

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

The U.S. Geological Survey (USGS) has been assessing, mapping, and reporting on Utah's earth resources for more than 100 years. Ongoing USGS programs in Utah include topographic and geologic mapping, surface- and ground-water data collection, geochemical and biological investigations of lakes and rivers, mineral exploration, and assessments of water-quality, hydrologic, and geologic conditions, including earthquakes and floods. The USGS contributes to the health, safety, and economic well being of Utah's citizens through each of these programs and in cooperative efforts with State, local, and Federal agencies, universities, and other public organizations.

These unbiased data, which span more than 100 years, are used by many agencies and local entities within the State to manage current water allocations and to make informed decisions when planning for future demands on the limited water resource. Data from the USGS also are used to improve bridge design for flood conditions and to help in the design of storm-run-off systems in urban environments.

Surface- and ground-water and water-quality data collected by the USGS are compiled and published in a series of annual reports that describe the hydrologic conditions in the State for each water year. Since 1964, the USGS, in cooperation with the

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Water-Data Collection and Monitoring Networks

The USGS has been collecting hydrologic data that relates to the occurrence, quantity, and quality of water resources in Utah since 1889. The USGS maintains a network of about 200 gaging stations on rivers, streams, lakes, and reservoirs in Utah, as well as in adjacent parts of Wyoming, Idaho, and Arizona and monitors about 1,100 wells throughout the State (fig. 1). Within this network, water-quality samples are collected at 15 surface-water sites and about 185 wells. Additional water-quality samples are collected throughout Utah as part of investigative studies in which the hydrology of specific areas is examined.

The USGS maintains a publicly accessible computerized data base with information that relates to more than 2,000 surface-water and 22,000 ground-water sites throughout Utah as well as adjacent parts of Wyoming, Idaho, and Arizona. In Utah, 37 streamflow-gaging stations are equipped with satellite data-collection platforms. The data are used by water managers to monitor and allocate water to those who hold water rights and by commercial rafting companies to plan river trips. These data also are available to the public on the World-Wide Web at:

<http://www.dutslc.wr.usgs.gov/>

Utah Department of Natural Resources, also has published annual reports that detail the changes in ground-water conditions throughout the State. The reports contain information on well construction, ground-water withdrawals, water use, water-level changes, and related changes in precipita-

