

New Mexico

Middle Rio Grande Basin Study

The Middle Rio Grande Basin, the area within the Rio Grande Valley extending from Cochiti Dam downstream to San Acacia, is the focus of a 5-year study by the U.S. Geological Survey (USGS) and other agencies to improve understanding of the area's water resources. The Santa Fe Group aquifer is the main source of municipal water. The New Mexico Office of the State Engineer manages the water resources in the basin and has declared the basin a "critical basin"—a ground-water basin faced with rapid economic and population growth for which technical information about the available water supply is inadequate. The study began in 1995, and it is scheduled to be completed in 2000. Additional information can be found at <http://rockyweb.cr.usgs.gov/mrgrb/>.

Ground-Water Studies

Projects are underway to improve understanding of how water enters and moves through the aquifer. Recharge where streams and arroyos enter the basin is being estimated by methods such as changes of ground-water temperature with aquifer depth, chemical tracer studies, laboratory examination of core samples, and streamflow measurements at multiple reaches. Environmental tracers are being used to trace and date water moving through the aquifer (fig. 1). Ground-water temperature profiles of water in wells installed near the Rio Grande are being used to determine the volume of water passing between the river and the aquifer. Electromagnetic surveys of the inner valley of



Figure 1. Collecting water samples for environmental tracers from the Rio Grande north of Albuquerque.

the Rio Grande were done to help map the extent of clay layers beneath the riverbed that retard recharge to the aquifer from the river.

Hydrogeologic Framework

The USGS, in cooperation with the New Mexico Bureau of Mines and Mineral Resources (NMBMMR) and faculty and students at the University of New Mexico and the New Mexico Institute of Mining and Technology, is studying the basin's hydrogeologic framework. Geologic mapping of more than 35 1:24,000-scale quadrangles is being done in cooperation with the NMBMMR. Stratigraphic studies of Santa Fe Group sedimentary units (fig. 2) include description of depositional environments and age and grain-size analysis. Depositional environments and grain size influence the permeability of rocks that make up the aquifer. Faults are studied in detail to determine the amount and timing of horizontal displacement and their effect on depositional patterns in the Santa Fe Group.

Geophysical techniques are providing important information about the structure of the basin and the sedimentary units that compose the aquifer. Among those techniques are airborne high-resolution magnetic (fig. 3) and electromagnetic surveys and ground-based gravity and electromagnetic surveys. These surveys have successfully identified faults that offset the Santa Fe Group and rock properties that control potential aquifer yield.

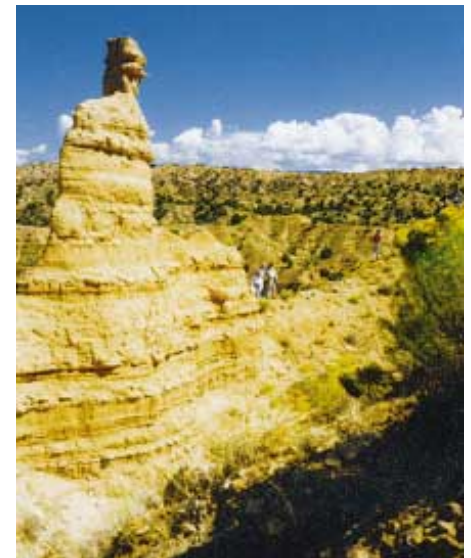


Figure 2. Exposed sedimentary units of the Santa Fe Group.

Urbanization

In 1990, 89 percent (502,100) of the basin's residents lived in the Albuquerque urban area. During the past century, the city's population increase has accounted for about 30 percent of New Mexico's growth (fig. 4). The USGS is mapping historical land use and land cover to model the basin's future urban growth.

