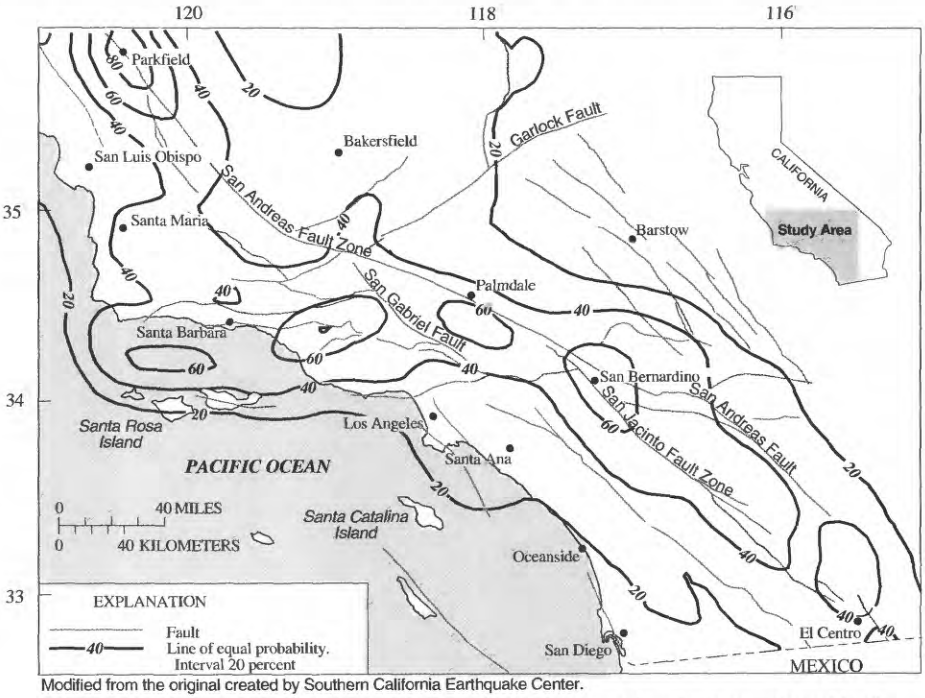
Fact Sheet

United States Geological Survey
Programs in California

The USGS provides maps, reports, and information to help others meet their needs to manage, develop, and protect America's water, energy, mineral, and land resources. We help find natural resources needed to build tomorrow, and supply scientific understanding needed to help minimize or mitigate the effects of natural hazards and environmental damage caused by human activities. The results of our efforts touch the daily lives of almost every American.

The U.S. Geological Survey (USGS) has been mapping and studying earth resources in California for more than 100 years. During that time, the State population has grown from less than 1 million to more than 30 million, thus putting ever-increasing demands on these resources. As a result, there has never been a more important time to map, describe, and understand the conditions and processes that affect California's use of water, minerals and the geologic foundation on which we all live.

Many population centers are in areas of natural hazards, including earthquakes, floods, landslides, and mudflows. Population growth, combined with industrial and agricultural development in arid and semiarid regions of the State, have stressed California's surface- and groundwater resources. The information produced by the USGS is used by public and private organizations and individuals to understand and make better decisions on these issues of concern throughout California and the Nation. USGS information is available to all.



Modified from the original created by Southern California Earthquake Center.

Figure 1. Lines of equal probability, in percent, of earthquake-caused earth movement capable of significant damage in the next 30 years; these lines represent a measure of risk.

Natural Hazards

The USGS is perhaps most recognized by Californians for its identification and characterization of earthquake-related hazards. Earthquakes pose a severe threat to life and property in California where one or more major earthquakes are expected to strike metropolitan centers within the next decade. Floods, landslides, and mudflows are facts of life in California and, like earthquakes, can be anticipated and prepared for by studying and interpreting the Earth's history and processes.

Earthquakes

Most major population centers in California are in seismically active areas, yet none of the earthquakes that have struck in the past few decades approach the maximum magnitude anticipated for these areas. The principal threat from earthquakes is the damage or collapse of buildings, or of infrastructure—bridges, overpasses, roads, railways, and water, power, and communication lines. The USGS works in collaboration with the California Department of Conservation, Division of Mines and Geology (CDMG), statewide and the California Institute of Technology and the Southern California Earthquake Center in southern California, to collect ground-motion data used to produce regional risk-assessment maps that provide estimates of the probability of significant ground movement (fig. 1). Combined with other geologic information, the data are used to produce hazard maps for ground shaking, landslides, and liquefaction (the temporary change of a saturated soil or fill to a liquid with the loss of support strength for structures). These hazard maps are a basis for building codes and land-use zoning. The CDMG is producing integrated hazard-zone maps with geologic and seismic information; these were mandated to be used by local governments in regulated land-use decisions that can reduce loss of life and property damage.

