Middle Rio Grande Basin Study

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

What is the USGS Middle Rio Grande Basin Study?

The U.S. Geological Survey (USGS) Middle Rio Grande Basin Study is a 5-year effort by the USGS and other agencies to improve the understanding of the hydrology, geology, and land-surface characteristics of the Middle Rio Grande Basin. The Santa Fe Group aquifer is the main source of municipal water for the region, and the main purpose of the study is to improve the understanding of the water resources of the basin. The New Mexico State Engineer Office manages the water resources in the basin and has declared the basin a "critical basin"; that is, a ground-water basin faced with rapid economic and population growth where there is less than adequate technical information as to the available water supply (New Mexico State Engineer Office, written communication, 1995). The USGS will study the hydrology, geology, and land-surface characteristics of the basin to provide the scientific information needed for water-resources management. The study began in 1995 and is scheduled to be completed in 2000.

What is the extent of the Middle Rio Grande Basin?

The Middle Rio Grande Basin, as defined hydrologically and used here, is the area within the Rio Grande Valley extending from Cochiti Dam downstream to the community of San Acacia (fig. 1). The study area contains approximately 3,000 square miles and includes the ground-water basin that contains the Santa Fe Group aquifer.

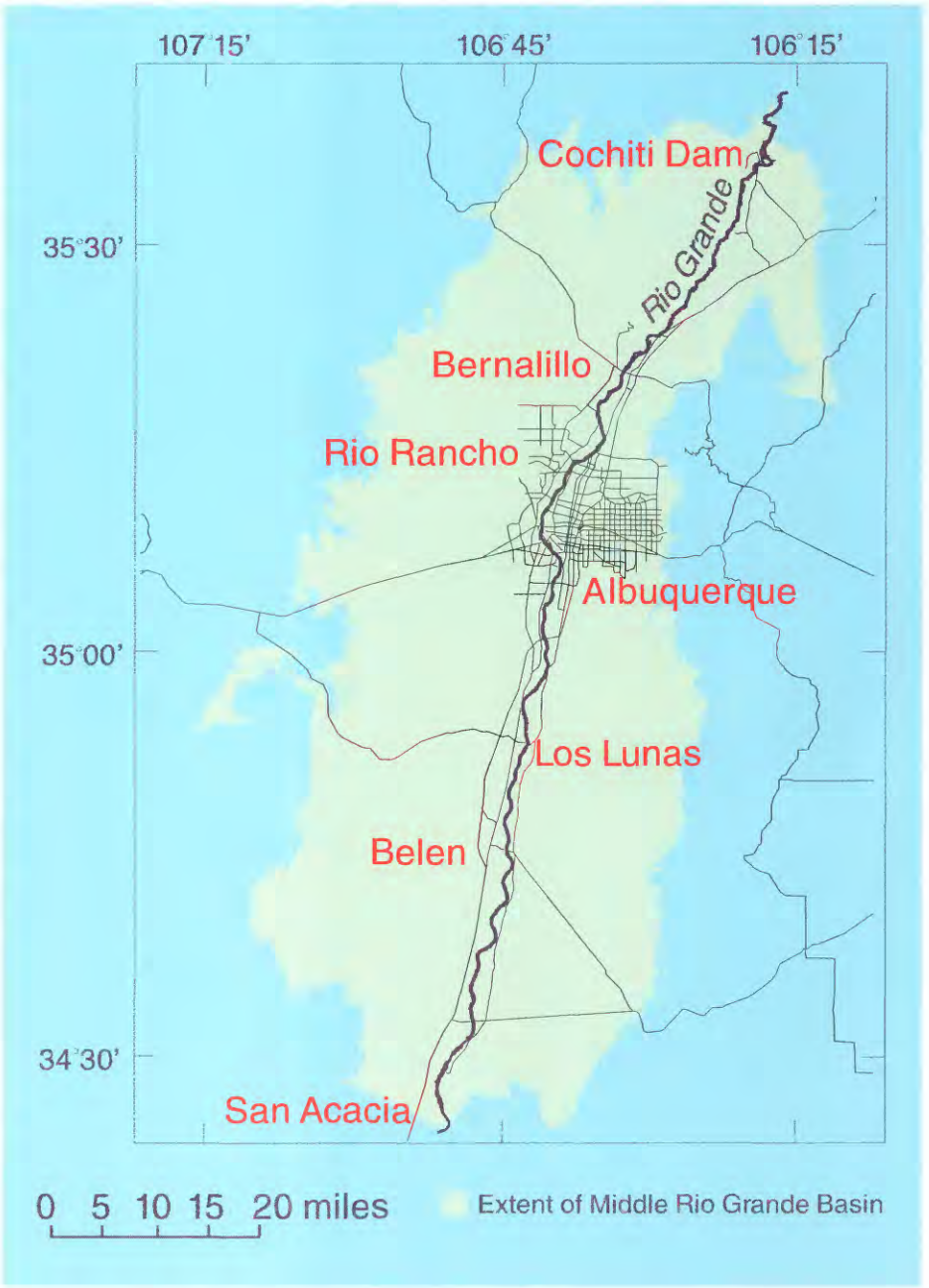

Figure 1. Extent of the Middle Rio Grande Basin, central New Mexico.

Why is the study necessary?