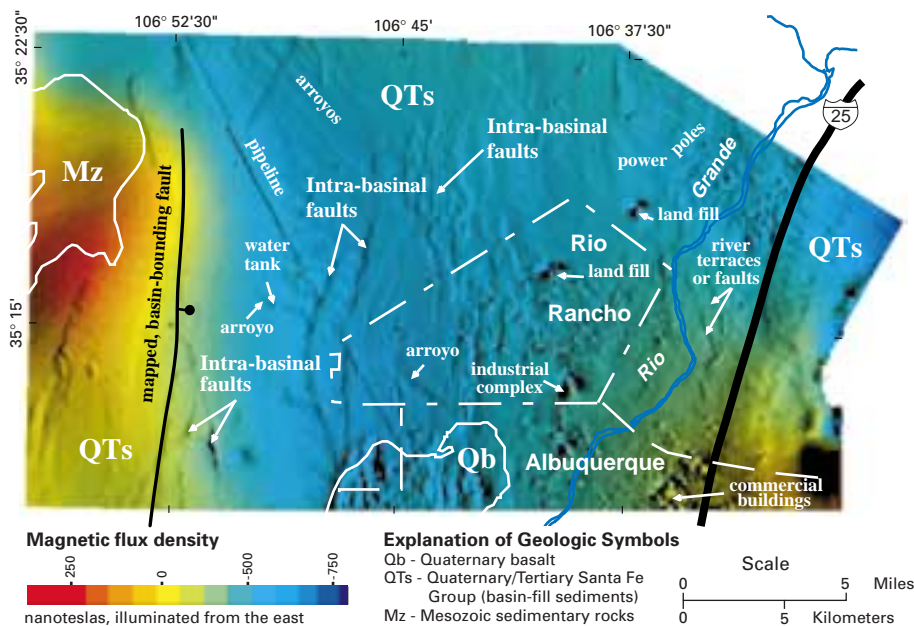


Figure 3. Airborne high-resolution magnetic data for the central Middle Rio Grande Basin and features related to faults and volcanic rocks, terraces and gullies, and manmade metallic items.

The Middle Rio Grande Council of Governments is developing a regional land-use plan (FOCUS 2050) and, with the technical assistance of the USGS, a land-use analysis model that will produce a long-range strategy for managing urban growth. The ultimate goal of this urban-growth modeling is to provide the basis for a comprehensive, quantitative analysis of alternative land-use patterns.

Rio Puerco Assessment

The Rio Puerco Basin, which covers 6,177 square miles of northwestern New Mexico (fig. 5), supplies more than 70 percent of the sediment carried by the Rio Grande upstream from Elephant Butte Reservoir. The USGS, in conjunction with the Rio Puerco Watershed Management Committee, Bureau of Land Management, Bureau of Reclamation, Colorado State University, and the Universities of New Mexico and Vermont, is assessing the sources, transport, and deposition of sediment in the Rio Puerco. The objective of the project is to determine the roles of

bedrock, soils, vegetation, climate, and land use in sediment deposition/erosion cycles.

Late 19th century arroyo carving and subsequent sediment deposition are being documented through repeat

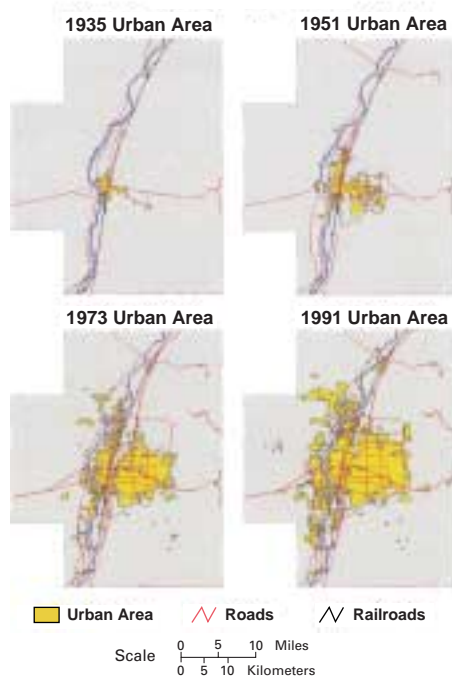


Figure 4. Growth of the Albuquerque urban area.

photography, streamflow and sediment gaging, sediment trap studies, and geochemical and isotopic investigations. The past 30,000 years of arroyo physiography is being studied with mapping and radiocarbon analysis of fluvial sediments.

The future response of the basin to climate cycles and land-use changes is being studied using remote sensing, “ground-truth” monitoring, and computer modeling to provide information for minimizing unwanted consequences of land-use decisions. More information can be found at http://climchange.cr.usgs.gov/rio_puerco/.

Hydrologic Monitoring

Hydrologic data are essential for monitoring and managing New Mexico’s limited water resources. The USGS network of water data-collection stations throughout New Mexico records information on streamflow and streamwater levels, reservoir and lake storage, groundwater levels, spring discharge, and water quality. These stations are funded in cooperation with Federal, State, tribal, and local agencies. The data-collection program in New Mexico consists of 196 continuous streamflow-gaging stations, 32 streamflow partial-record stations, 43 water-quality stations, 46 precipitation stations, and 7,265 wells.

Source, Transport, and Fate of Mercury in South-Central New Mexico

As early as 1971, mercury concentrations in fish from some New Mexico reservoirs exceeded human-health guidelines. USGS scientists from the New Mexico Cooperative Fish and Wildlife Research Unit are working to determine the source of the mercury contamination.

