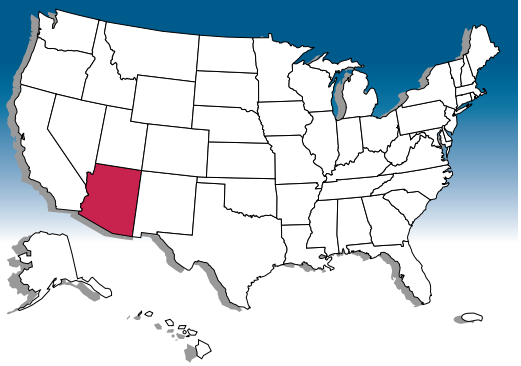
U.S. Geological Survey Programs in Arizona



U.S. Department of the Interior ■ U.S. Geological Survey

Collecting, analyzing, and disseminating earth science information to solve problems that concern the natural resources of the Nation has been an integral part of the USGS mission since its creation in 1879. A long tradition of providing accurate and impartial information to everyone underscores our continued dedication to "Earth Science in the Public Service."

Water and Mineral Data

Streamflow data are needed for water-rights issues (compacts, court decrees, and adjudications), flood-plain management, bridge design, water supply, reservoir operations, and flood warning. The U.S. Geological Survey (USGS), in cooperation with State, local, and other Federal agencies, operates 234 streamflow-gaging stations in Arizona and provides data to those agencies, utilities, and irrigation districts that actively manage the storage and release of water. At 110 of these stations, streamflow data are relayed by satellite (fig. 1) to a USGS computer in Tucson and can be accessed by agencies in near real time for immediate water-management decisions. The importance of the streamflow network was demonstrated during the floods of January and February 1993 when streamflow data from satellite telemetry were used by the Bureau of Reclamation (BOR) and the Salt River Project (SRP) to manage storage and releases from the reservoir systems along the Verde, the Salt, and the Gila Rivers.

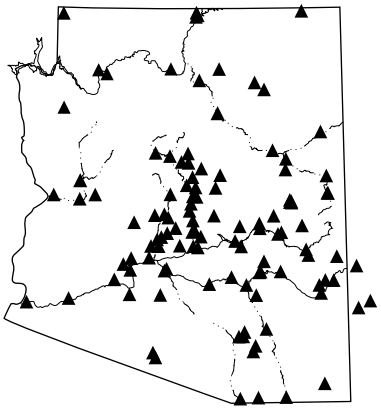


Figure 1. Streamflow data-collection network.

The USGS also collects data on minerals in Arizona. As a result of the North American Free Trade Agreement, the USGS is developing cooperative projects with Mexican counterparts to inventory and assess the quantity and quality of mineral resources in the border area between Arizona and Sonora, Mexico. This information is vital to land-management agencies, regional planners, industries, and local governments that are responsible for ensuring adequate mineral supplies.

Topographic Mapping

Among the most popular and versatile products of the USGS are its 1:24,000-scale topographic maps (1 inch on the map represents 2,000 feet on the ground). These maps depict basic natural and cultural features of the landscape, such as lakes and streams, highways and railroads, boundaries, and geographic names. Contour lines are used to depict the elevation and shape of terrain. Arizona is covered by 1,968 maps at this scale, which are useful for civil engineering, land-use planning, natural-resource monitoring, and other technical applications. These maps have long been favorites with the general public for outdoor uses, including hiking, camping, exploring, and back-country hunting and fishing expeditions.

National Water-Quality Assessment

In 1993, the USGS initiated a regional assessment of water quality in central Arizona and northern Mexico. The purpose of the study is to describe the status and trends in the quality of Arizona's major ground- and surface-water resources (fig. 2) and to provide a better understanding of the factors that affect water quality. The study area encompasses 34,700 square miles and includes a population of more than 3.1 million people. The Pro-

