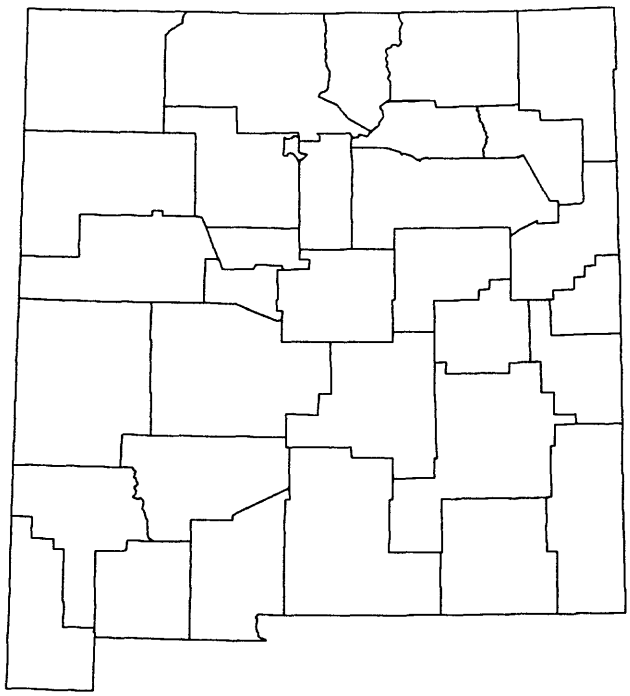
WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN NEW MEXICO, FISCAL YEAR 1990

Compiled by Harriet R. Allen



U.S. GEOLOGICAL SURVEY

Open-File Report 91-231

Albuquerque, New Mexico
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U.S. DEPARTMENT OF THE INTERIOR

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CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To obtain
inch	25.4	millimeter
foot	0.3048	meter
mile	1.609	kilometer
square mile	2.590	square kilometer
gallon per minute	0.06309	liter per second

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929--a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

MESSAGE FROM THE DISTRICT CHIEF

Awareness of our environment in general, and water resources in particular, has brought increased interest in and support of hydrologic data collection and research. The quantity, quality, and distribution of water are extremely important to the future well-being of New Mexico. The State's surface-water resources are minimal and highly variable due to climate and to regulation and diversion; ground-water resources are subject to development that exceeds natural recharge and to potential contamination by land use. Issues related to global climate change, disposal of hazardous wastes, toxic substances in water, water rights, and ground-water contamination are evolving areas of greater public concern. At the same time there is a continuing need for a better understanding of various hydrologic systems and processes in order to manage these limited water resources for maximum benefit to present and future generations.

The U.S. Geological Survey has collected and disseminated information on the water resources of New Mexico for more than a century. The Survey began to collect records of streamflow in New Mexico in December 1888 when the first discharge measurements were made on the Rio Grande near the present gaging station at Embudo. This site, called the "birthplace of systematic stream gaging," was chosen to be the training center for the first hydrographers of the Irrigation Survey, a bureau within the original Geological Survey. Since that time, in cooperation with local, tribal, State, and Federal agencies, we have monitored streams at hundreds of sites throughout the State and have a current network of more than 200 streamflow-gaging stations. Through the cooperative program, we also have established sites where ground-water levels are monitored to document changes in ground-water storage or where surface-water and ground-water samples are collected to determine the water chemistry, and we have undertaken investigative studies to define the availability, quality, and distribution of water resources. Information from the data program and results of investigative studies are made available to water-resources managers, regulators, and the public to be used for the effective management of the State's water resources.

This report provides a brief summary of the activities of the New Mexico District for fiscal year 1990, including our mission, organization, sources of funding, and descriptions of current projects. This report serves to document not only the content of the program, but also the diversity and complexity of that program. Cooperation among water-resources agencies will be essential in effectively dealing with water-related issues facing New Mexico, and we look forward to the challenge of addressing these issues by continuing to provide factual hydrologic data and technically sound areal appraisals and interpretive studies.