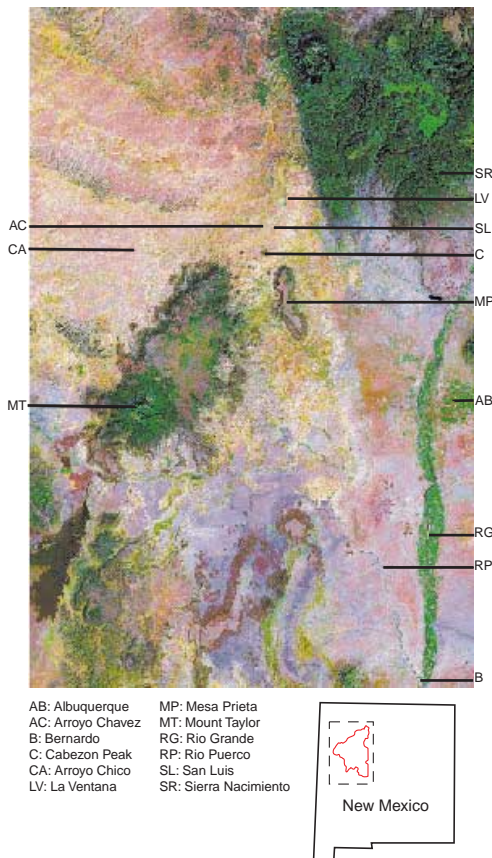


Figure 5. Rio Puerco Basin.

Airborne mercury is captured by rain drops and deposited on the landscape when it rains. Gaseous and particle-bound mercury deposition from the air during dry periods might also contribute to mercury contamination. Once in the aquatic food chain, concentrations of mercury may increase 300 fold passing from microscopic plants and animals to fish. Thus, even small amounts of atmospheric deposition of mercury may significantly increase mercury concentrations in fish, with possible implications for ecological and human health.

Wildfires also may contribute to mercury loading and availability in reservoirs. Following a fire at the headwaters of Caballo Reservoir, mercury concentrations in reservoir sediments collected near the burned site were greater than those at other reservoir sites. Concentrations of methylmercury, one of the most toxic

forms of mercury, were as much as six times higher; this increase may have been related to increased sediment-inhabiting bacteria populations enhanced by carbon-rich, burnt vegetation carried to the reservoir by runoff from summer rains. The results of this study could be used to integrate fire-management and reservoir-management planning.

Water Resources on Pueblo Lands

The USGS has cooperative projects with the Pueblo of Jemez and the Pueblo of San Ildefonso to describe water resources on pueblo lands. The primary objective of the Pueblo of Jemez project is to continue the water-quality sampling program to determine the extent of environmental effects from internal and external sources on the hydrologic system of the upper Jemez River watershed.

The Pueblo of San Ildefonso project focuses on a water-quality assessment of pueblo lands. This assessment includes collecting, analyzing, and interpreting surface-water, bottom-sediment, and ground-water-quality data for pueblo lands and adjacent U.S. Department of Energy lands.

Coalbed Methane in the San Juan Basin

In the 1970's, coalbed methane was discovered in commercial quantities in Fruitland Formation coalbeds in the San Juan Basin in northwestern New Mexico. Coalbed gas production reached an annual production rate of 940 billion cubic feet in 1997. Approximately 3,000 wells now produce coalbed methane in the basin.

The USGS has been conducting a detailed study of coal resources of the Fruitland Formation as part of its

National Coal Assessment Program. Preliminary results show that the Fruitland contains about 230 billion tons of coal in the basin. Because the San Juan Basin is the world's largest producer of coalbed methane, current studies of the occurrence and yield of this resource in the basin may provide models for predicting coalbed methane distribution in other basins.

Fire Ecology

Fire is a key process in most southwestern ecosystems, yet current knowledge of the ecological effects of past and present fires is inadequate to support informed resource management. USGS scientists are studying fire scars on trees (fig. 6), charcoal deposits in ancient bog sediments, and historical photographs of landscape changes in Bandelier National Monument and the Santa Fe National Forest to reconstruct regional fire histories of the Jemez and Sangre de Cristo Mountains. Historical patterns help define the natural variability among fires including their frequency, extent, seasonality, and severity. This information is needed to define the role of fires and to assess and manage forest health and restoration needs. The effects of modern fires on forest communities and processes also are being examined; these study topics range from Mexican spotted owls and salamanders to arthropods and the nitrogen cycle. Collaborators include the University of Arizona Tree-Ring



Figure 6. Studying fire scars on trees.