Index of Subjects

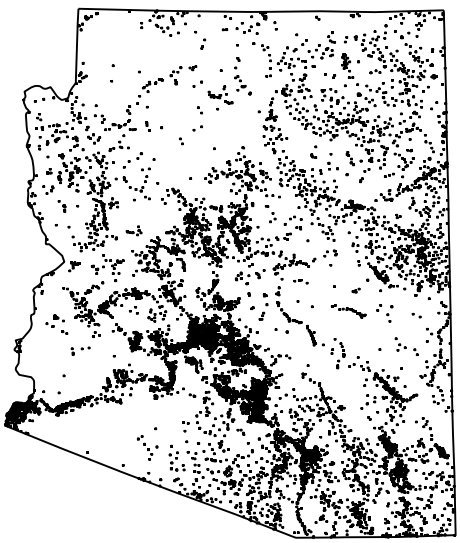


Figure 2. Water-quality data-collection sites in Arizona.

gram focuses on pesticides; nutrients, such as nitrates and phosphates; volatile organic compounds; and aquatic ecology. Data are being collected during the sampling phase from 1996 to 1998.

Sediment Resources in Grand Canyon National Park

In Grand Canyon National Park (fig. 3), operations of Glen Canyon Dam are affecting recreational use of sand bars, changing riverine habitat for plants and animals, and threatening a loss of archeological sites. The dam has reduced the sediment supply to the Grand Canyon and decreased the magnitude and frequency of floods that rebuild sand bars and transport coarse debris. Understanding the effects of regulated flows on the physical and biological systems along the Colorado River downstream from the dam is the objective of a series of studies which began in 1982. The studies, being conducted by or in cooperation with contractors, universities, federal and state agencies, and Indian tribes, will provide managers with a scientific basis for optimizing dam operations.

USGS studies show that low, moderately fluctuating flows through the dam transport sand, brought to the canyon by tributaries downstream from the dam, through the canyon along the channel bed. These low flows also allow the build up of coarse debris that can affect the navigability of the river. A test of controlled flood releases in the spring of 1996 showed that enough sand is available from tributaries downstream from the dam to rebuild sand bars, and that controlled floods can redistribute recently-deposited coarse debris. The USGS is developing a series of computer models to describe the deposition and erosion processes in the Grand Canyon. These models will make it possible to simulate different operational plans for the dam, and to predict their effects on sediment resources in the canyon.

Water Resources of the Upper San Pedro River Basin

The San Pedro River in southeastern Arizona has perennial flow along much of its length, from its headwaters near Cananea in Sonora, Mexico, to its confluence with the Gila River at Winkleman. The San Pedro River includes the site of the first National Riparian Conservation Area established by the Bureau of Land Management (BLM). The area (fig. 3) is habitat for diverse plants and animals, some of which are threatened or endangered; a vital flyway for migrating birds; and the basis of the substantial ecotourism industry in the area.

Ground-water withdrawals associated with population growth in Cochise County and the city of Sierra Vista may decrease streamflow in the upper San Pedro River and, thus, adversely affect the riparian corridor. These withdrawals also may complicate the adjudication of water rights that involve Native American Tribes. Subsidence and the development of earth fissures are other features that may result from lowering of the water table.

USGS geologists, hydrologists, and geophysicists are working to determine the three-dimensional subsurface shape of the San Pedro Basin, to estimate the character and distribution of the basin-fill sediments, and to obtain objective data on the amount of ground water stored in basin aquifers and on the connection between these aquifers and the river. The geological and geophysical studies are currently (1996) focused in the upper San Pedro Valley between Cananea and Benson.

To date, geologic mapping is being conducted north of Cananea. New geophysical data in Arizona have defined two northwest-trending subbasins beneath the upper San Pedro Valley. The Palominas Subbasin is about 2,300 meters deep, and the Huachuca City Subbasin is about 1,100 meters deep. They are separated by an east-trending buried ridge beneath Sierra Vista.

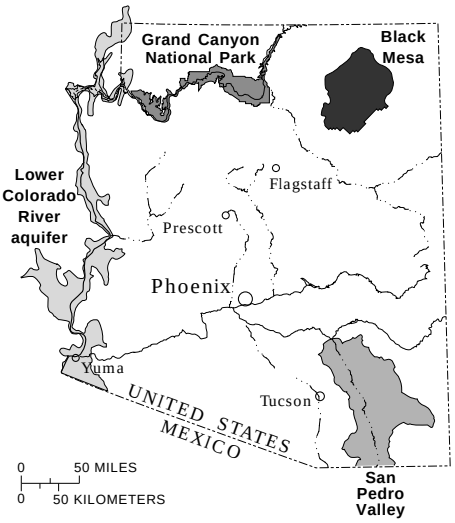


Figure 3. Selected project areas.