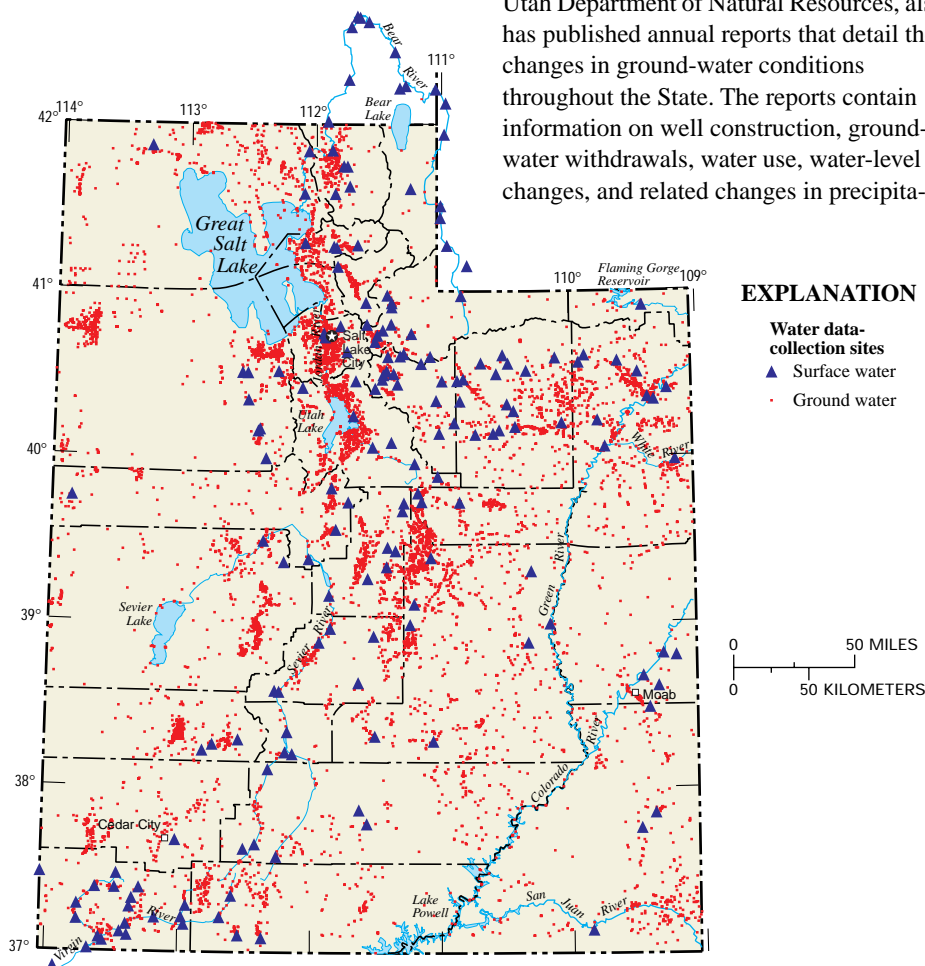


Figure 1. Surface- and ground-water data-collection sites.

tion, streamflow, and the chemical quality of water. Included in the annual report are maps that show ground-water-level contours during a specified period of time and that allow interested parties to keep abreast of changing ground-water conditions in local areas.

National Water-Quality Assessment Program

In 1991, the USGS began implementing a full-scale National Water-Quality Assessment (NAWQA) Program. The long-term goals are to describe the status and trends in the quality of a large representative part of the Nation's surface- and ground-water resources and to provide a sound, scientific understanding of the primary natural and human factors that affect the quality of these resources. In meeting these goals, the NAWQA produces a wealth of water-quality information that is useful to policymakers and managers at Federal, State, and local levels.

A major design feature of the NAWQA Program enables integration of water-quality information at different areal scales. The basic buildingblock of the NAWQA Program is the study-unit investigation. The 60 study-unit investigations that make up the NAWQA Program are hydrologic systems that include principal river basins and aquifer systems throughout the Nation. These study units cover areas from less than 1,000 to more than 60,000 square miles and incorporate about 60 to 70 percent of the Nation's water use and population served by public water supply.

In 1993, assessment activities began in the Great Salt Lake Basins NAWQA study unit. Most of the 14,500-square-mile Great Salt Lake Basins study is in Utah but also includes areas in Idaho and Wyoming (fig. 2). The study area encompasses three major river systems that enter Great Salt Lake—the Bear, the Weber, and the Jordan. The study area includes Utah's three largest cities (the Salt Lake City metropolitan area, Ogden, and Provo) and about 1.4 million people, or 85 percent of the population of the State.

Communication and coordination among the USGS and water-management and other water-resource agencies are key components of the Great Salt Lake Basins NAWQA study unit in the State. The projects distribute findings in a variety of

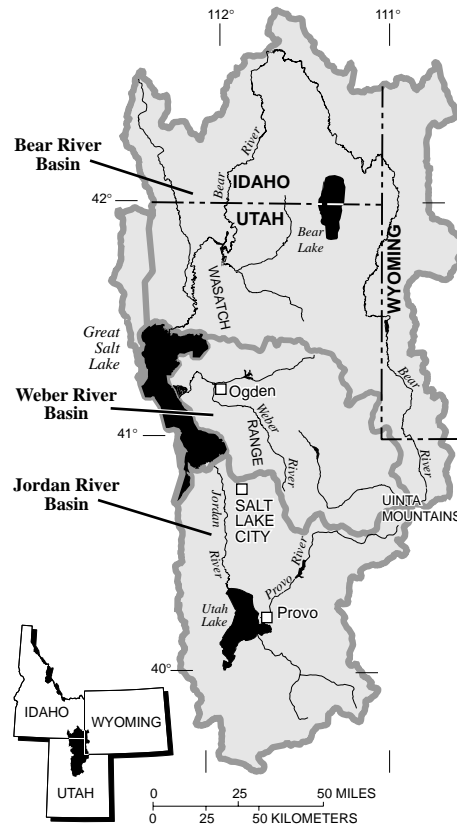


Figure 2. Great Salt Lake Basins National Water-Quality Assessment study area.

reports to local, State, and Federal agencies as results become available.