Russell K. Livingston
District Chief, New Mexico District

WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY

IN NEW MEXICO, FISCAL YEAR 1990

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MISSION AND PROGRAM OF THE U.S. GEOLOGICAL SURVEY

The U.S. Geological Survey was established by an act of Congress on March 3, 1879, as a permanent Federal agency in the U.S. Department of the Interior. Its mission is to conduct the systematic and scientific classification of the public lands and to examine the geological structure, mineral resources, and products of the national domain. An integral part of that original mission includes publishing and disseminating the earth-science information needed to understand, to plan the use of, and to manage the Nation's energy, land, mineral, and water resources.

Since 1879, the Geological Survey has become the Federal Government's largest earth-science research agency, the Nation's largest civilian mapmaking agency, the primary source of data on the Nation's surface- and ground-water resources, and the employer of the largest number of professional earth scientists. Today, programs of the Geological Survey serve a diversity of needs:

1. Conducting detailed assessments of the energy and mineral potential of the Nation's land and offshore areas.

2. Investigating and issuing warnings of earthquakes, volcanic eruptions, landslides, and other geologic and hydrologic hazards.

3. Conducting research on the geologic structure of the Nation.

4. Studying the geologic features, structure, processes, and history of the other planets of our solar system.

5. Conducting topographic surveys of the Nation and preparing topographic and thematic maps and related cartographic products.

6. Developing and producing digital-cartographic data bases and products.

7. Collecting data on a routine basis to determine the quantity, quality, and use of surface and ground water.

8. Conducting water-resources appraisals in order to describe the consequences of alternative plans for developing land and water resources.

9. Conducting research in hydraulics and hydrology and coordinating all Federal water-data acquisition.

10. Using remotely sensed data to develop new cartographic, geologic, and hydrologic research techniques for natural-resources planning and management.

11. Providing earth-science information through an extensive publications program and a network of public access points.

The Geological Survey, through its Office of Water Data Coordination, also coordinates the water-data acquisition activities of other Federal agencies. Information on these Federal activities is consolidated into a "Catalog of Information on Water Data." Many State and local agencies and private organizations that have water-data-acquisition activities also contribute information to this catalog. This information is made available to all users of water data by means of a national network of assistance centers managed by the Geological Survey's National Water Data Exchange (NAWDEX). In New Mexico, NAWDEX services can be obtained from the District Chief, U.S. Geological Survey, Water Resources Division, Albuquerque, New Mexico. A leaflet explaining NAWDEX services is available from the NAWDEX Program Office, U.S. Geological Survey, 421 National Center, Reston, Virginia 22092.

MISSION AND PROGRAM OF THE WATER RESOURCES DIVISION

The Water Resources Division is one of five operational divisions of the U.S. Geological Survey. The overall mission of the Water Resources Division is to provide the hydrologic information and understanding needed for the best use and management of the Nation's water resources. For more than 85 years, the U.S. Geological Survey has studied the occurrence, quantity, quality, distribution, and movement of the surface and ground water that composes the Nation's water resources. As the principal Federal water-data agency, the Geological Survey collects and disseminates about 70 percent of the water data currently being used by numerous State, local, private, and other Federal agencies to develop and manage our water resources. This nationwide program, which is carried out through the Water Resources Division's 43 District offices and 4 Regional offices, includes the collection, analysis, and dissemination of hydrologic data and water-use information; areal resource appraisals and other interpretive studies; and research projects. Much of this work is a cooperative effort in which planning and financial support are shared by State and local governments and other Federal agencies. Typical programs include:

1. Collecting, on a systematic basis, data needed for the continuing determination and evaluation of the quantity, quality, and use of the Nation's water resources.

2. Conducting analytical and interpretive water-resources appraisals that describe the occurrence; availability; and physical, chemical, and biological characteristics of surface and ground water.

3. Conducting basic problem-oriented research in hydrology to improve the scientific basis for investigations and measurement techniques and to predict quantitatively the response of hydrologic systems to stress.

4. Disseminating water data and the results of investigations and research through reports, maps, computerized information services, and other forms of public releases.

5. Coordinating the activities of Federal agencies in the acquisition of water data for streams, lakes, reservoirs, estuaries, and ground waters.