These data obtained in the USGS investigations are essential to all the parties involved in discussions on water usage in the San Pedro Valley, including the cooperating agencies—the BLM, the BOR, the U.S. Army, the Arizona Department of Water Resources, the University of Arizona, the Arizona Geological Survey, the San Pedro Technical Advisory Committee, The Nature Conservancy, and Cochise County.

Revised Maps of Phoenix

The USGS has started a 1:24,000-scale series mapping revision/replacement project for the 41 maps that cover Phoenix and the surrounding area. Existing maps are being updated to reflect recent urban growth and ground subsidence. The project is part of the USGS program for replacement mapping in areas of critical need, such as those with rapid urban growth.

To date, aerial photographs have been acquired for the area and high-accuracy surveys have been completed in partnership with the U.S. Department of Commerce, National Geodetic Survey. The USGS is evaluating additional cartographic-control requirements that are necessary for compiling new maps. Once analyzed, these data provide critical information that concerns the location and magnitude of subsidence in the Phoenix area.

Mineral-Resource and Mineral-Environmental Assessment of the Prescott National Forest

At the request of the U.S. Forest Service, the USGS is conducting mineral-resource and mineral-environmental assessments of the 1.2-million-acre Prescott National Forest. The forest is centered around the rapidly growing city of Prescott and borders the developing Verde and Chino Valleys in central Arizona. It includes or is close to current and historic

mining districts that have made significant contributions to the Nation's mineral wealth. The forest and surrounding areas continue to attract commerce, recreation, and mineral exploration. Recent economic development and growth around the forest have placed demands on water resources and industrial materials within the forest and have created conflicting views on future mining.

In 1994, the USGS began a project to assess the mineral resources of the forest and to evaluate the historic and current environmental hazards associated with mining. These studies considered a variety of point sources, including old mines, recent mines, mills, and smelters; desert, semiarid, and montane climatic regimes; and several geologic settings. Geochemical studies of mining and smelting sites in the Prescott/Jerome area have determined the probable dispersion into and possible natural mitigation of toxic metals by the environment.

The USGS has completed mineral resource assessments of the Kaibab, the Coronado, and the Coconino National Forests. These assessments have become part of the basic data used for management planning for these National Forest areas.

Accounting for Consumptive Use of Lower Colorado River Water

The Colorado River Compact of 1922 requires the participation of the USGS and the BOR to monitor flow and estimate consumptive use of water from the Colorado River. The U.S. Supreme Court Decree of 1964, Arizona v. California, is specific about the responsibility of the Secretary of the Interior to account for the consumptive use and distribution of water from the lower Colorado River in Arizona, California, and Nevada. Domestic, municipal, and industrial consumptive uses of water pumped from wells are components of the water budget; therefore, accounting for consumptive use from all these wells provides an estimate and distribution of consumptive use by vegetation to agricultural users. The identification of wells outside the flood plain that yield water that will be replaced by water from the river is based on the concept of a river aquifer and an “accounting surface” within the river aquifer. The “accounting surface” provides a uniform criterion of identification based on hydrologic principles for all users that pump water from wells. Accounting for the consumptive use of Colorado River water requires the identification of all points of withdrawal of water; however, this accounting is incomplete because the location of all wells is unknown. Cooperative work continues with the BOR to inventory all wells completed in the river aquifer so they can be included in the water-accounting process.

Trace Metals Related to Mining

Trace-metals and radionuclides in water and sediments from mining is a possible hazard for the people and environment of Arizona. Copper has been mined near Globe since 1903. In 1984, the USGS, in cooperation with the Arizona Department of Health Services and the SRP, initiated a study of ground-water quality. The study focuses on the geochemical processes that control trace-metal movement in ground-water systems. An understanding of the processes that control trace-metal movement obtained during this ongoing study may be useful in other areas of the United States.