Owing to budget restraints in the NAWQA Program in 1994-95, however, the assessment activities in the Great Salt Lake Basins as well as four other NAWQA study units were curtailed. The 1996 budget for the NAWQA Program includes funding to restart assessment activities in the Great Salt Lake Basins study unit.

Mineral-Resource Assessments of the Great Basin Province

The Great Basin Province, which occupies the western one-third of Utah, contains the majority of commercial mineral deposits of the State and has the greatest potential for mineral deposits that remain to be discovered. The USGS, in collaboration with the Utah Geological Survey, has had a continuing program of regional and local mineral-resource assessments. The collaborative work has resulted in updating and compilation of mineral-resource information throughout the Province, these are valuable long-term data bases for governmental agencies and private industry. In addition, many new geologic maps have been pro-

duced at various scales for supporting multipurpose land-management evaluations. Preliminary mineral-resource assessments have been completed for the Tooele and the Cedar City 2-degree quadrangles, a final assessment has been completed for the Richfield quadrangle, and an assessment of the Delta quadrangle is nearing completion. During studies for the Delta project, USGS scientists identified a previously unrecognized volcanic feature, which is apparently related geologically to the Tintic mining district; this has prompted renewed mineral industry exploration interest in Utah.

Saline Water Source Identification

The most widespread contaminant of ground and surface waters in Utah is saline water. Increases in the salinity of water in some parts of the Navajo aquifer in southeastern Utah have been documented in recent years by the USGS. Oil is produced in this part of Utah, and saline ground water, which is produced with the oil (referred to as "oil-field brine") and later injected into the subsurface to enhance oil recovery, was considered to be the most probable cause for the increase in salinity of water in the Navajo aquifer, according to previous studies. Additional possible sources of saline water include water from the underlying aquifer and brines not associated with oil deposits (referred to as "non-oil-field brine").

Beginning in 1989, the USGS, with guidance from the Aneth Technical Committee, began collecting and interpreting geochemical data from ground-water samples in the study area to determine the possible origin(s) of saline water that could be mixing with the fresh ground water in the Navajo aquifer. Represented on the Aneth Technical Committee were the Bureau of Reclamation; the Bureau of Land Management; the U.S. Environmental Protection Agency; the Bureau of Indian Affairs; Texaco Exploration and Production, Inc.; Mobil Exploration and Producing U.S., Inc.; Phillips Petroleum, Inc., Utah Division of Oil, Gas, and Mining; the Navajo Environmental Protection Administration; the Navajo Nation Water Resources Management Department; and the USGS.

The geochemical (bromide-chloride and iodide-chloride ratios) and isotopic data from the study area were combined with hydrologic data and mixing models to improve understanding of the source of saline water. Results from this study indicate

that the injected oil-field brines are not the source of saline water to the Navajo aquifer as was previously thought. Instead, the geochemical data consistently indicate that saline water from the underlying aquifer is the probable source that increases the salinity of water in the Navajo aquifer. The application of these geochemical data and techniques in demonstrating that injected oil-field brines are not the source of increased salinity precludes the possibility of devoting considerable financial resources to unnecessary remediation.

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 natural and cultural features of the landscape, such as lakes and streams, highways and railroads, boundaries, and geographic names. Utah is covered by 1,537 maps at this scale. These maps have long been favorites with the general public for outdoor uses and scientists and engineers for conventional technical applications.