The level of seismic safety in California results from efforts made by local, State, and Federal agencies; universities; and the private sector. As part of this comprehensive task, USGS scientists provide valuable scientific information to public and private organizations that develop building codes and zoning regula-

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tions. The California level of safety compares favorably with other earthquake-prone parts of the world. For example, a 1988 earthquake in Armenia (magnitude 6.8) resulted in a loss of 25,000 to 30,000 lives, but the larger 1989 Loma Prieta earthquake (magnitude 7.1) in the San Francisco area caused only 67 deaths.

Floods

Floods are a constant concern for much of California, and flood forecasting is an essential part of flood management. The ability to predict flood frequency and magnitude depends on long-term, widespread, continuous flow records at many sites. The USGS, in cooperation with Federal, State, and about 140 local water agencies, operates or reviews data from about 1,000 surface-water stations throughout California. The data collected are used to design programs for flood protection that are demonstrated to have measurable, effective and economically sound benefits. Strategically located gaging stations equipped with automatic recording instruments are connected to computerized flood-warning systems. Water levels, precipitation, and other data can be accessed by computer from anywhere.

Landslides and Mudflows

Landslides and mudflows are common events in California because of active mountain-building processes, rock characteristics, earthquakes, and intense storms. More than 10,000 landslides were triggered by the 1994 Northridge earthquake. By using earthquake information and geologic data bases, USGS scientists are creating a computer-generated landslide-hazard map of the Los Angeles area. This map shows the slopes most likely to fail in future earthquakes. In the San Francisco area, a 1982 storm triggered more than 18,000 landslides and debris flows, which resulted in 25 fatalities. To prevent future loss of life, a public warning system was developed by the USGS in cooperation with the National Weather Service. It has been activated during large storms, most recently in January 1995. The identification of areas likely to produce landslides in conjunction with earthquakes or severe storms enables the public, urban planners, and the private sector to address these conditions as part of any future development.

Resources Assessments

Water Resources

Historically, the quantity and distribution of water has been a central issue in California because most of the water is used by agriculture and municipalities in the semiarid areas of the State. Statewide, agriculture dominates developed water use—more than 80 percent of the total. Increasingly, however, the protection and restoration of surface- and ground-water quality are becoming major objectives. The USGS is assessing the quantity and quality of water resources throughout California, especially in the Central Valley, the San Francisco Bay/Sacramento–San Joaquin Delta system and the urban and agricultural areas of southern California (fig. 2).

The USGS has been evaluating surface- and ground-water resources in the Central Valley for more than a century. Building on this base, the USGS is conducting large-scale studies in the Central Valley to describe the status of and trends in the quality of the surface- and ground-water resources and to provide a scientific understanding of the primary natural and human factors that affect the quality of these resources. These projects, which are parts of the National Water-Quality Assessment Program, are being conducted with the cooperation and assistance of Federal, State, and local agencies; private interest groups; and other interested parties. These groups participate in advisory committees that provide historical and current information and guidance on the priorities for studies and reports.

Bay/Delta System

The San Francisco Bay/Sacramento–San Joaquin Delta system has been greatly modified by human activity. During the past 150 years, 95 percent of the tidal wetlands have been leveed and filled for development or have been converted to agricultural use. Freshwater flows into San Francisco Bay have been markedly reduced, especially during spring, because of the export of water for agricultural and urban uses to central and southern California. At the same time, water and sediment have been adversely affected by contamination from the dredging and disposal of dredge spoils, sewage discharges, and nonpoint-source urban and agricultural runoff. The biological communities also have been contaminated and greatly modified.