6. Providing scientific and technical assistance in hydrologic fields to other Federal, State, and local agencies; to licensees of the Federal Power Commission; and to international agencies on behalf of the U.S. State Department.

7. Administering the provisions of the Water Resources Research Act of 1984, which includes the State Water Resources Research Institute Program (Section 104) and the National Water Resources Research Grant Program (Section 105).

8. Acquiring information useful in predicting and delineating water-related natural hazards from flooding, volcanoes, mudflows, and land subsidence.

HISTORY AND PROGRAM OF THE NEW MEXICO DISTRICT

The history of the U.S. Geological Survey's New Mexico District begins with the camp at Embudo, a tent compound on the banks of the Rio Grande near the tiny Mexican village of Embudo. It was there, beside the tracks of the Denver and Rio Grande Railroad, that the first Survey hydrographers gathered for training in February 1895. The site was chosen because of the diverse climate, which provided a variety of stream-gaging conditions; the proximity to the railroad for transportation and supplies; and general interest in the Rio Grande, a major resource for future irrigation of the arid West.

The first Survey office in New Mexico was established in Carlsbad in 1903. Responsibilities included operating stream-gaging stations in parts of New Mexico and Oklahoma and conducting irrigation investigations of the Pecos Valley. This office was headquarters for the Oklahoma-Eastern New Mexico District that existed until 1907. In 1907 the first cooperative water-resources program in New Mexico, which was between the U.S. Geological Survey and the New Mexico Territory, was established. Establishment in 1912 of the Santa Fe Subdistrict office was a result of this continuing cooperative program and of the change of status from Territory to State in 1912. The Santa Fe Subdistrict office was one of several field offices of the Rocky Mountain District headquartered in Denver, Colorado.

The increasing importance of the cooperative program in New Mexico, which boosted the number of recorder-equipped stations in the Nation at the time, resulted in a reorganization in 1913 that established the New Mexico-Arizona District headquartered in Santa Fe. With the unexpected withdrawal in 1915 of New Mexico from the cooperative program, the Santa Fe office returned to Subdistrict status, again under the Rocky Mountain District. In 1920 the New Mexico State Engineer resumed a cooperative program with the Ground Water Division of the Survey. Over the next 10 years, the program grew to include a number of interpretive investigations, such as a study of water-level declines in the Roswell artesian basin and irrigation water-supply studies in Socorro, Torrance, and Baca Counties.

The New Mexico District office was established in Santa Fe on July 1, 1931, after the New Mexico State Engineer reestablished a cooperative program with the Surface Water Division of the Survey. At this time the program consisted of about 60 streamflow studies, which increased dramatically to more than 300 by 1940. To maintain such an extensive network, field offices over the next 20 years were operated for at least 1 year at the following locations: Bernalillo, Albuquerque, Belen, Farmington, Socorro, Roswell, Lordsburg, Carlsbad, Santa Rosa, Tyrone, and Las Vegas. In 1967 the three branches of the U.S. Geological Survey--Surface Water, Ground Water, and Water Quality--were formally combined to form the Water Resources Division.

Organization

The New Mexico District's program consists of two broad categories of activities: (1) collection of hydrologic data, and (2) areal appraisals and interpretive studies. Approximately 40 percent of the program is for collection of hydrologic data and 60 percent for interpretive studies. Approximately 89 full-time and 8 part-time employees work in the New Mexico District, which consists of the District office in Albuquerque; Subdistrict offices in Albuquerque, Santa Fe, and Las Cruces; and a Field Headquarters in Carlsbad (fig. 1). The Carlsbad office reports to the Santa Fe Subdistrict office.

The New Mexico District is organized into two operating sections and two support sections under the Office of the District Chief (fig. 2). The operating sections are the Hydrologic Investigations Section, which includes three Investigations Units and the Las Cruces Subdistrict office; and the Hydrologic Data Collection/Management Section, which includes a Technical Support Unit, a Quality Assurance Unit, and the offices in Albuquerque, Santa Fe, and Carlsbad. The District support sections are the Administrative Services Section and the Computer Services and Scientific Publications Section, which includes a Computer Unit, GIS (Geographical Information System) Unit, Manuscript/Editorial Unit, and Drafting Unit.