Laboratory, Northern Arizona University, University of New Mexico, Los Alamos National Laboratory, and Santa Fe National Forest.

United States-Mexico Border Mapping and Shared-Water Resources

New Mexico is one of four States involved in U.S.-Mexico border mapping and shared-water resources activities (fig. 7). 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. From color infrared aerial photography for the U.S. side of the border, the USGS is producing digital orthophoto quadrangles (DOQ's). DOQ's are scanned, high-resolution aerial photographs in which distortion and displacements caused by the camera orientation and terrain have been removed. A DOQ may be incorporated into a computerized geographic information system and used with other data layers for analysis and geographic applications.

The USGS has digitized boundary and Public Land Survey System Digital Line Graphs (DLG's) from USGS 1:24,000-scale maps of the U.S. border area. Transportation and hydrologic feature DLG's are scheduled for production under the U.S. Department of the Interior High Priority Base Data Program. The USGS also has produced 1:24,000-scale Digital Raster Graphics (DRG's) of 1:24,000-scale maps in the border area. DRG's are scanned images of USGS topographic maps that depict features such as lakes and streams, highways and railroads, boundaries, geographic names, elevation, and topography.

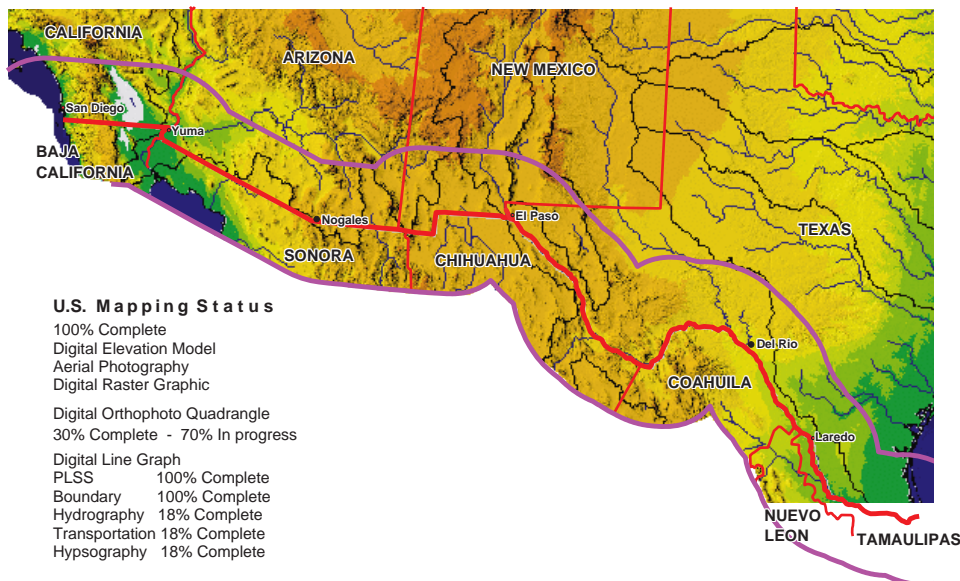


Figure 7. United States-Mexico transboundary mapping.

A multibureau Shared-Water Resources Issues Team was created in the U.S. Department of the Interior to identify, compile, and communicate shared-water resources issues in the U.S.-Mexico border area. Additional information can be found at <http://www.doi.gov/fcc/>.

Geospatial Data Status

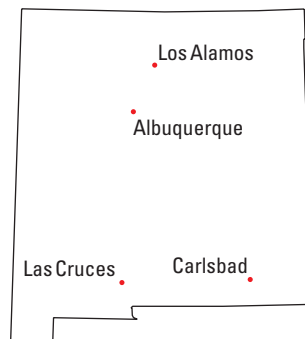
The USGS is developing DOQ coverage of New Mexico. More than 2,600 DOQ's will be generated using black-and-white and color infrared aerial photography acquired by the National Aerial Photography Pro-

gram. Approximately 75 percent of New Mexico is covered by either completed or "authorized for production" DOQ's.

The Digital Elevation Model (DEM) Program for New Mexico is complete for the 1:100,000-scale map series. The state 1:24,000-scale map coverage is complete with either 10-meter- or 30-meter-resolution DEM's. DEM's are sampled rectangular areas of regularly spaced elevations used to show topographic relief. They will be used for hydrologic modeling, flood analysis, streamflow dynamics, and hazard mitigation.

USGS office locations

The USGS has 115 employees in New Mexico



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