Today, scientists and engineers depend increasingly on digital (computerized) base maps for their research and analyses. The USGS is working to ensure the availability of accurate digital cartographic data for the Nation to facilitate ground-water and hazards studies and land- and resource-management activities.

Mapping Partnerships

The USGS and the State of Utah Automated Geographic Reference Center (AGRC) are entering into a partnership to complete the digitizing of 1:24,000-scale maps that cover the State. The USGS provides financial assistance to the AGRC to contract for digital line graph (DLG) production for placement in the public domain. DLG data are especially valuable to State and local agencies for land and resource management.

The USGS and the Utah AGRC also have entered into agreements for the production of digital orthophotoquad (DOQ) coverage of Wasatch, Uintah, Cache, Utah, and Washington Counties. A DOQ is a digital image of an aerial photograph in which displacements caused by the camera and the terrain have been removed. It combines the image characteristics of a photograph with the geo-

metric qualities of a map. DOQ data are especially valuable to State and local agencies for growth analysis, identification of land parcels, and environmental quality studies.

Earth Science Information Center Consolidation

The USGS Earth Science Information Center (ESIC), Salt Lake City Office, is now colocated with the U.S. Forest Service (USFS) Geometronics Service Center which is a national facility for USFS mapping and geospatial data development. The national ESIC network provides information about the USGS and its programs, products, and technological developments and distributes USGS and other public domain maps and charts, digital data, and earth science publications and reports.

The National Spatial Data Infrastructure Competitive Cooperative Agreements Program

The Competitive Cooperative Agreements Program (CCAP) was established by the Federal Geographic Data Committee (FGDC) through the USGS to help form data-sharing partnerships with the non-Federal sector. This program provides funding to State and local government agencies, academia, and the private sector to encourage resource-sharing projects through the use of technology, networking, and interagency coordination.

Supported by the CCAP, the State of Utah AGRC works with participating Federal, State, and local agencies throughout the State to develop interfaces that will make their data available as part of the National Spatial Data Infrastructure (NSDI). The project involves establishing multiple NSDI clearinghouse nodes through the Internet, documenting existing geographic and cartographic data by using the FGDC metadata standard, developing easy-to-use tools to access clearinghouse data, and conducting training for agencies that are considering adopting the FGDC standards.

Geologic Mapping

The STATEMAP component of the National Cooperative Mapping Program funds important geologic mapping in several areas of Utah. The mapping is focused on land-

use planning and mitigation of earthquake and other geologic hazards.

The corridor of rapid population growth along Interstate I-15 from Cedar City through St. George and adjacent communities is often subjected to landslides, slumps, and rockfalls, which move rocks down weak, unstable slopes. On September 2, 1992, visitors at Zion National Park and local residents at Springdale were reminded of these slides when a magnitude 5.8 earthquake (epicenter, 8 miles southeast of St. George) reactivated a past landslide, blocked State Highway 9 into the park, and cut electrical power and telephone lines into the Park. Structures built on the slide area were damaged as they slid downhill with the slide. These landslides can be reactivated by periods of prolonged or heavy rainfall. This particular landslide had a history of moving after such rainy periods. Fortunately, past landslides can be readily identified from geologic maps of landslide-prone areas.

Maps also are needed to aid in developing mineral-resource sites, locating wastewater-disposal sites, and defining flood-prone areas. The USGS, in a cooperative geologic mapping program with the Utah Geological Survey, is finishing a series of geologic maps along the I-15 corridor that particularly emphasize geologic hazards. These maps include texts that specifically address geologic hazards, such as potential flooding, earthquake epicenters, active faults, and resultant landslides and rockfalls. Counties and municipalities use this information to aid in zoning decisions that can minimize potentially expensive damage to private and public buildings and roads.

Ground-Water Movement in Salt Lake Valley

Salt Lake Valley is the main population, economic, and industrial center in Utah. Maintenance of an adequate supply of water suitable for domestic use is one of the most important factors in sustaining the current population and in allowing for continued economic growth. Water managers need detailed information on the occurrence and potential movement of poor-quality ground water to anticipate and prevent migration of this water to points of withdrawal and to manage development of the ground-water system better.