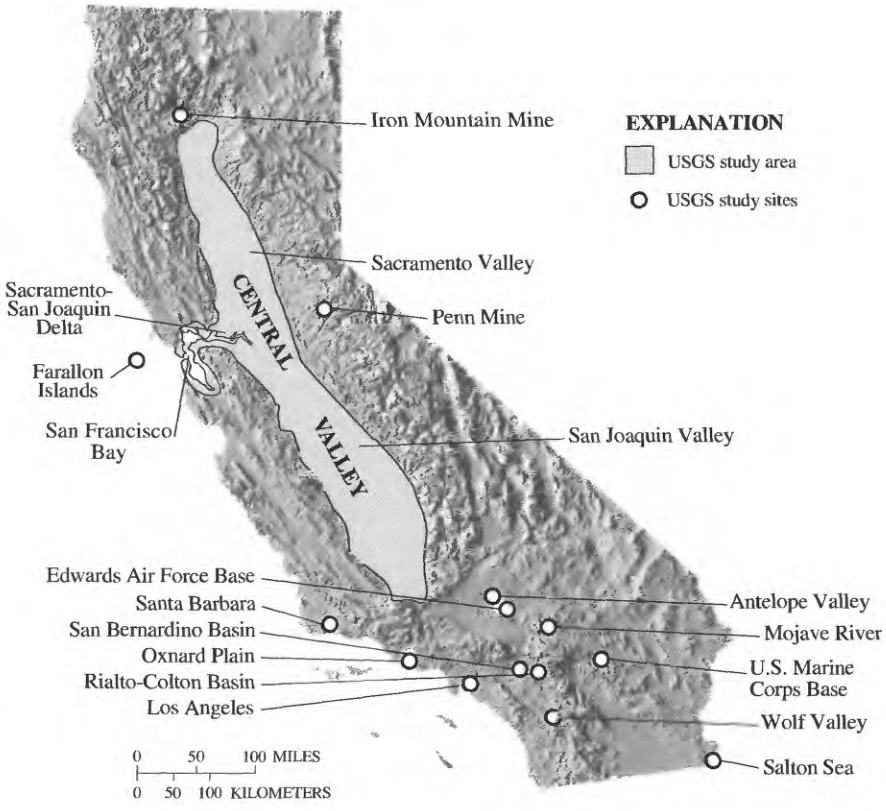

Figure 2. Selected U.S. Geological Survey water-resources study areas, California.

The USGS, as part of a cooperative effort sponsored by the U.S. Environmental Protection Agency (USEPA), involving 14 Federal, State, and local public and private organizations, is addressing some of these issues. USGS scientists directly measure water circulation, salt transport, and the movement of dissolved and sediment-bound contaminants within the Bay/Delta system. Wetland studies are evaluating the functioning of pristine wetlands and the changes that have occurred during the past 150 years. The results of these studies will provide a better understanding of specific causes of biological and water-quality problems in the Bay/Delta system and will be used to reestablish functional tidal wetlands in the Bay area. For example, USGS studies of trace metals in the aquatic food chain have identified specific biologic processes and geologic factors affecting Bay water quality.

Marine Wastes

Wastes generated by land-based human activities have been relocated to the ocean floor off the California coast. In one instance, 47,800 containers of low-level radioactive waste were dumped on the continental margin between 1946 and 1970, many in the Farallon Islands, which is a National Marine Sanctuary. The USGS, in cooperation with several Federal agencies, has developed computer-enhanced sidescan images to locate drums and other objects. Similar techniques also are used to characterize the deep-ocean areas that may be used as disposal sites for spoil material dredged from San Francisco Bay. The results of this USGS work also can be used by environmental, military, and fisheries-management agencies locally and elsewhere to manage waste-disposal problems and by the fisheries industry to identify areas critical to fish populations.

Marine sediment on the continental shelf south of Los Angeles is contaminated with DDT and PCB's from past sewage-effluent discharges. USGS scientists, in cooperation with Federal and State agencies, have identified the distribution and character of the effluent-affected sediment body and have modeled its natural recovery over the next century. This information will be used to develop and evaluate long-term management options for the contaminated sediments.