Water, Mineral, and Energy Resources on Indian Reservations

The desert environment, drought, continued growth, and planned development are placing increasing demands on the water and mineral resources and complicating the adjudication of water rights for Native American Tribes throughout Arizona. The diversion of surface flows, pumpage of ground water, and degradation of water quality from agriculture, urbanization, and mining have decreased the amount of usable water in a region where water is scarce.

The USGS is involved in data collection and interpretive studies on 10 reservations in Arizona that will assess the quantity and quality of the Tribes’ water resources, provide an understanding of the hydrologic system, and determine how activities in a basin could divert streamflow and ground water and affect water quality. The results from this work will help the Tribes plan growth and economic development.

The Black Mesa coal field in northeastern Arizona is a major producer of coal for powerplants in the Southwestern United States. Production from this field is a major source of revenue for the Navajo and the Hopi Tribes. The USGS study of the Black Mesa, in cooperation with the Tribes, outlines the distribution of coal, determines the geologic controls on coal thickness and distribution, estimates the amount of coal that is economically recoverable, and analyzes the composition of coal. Both Tribes can use the results of this study to aid in resource inventories, land-use planning, and predicting environmental effects of coal use.

The Tohono O’Odham Nation is supporting a study to measure streamflow in which an array of sensors are buried in transects across an unstable sand channel of a large ephemeral wash. This installation of sensors should significantly decrease missing records and improve the accuracy of records of surface inflow to the Nation’s lands at the Mexican border.

Geologic Information Centers

The National Geomagnetic Information Center (NGIC), which is located in Golden, Colorado, provides magnetic data to the scientific community and the general public over a commercial telephone network. The USGS operates 11 magnetic observatories across the United States, 1 of which is located in Tucson. Data from these observatories are used to prepare nautical and aeronautical navigation charts, by the Federal Aviation Administration to update magnetic headings on runways and airports and by other users to improve the accuracy of ground-level base data for satellite and airborne surveys. Information from the NGIC also is used to help power companies understand and plan for power-system failures caused by high-frequency magnetic variations. An Earth Science Information Center, operated by the USGS and the Arizona Geological Survey, is located in Tucson.

Geochemistry of the Patagonia Mountains

The Patagonia Mountains are the most highly mineralized part of the Coronado National Forest but have seen little large-scale mining development. For this reason, the area (fig. 4) is a unique laboratory in which to study the natural effects of mineralizing processes on rocks, water, and vegetation in arid environments. USGS scientists are beginning studies to measure naturally occurring levels of metals in rocks, stream sediments, water, and vegetation and to determine their mobility, bioavailability, and leachability in this arid environment. Samples of surficial materials are analyzed and compared with drill core data from the Red Mountain porphyry copper deposit, which is in the Patagonia Mountains.

The results of this work provide the data on which to base remediation expectations and standards as new mining operations are undertaken. Appropriate and effective remediation standards will ensure the availability of materials, such as copper, that are critical to the Nation's industrialized economy and, at the same time, ensure the continued safety of drinking water and water-based recreational sites that surround the mountain range.

United States/Mexico Border

Arizona is one of four States involved in U.S./Mexico border mapping activities. The USGS is working with Federal, State, and local agencies and other organizations in the United States and Mexico to develop digital-map data for a 100-mile zone on each side of the border. The USGS is obtaining color infrared aerial photography for the zone on the U.S. side of the border. From these aerial photographs, the USGS produces digital orthophotoquads that are used to revise maps and data bases to support studies by scientists and government agencies that deal with the environment and resource management.

Cooperative Programs

Work is pursued in partnership with numerous State, local, and tribal agencies, as well as Mexican agencies. A few examples not referenced above are the Flood Control District of Maricopa County, the Pima County Department of Transportation and Flood Control District, the city of Tucson, the White Mountain Apache Tribe, and Consejo Recursos Minerales. The USGS provides support to the Arizona Water Resources Research Institute, which conducts research, education, and information and technology transfer.

Figure 4. The creek drains a small prospect and tailings pile. Location is downstream from 3-R mine. The photograph was taken December 6, 1994

For More Information

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

For more information on all USGS reports and products (including maps, images, and computerized data), call **1-800-USA-MAPS**

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

U.S. Geological Survey
Fact Sheet FS-003-96