The USGS, in cooperation with the Utah Department of Natural Resources, the Utah Department of Environmental Quality, and

For More Information

local water managers completed a study that describes the chemical composition of ground water in Salt Lake Valley and the movement of poor-quality ground water near selected points of withdrawal. As part of the study, a computer model of the ground-water flow system in the Valley was constructed and used to evaluate the movement of ground water in the vicinity of hypothetical wells. The model, combined with other software, was used to define zones of the aquifer that contribute water (capture zones) to the hypothetical wells. By defining capture zones of wells located near areas of poor-quality or contaminated ground water, the potential effects of current and future ground-water development on the quality of water withdrawn by those wells can be predicted.

The ground-water flow model is currently being used by local municipalities and water districts to evaluate the direction and rate of flow to more than 100 supply wells in the valley. The model and the results of the USGS study also will provide water managers in Salt Lake Valley with a tool to evaluate the potential effects of development on other aspects of the hydrologic system, including ground-water levels and rates of ground-water flow to streams.

Great Salt Lake Brine Shrimp

Brine shrimp in Great Salt Lake are a primary source of food for migratory birds and an economically valuable resource for Utah. Brine shrimp in Great Salt Lake have been harvested as adults since 1950 and as eggs since 1952. Harvest of the cyst form of shrimp egg has expanded dramatically, increasing from about 265 pounds in 1968 to more than 3 million pounds in 1994, virtually replacing the harvest of adult brine shrimp. The retail value of the egg harvest varies from about \$30 million to \$90 million per year, and the rapid increase in egg harvest has increased concerns that both the food resource and the economic resource may be damaged by continued harvest at these greater levels.

Although much is known about brine shrimp, very little is known about the shrimp population and the biotic and abiotic conditions in Great Salt Lake. The USGS, in cooperation with the Utah Division of Wildlife Resources and Utah State University, is conducting a study of the population structure for the shrimp at various times of the year and the dynamics of the algal food

source for the shrimp. The study includes collection of shrimp, egg, and algal data throughout the year and measurements of changing physical and chemical conditions in the lake, including nutrients, light quality and penetration, temperature, dissolved oxygen, and salt concentration. The program is designed to develop a consistent and reproducible protocol for the collection and analysis of biotic and abiotic variables that interact to determine the health and reproductive capacity of the brine shrimp population.

Cooperative Programs

The USGS supports an extensive variety of cooperative programs designed to assist State and local governments in answering critical natural-resource questions. These efforts frequently involve multi-State and multiagency cooperation and are an important aspect of many local, State, and Federal programs (fig. 3). Cooperative activities include water-resources data collection, interpretive water-availability and water-quality studies, biological sampling, mineral-resource assessments, earthquake and hazards monitoring, and mapping efforts.

Reports published as a result of these cooperative efforts serve as records for future reference and study. Many early USGS maps and reports are valuable sources of historical information and continue to be referenced in public and private-sector investigations.

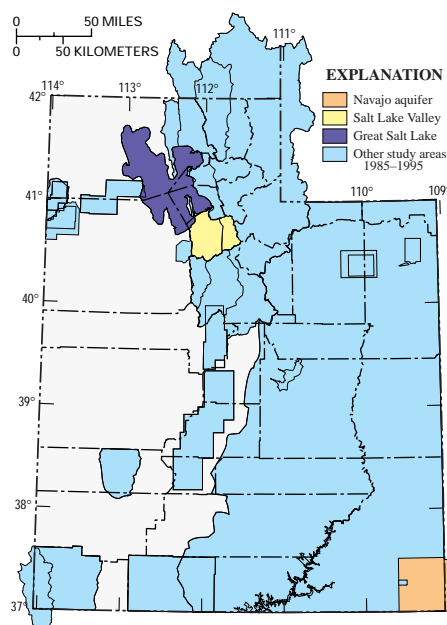


Figure 3. Location of recent cooperative studies.

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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.

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