Water Management

Throughout southern California's hydrologic basins, complex and conflicting issues exist that need to be considered in managing water resources. Because locally derived water supplies are limited, much of the water supply is imported from northern California, the Colorado River, and the Owens Valley. Aquifers provide important storage capacity for water derived from imported and local sources. Increasingly, water-management agencies are concerned with meeting demand for potable water and are seeking ways to make better use of existing and future supplies. The USGS is conducting a wide range of studies that constitute a comprehensive approach to integrated watershed management, including surface- and ground-water resources. The use of reclaimed wastewater for ground-water recharge and irrigation is one area of study. The USGS, in cooperation with the Water Replenishment District of Southern California, is evaluating the effects of a pilot recharge project on ground-water quality in the Los Angeles area. The results will assist water-resource managers to develop water-quality criteria for artificial ground-water recharge by using reclaimed wastewater and to identify specific characteristics of recharge sites that contribute to contaminant reduction.

Saltwater Intrusion

Intensive ground-water pumping in coastal areas has contributed to saltwater intrusion in a number of areas. In Ventura and Santa Barbara Counties the USGS is investigating the potential for seawater intrusion into coastal aquifers. Ground-water models are used with optimization techniques to develop management strategies for controlling seawater intrusion and accommodating water demands. Water managers are using study results to modify recharge, pumping, and pipeline delivery practices to manage water resources more effectively.

Water Banking

In parts of San Bernardino and Riverside Counties, water-management agencies are anticipating large increases in demand for water supplies early in the next century. The USGS, in cooperation with local water-management agencies, is engaged in a number of studies designed to characterize hydrogeologic conditions in areas that appear to have good potential for water banking (recharging ground-water systems for future pumping) or where ground-water quality may be subject to degradation from land-use practices or other causes. The study results will provide a bases for water-management agencies to improve ground-water management practices. In the San Bernardino Valley, the USGS is developing an optimum water management plan that deals with combined use of surface and ground water, control of water levels in an urban area subject to liquefaction during a major earthquake, and containment of ground-water pollutants from two USEPA Superfund sites. Computer models of the surface- and ground-water systems were combined to operate the basin and to meet various and often conflicting objectives. When fully developed and operational, the optimum water-management program will be useful to water-management agencies for developing sound ground- and surface-water-resource-management plans.

The Mojave Desert region is one of the most rapidly growing areas in California. As a result, water is becoming more scarce, and ground-water resources are frequently pumped at rates far exceeding their natural recharge. The USGS, in cooperation with the Mojave Water Agency, is investigating the surface- and ground-water relations along the Mojave River, which is the principal source of ground-water recharge. The results of the study can help the Mojave Water Agency and other water-management agencies to manage ground-water resources more efficiently by planning artificial recharge in areas that can store water most effectively for future pumping.

Mapping

USGS quadrangle maps provide the only continuous mapping coverage of California and the Nation at a scale adequate to show major buildings and infrastructure components and every road, creek, and political boundary, all precisely registered to a topographic base represented by contour lines. This coverage includes 3,289 maps at a scale of 1:24,000 and is in continuous revision. These maps are used for many different purposes and are essential for most resources studies to provide accurate location of study sites. The USGS is cooperating with California's Teale Data Center to reproduce these maps for computer use. The resulting digital maps will be on emergency service agencies' computers for use during earthquake or fire emergencies and for search and rescue. Other organizations also will have access to these digital USGS maps in plotting other information and in geographic information systems to address many issues. Instruction in geography, geology, and other subjects in California's schools will be enhanced by computerized maps and other digital information.

Geologic Resources

The USGS, in cooperation with the California Department of Conservation, Division of Mines and Geology (CDMG), conducts geologic mapping activities throughout California for the production and dissemination of geologic information to all levels of government, the private sector, and the general public. Mapping programs involve many government agencies and are linked to research projects at various universities. The USGS and the CDMG are producing geologic maps at a scale of 1:100,000, thus improving on the present statewide coverage at the 1:250,000 scale. Field mapping is conducted at a scale of 1:24,000; these maps are being produced for areas with special interests, including various geologic hazards, specific properties, fault zones, and mineral resources. In addition, maps are being produced that provide three-dimensional representations of geologic structures, such as subsurface connections of parallel faults. There also are maps that represent geologic changes, such as repeated volcanic eruptions. Mapped geologic information is computerized; this allows maps to be updated as new information is available and facilitates the production of customized maps for individual needs. As an example, the Southern California Areal Mapping Project has completed more than fifty 1:24,000-scale maps, five 1:100,000-scale regional geology maps, and a number of more-specialized maps.