In 1995, the USGS published the results of a 2-year study of the Santa Fe Group aquifer, which serves as the main source of municipal supply for Albuquerque and other communities in the Middle Rio Grande Basin. This earlier study described the hydrogeology of the Albuquerque area (Thorn, McAda, and Kernodle, 1993) and the development of a ground-water-flow model (a computer simulation of the aquifer and its behavior) that simulated water levels in the aquifer through the year 2020 using four different water-use scenarios (Kernodle, McAda, and Thorn, 1995). The study found that the quantity of water in the aquifer available for municipal supply was significantly less than previously estimated. Because approximately 600,000 people (40 percent of the population of New Mexico) live in the study area, water

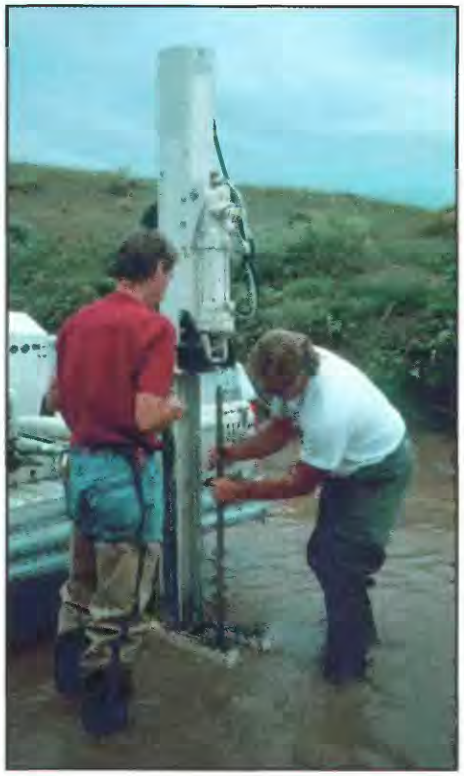

Figure 2. USGS researchers collecting core samples of the aquifer in the Santa Fe River near La Bajada.

shortfalls could have serious consequences for the State.

The earlier study concentrated on the metropolitan Albuquerque area primarily because that is where the aquifer is most heavily pumped. The Middle Rio Grande Basin Study will increase our understanding of the aquifer system as well as extend our knowledge of geology and land-surface characteristics into the northern and southern reaches of the basin.

As stated earlier, the primary purpose of the Middle Rio Grande Basin Study is to improve the understanding of the water resources of the basin. This understanding will then provide the information needed by managers to plan and develop water supplies for the population of the Middle Rio Grande Basin.

Another important purpose of the study is to determine to what extent the Rio Grande and the Santa Fe Group aquifer are hydrologically connected. A plan of study to quantify the hydrologic connection between the aquifer and river was prepared (McAda, 1996). Because the aquifer is hydrologically connected to the Rio Grande and water in the river is fully appropriated, the ability to reliably estimate the effects of ground-water withdrawals on flow in the river is important.

What other agencies are involved in studying the water resources in the basin?

