 1. List of Analytes

Sampled Constituents	Why are They of Interest?
Specific conductance	The ability of a water sample to transmit an electrical current, which is related to the salinity of the water
Alkalinity, pH, and dissolved oxygen	The cation and anion activity, and oxygen concentration in water. These properties affect the mobility of dissolved chemical compounds
Temperature	Temperature can influence the concentration of dissolved gases (e.g. oxygen, nitrogen, carbon dioxide) in water
Major and minor ions	Naturally occurring elements that influence water quality
Nutrients	Elevated concentrations of compounds (e.g. nitrogen, phosphorous) can degrade water quality
Dissolved organic carbon (DOC)	DOC compounds impact water chemistry (O_2 concentrations and pH), biological productivity and trihalomethane formation
Trace elements	Naturally occurring elements, in low concentrations, define water characteristics and affect water quality
Chromium (total and VI)	Naturally occurring and industrial element that can degrade water quality
Isotopes, radioactivity	Naturally occurring atoms and radioactivity used to track water movement and may degrade water quality at high concentrations
Tritium (^3H)	Isotope of hydrogen used to identify water masses less than 50 years of age
Noble Gases	Dissolved gases used to trace ground-water movement, for chronology, and to indicate climate change
Stable isotopes $\delta^{18}O$, δD	Naturally occurring isotopes of oxygen and hydrogen used to track water through the hydrologic cycle
Radon (Rn)	A naturally occurring radioactive gas which, at high levels, can cause health problems such as lung cancer
Radium (Ra)	A naturally occurring radioactive element that is present in varying amounts in the Earth's crust
Volatile organic compounds (VOCs)	Anthropogenic compounds including solvents, gasoline additives, and organic synthesis products that can degrade water quality
Methyl tert-Butyl Ether (MTBE)	A compound added to gasoline to improve air quality. At high concentrations it can degrade water quality
Perchlorate (ClO_4^-)	Anthropogenic compound recently identified as a potential water-quality concern
N-nitrosodimethylamine (NDMA)	A byproduct of water treatment from the reaction of dimethylamine and chloramines which can degrade water quality
Pesticides	Used to control weeds, insects, and other pests and can degrade water quality
Wastewater indicators	Commonly used compounds (e.g. caffeine, fragrances, insect repellents) that can enter ground water from the discharge of treated wastewater
Pharmaceutical products	Medicinal compounds that can enter ground water from discharge of treated wastewater, recycled water, or reclaimed water
Coliphage and *Escherichia coli* (*E. coli*)	Used as microbial indicators of fecal pollution