Historical Urban Extent

Computerized maps of historical urbanization in the San Francisco–Sacramento region were created to show the extent and pace of urbanization (fig. 3). These maps are being used to illustrate the relation among urbanization, water and air quality, and the changing risks of earthquakes, mudflows, and fire over time. A model that is based on these relations is being calibrated. The model can help resource managers project future growth and be used to anticipate and plan California's future development. In the San Francisco Bay area, the USGS is producing computerized digital orthophotos as part of the Smart Valley, which is a public–private partnership. This high-resolution photo base map shows features as small as a few feet across and will be the basis for a Bay area digital geographic resource. Cities and businesses can use these photo maps and the analytical tools provided to meet environmental control requirements. As an example, cities using these maps and information will be able to target opportunities for stormwater pollution reduction more accurately.

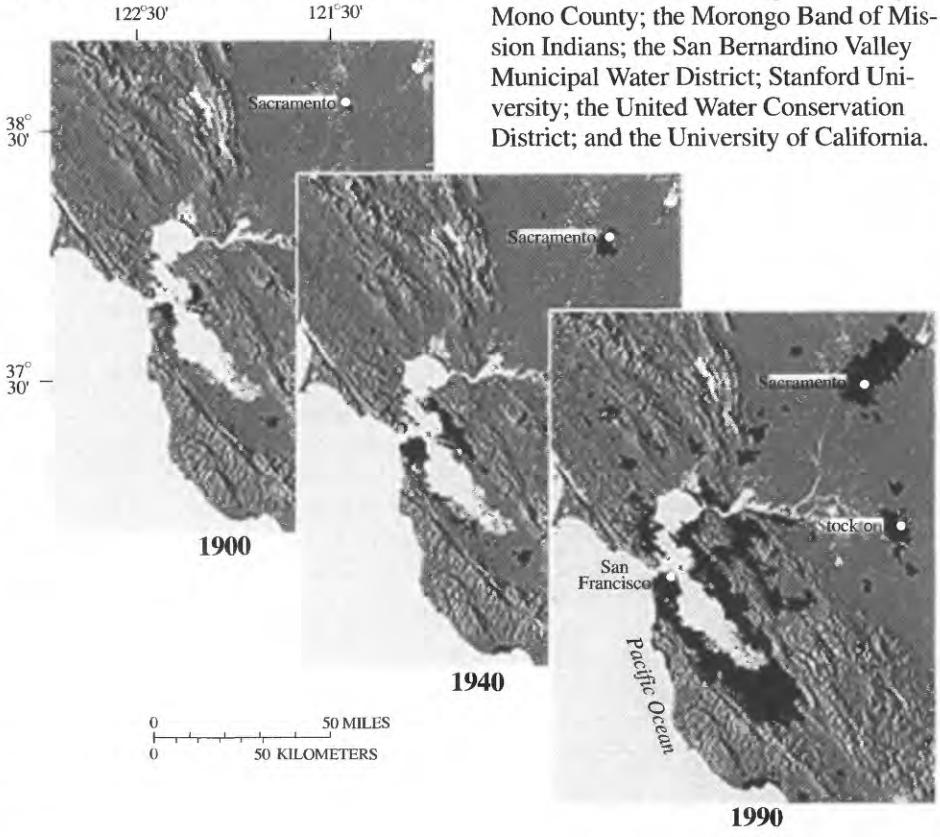

Figure 3. The extent of urban land use in the San Francisco/Sacramento region, 1900 to 1990, was mapped using historical USGS quadangle maps and satellite images. This illustrates the rapid post-war growth and expansion into the Central Valley.

Partnerships

The work of the USGS is pursued in partnership with many State and local agencies. Examples of a few of these agencies not referenced above are the California Departments of Water Resources and Transportation; the Water Resources Control Board; the Antelope Valley–East Kern Water Agency; the city and county of San Francisco; the Coachella Valley Water District; the East Bay Municipal Utility District; the Eastern Municipal Water District; the Los Angeles County; Mono County; the Morongo Band of Mission Indians; the San Bernardino Valley Municipal Water District; Stanford University; the United Water Conservation District; and the University of California.

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California Earthquake Home Page
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For more information on all USGS reports and products (including maps, images, and computerized data), call 1-800-USA-MAPS.

Additional earth science information can be found by accessing the USGS "Home Page" on the World Wide Web at "http://www.usgs.gov".

U.S. Department of the Interior
U.S. Geological Survey
Fact Sheet FS-005-95