In addition to the USGS, many other Federal, State, and local governments and agencies are contributing resources to or cooperating in the characterization of the water resources, geology, and land surface of the Middle Rio Grande Basin. These governments and agencies include the City of Albuquerque, New Mexico State Engineer Office, New Mexico Bureau of Mines and Mineral Resources (NMBMMR), Albuquerque Metropolitan Arroyo Flood Control Authority, Middle Rio Grande Council of Governments, Middle Rio Grande Conservancy District, Bureau of Reclamation, Pueblo of Cochiti, Pueblo of Isleta, Pueblo of Jemez, Pueblo of Laguna, Pueblo of San Felipe, Pueblo of Sandia, Pueblo of Santa Ana, Pueblo of Santo Domingo, Pueblo of Zia, City of Santa Fe, Bernalillo County, Santa Fe County, New Mexico Environment Department, Sandia National Laboratories, Los Alamos National Laboratory, U.S. Environmental Protection Agency, and the U.S. Army Corps of Engineers.

To facilitate coordination between the various agencies and avoid duplication of effort, the New Mexico State Engineer Office has established a Technical Advisory Committee for the Middle Rio Grande Basin. The USGS is an active participant on this committee, as well as a host for other formal and informal meetings to bring researchers and data users in the basin together.

What projects are included in the study?

Three divisions of the USGS are participating in the Middle Rio Grande Basin Study: the Water Resources Division, the Geologic Division, and the National Mapping Division. Through a coordinated approach, scientists from each division have scheduled a series of projects designed to further the understanding of the hydrology, geology, and land-surface characteristics of the basin. The projects that are planned or already underway in the basin are:

- Recharge where streams and arroyos enter the basin is being estimated by several different methods, such as changes of ground-water temperature with depth, chemical tracer studies (using stable isotopic ratios), laboratory examination of core samples, and streamflow measurements at multiple reaches.
- Studies using environmental tracers, such as chlorofluorocarbons, sulfur hexafluoride, and tritium/helium-3, are being used to estimate recent (last 50 years) recharge to the aquifer and to trace and date the movement of water through the aquifer.
- Ground-water temperature profiles obtained from wells installed near the Rio Grande will be used to determine the volume of water passing between the river and the aquifer.
- Airborne geophysical surveys are being flown over selected areas of the Middle Rio Grande Basin. Among the types of geophysical methods to be used are high-resolution aeromagnetic, electromagnetic, and radiometric surveys. These surveys will identify differences between the various rock units that form the aquifer and geologic faults that create barriers to or pathways for ground-water flow.

Figure 3. Geophysical survey plane.

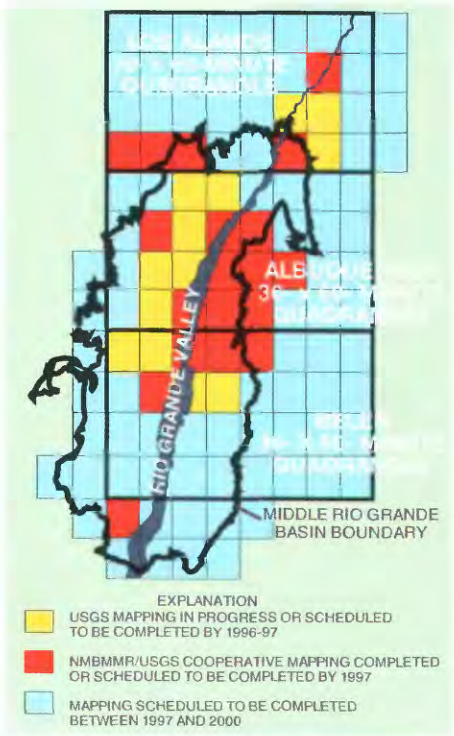

Figure 4. Status of geologic mapping of the Middle Rio Grande Basin.

- The conceptual geologic framework of the Middle Rio Grande Basin is being revised and updated by mapping the surficial and bedrock deposits of the Middle Rio Grande Basin and adjoining areas. The resulting 1:100,000-scale maps will be made available as digital data bases to improve our understanding of ground-water-flow patterns in three dimensions.
- Statistical-based methods will be used to evaluate uncertainty in the ground-water-flow model of the Middle Rio Grande Basin.
- A borehole has been constructed to obtain a continuous core of the aquifer for analyzing hydrogeologic properties (including arsenic concentrations), monitoring water levels, and calibrating geophysical logs.
- Electromagnetic surveys of the inner valley of the Rio Grande were designed to help map the extent of clay layers beneath the bed of the river that retard recharge to the aquifer from the river. These surveys will be done with handheld electromagnetic equipment along canal and levee roads.
- Wells are being inventoried in the northern and southern parts of the basin to obtain hydrogeologic information about each well. These inventories include measurement of water level and collection of a water sample for chemical analysis.
- Base cartographic data are being generated in support of the Middle Rio Grande Basin Study. The base data being produced are providing higher resolution and more recent datasets than what are currently available from the USGS. Based on user requirements, products generated may include 10-meter 1:24,000-scale (24K) Digital Elevation Models (DEM's), revised Digital Line Graph (DLG-3's) themes such as hydrography, and 1996 vintage 1-meter black and white Digital Orthophoto Quadrangles (DOQ's). High-resolution base cartographic data will be used as the foundation for Middle Rio Grande Basin surficial geologic mapping as well as be incorporated into the ground-water-flow model.
- Land-surface analysis is planned to characterize the Middle Rio Grande Basin's landscape processes and conditions and to develop techniques for determining landscape changes. Historical land development will be used to determine the locations, extent, and kind of development that has occurred. By using historical landscape patterns, land-use prediction methods will be investigated to forecast which areas are likely to experience development and to determine the subsequent effects of development on the Middle Rio Grande Basin hydrologic system. A decision-support system is planned to be developed that allows managers to analyze the relation between regional water planning and land-use planning and to investigate alternative scenarios to meet expanding water needs.
- Fault characteristics of the Middle Rio Grande Basin, such as timing of fault activity (earthquake hazards), fault zone history, and fault zone physical characteristics related to ground-water flow (such as distribution of cementation), are planned to

Figure 5. Sample digital orthophoto data for the Isleta, New Mexico, 1:24,000-scale quadrangle.

be incorporated into the geologic map data bases as well as into the existing ground-water-flow model.

- Precise gravitational-field measurements, coupled with ground-water-level information, will be used to estimate specific yield of the aquifer and changes in aquifer storage.
- In cooperation with the New Mexico Resource Geographic Information System Program, the geospatial data infrastructure activity will establish an Internet site for disseminating available Middle Rio Grande Basin project information. Where logistically feasible, project information will be retained online and be directly downloadable from a Middle Rio Grande Basin Internet site. Access to this clearinghouse site will be through the Middle Rio Grande Basin World Wide Web (WWW) "home page." Other governmental agencies involved in studying water resources in the basin also are accessible from the Middle Rio Grande Basin WWW home page.
- The Federal-State Cooperative Program has been the source of much of the work done to date in the basin. At present, a number of projects are in various stages of completion that are essential to understanding the hydrology of the basin.

What products are planned to result from these projects?

The synthesis of our current knowledge is the three-dimensional ground-water-flow model created by Kernodle, McAda, and Thorn (1995). Therefore, one of the most important products planned to come out of the study will be an improved ground-water-flow model. An improved model would allow managers to better plan for a sustained water supply for the population of the Middle Rio Grande Basin and contribute to understanding of the water quality of the aquifer. An evaluation is planned to determine how well the revised model represents the understanding of the hydrology of the basin.

Other planned products include reports on specific activities within the study, geologic maps (in both paper and digital form), base cartographic data, aerial photography, land-surface characterization data, and a decision-support system for use by regional planners.

When will we know enough about the water resources in the Middle Rio Grande Basin?

It is not possible for scientists to know everything about the hydrogeology of the Middle Rio Grande Basin; enough can be learned during this 5-year study, however, to allow planners and regulators to address the water-supply problems indicated by the ground-water-flow model. Questions and issues not envisioned today may become important in the future. Therefore, it is important to continue studying the Middle Rio Grande Basin to deal with the issues of today and to be prepared for those of tomorrow.

References cited

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Additional information on the Middle Rio Grande Basin Study can be found by accessing the home page on the WWW at: http://rmmcweb.cr.usgs. gov/public/mrgb/mrgbhome.html.

Additional earth science information can be found by accessing the USGS home page on the WWW 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.

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