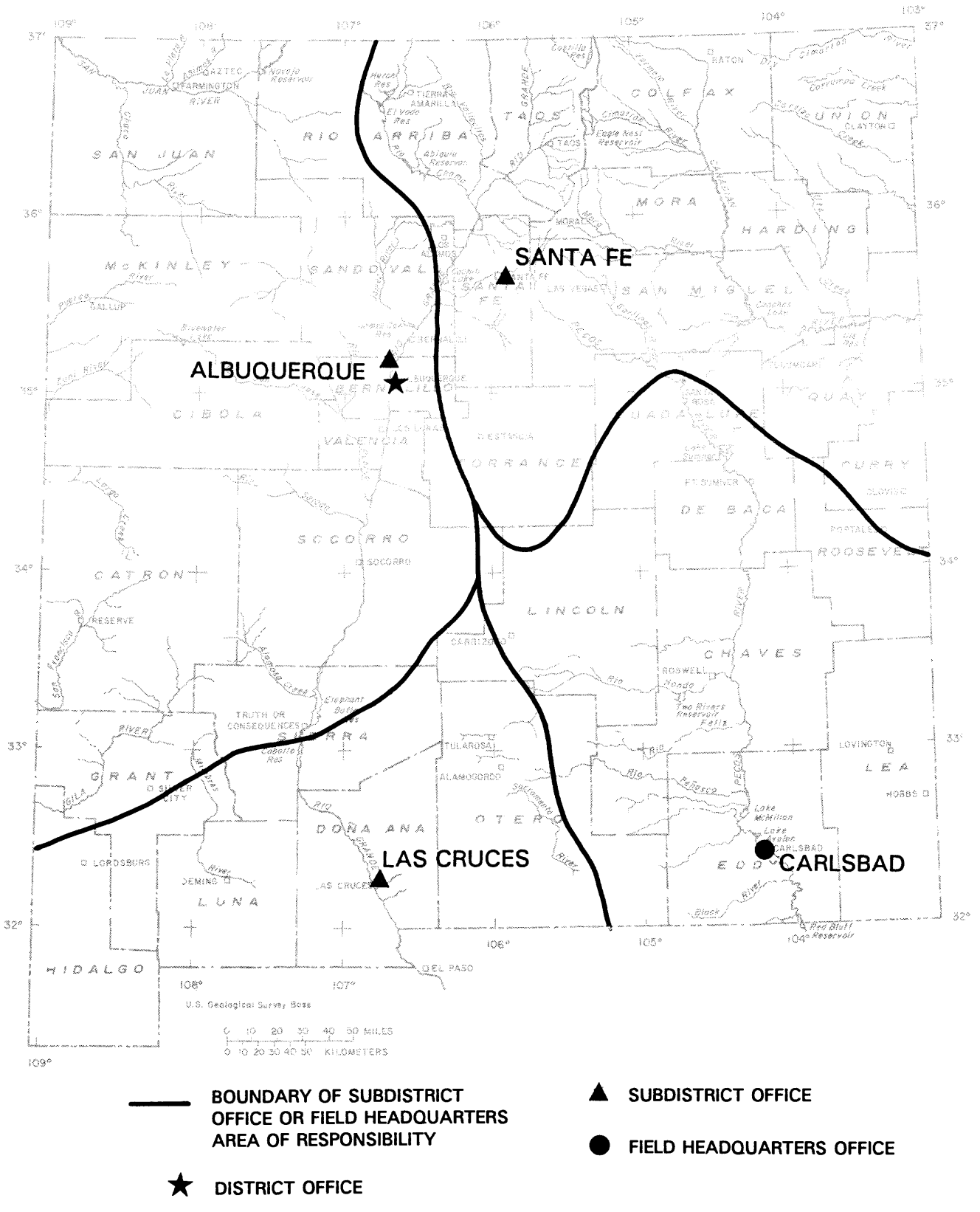


Figure 1.--Location of U.S. Geological Survey offices in New Mexico and general areas of responsibilities.

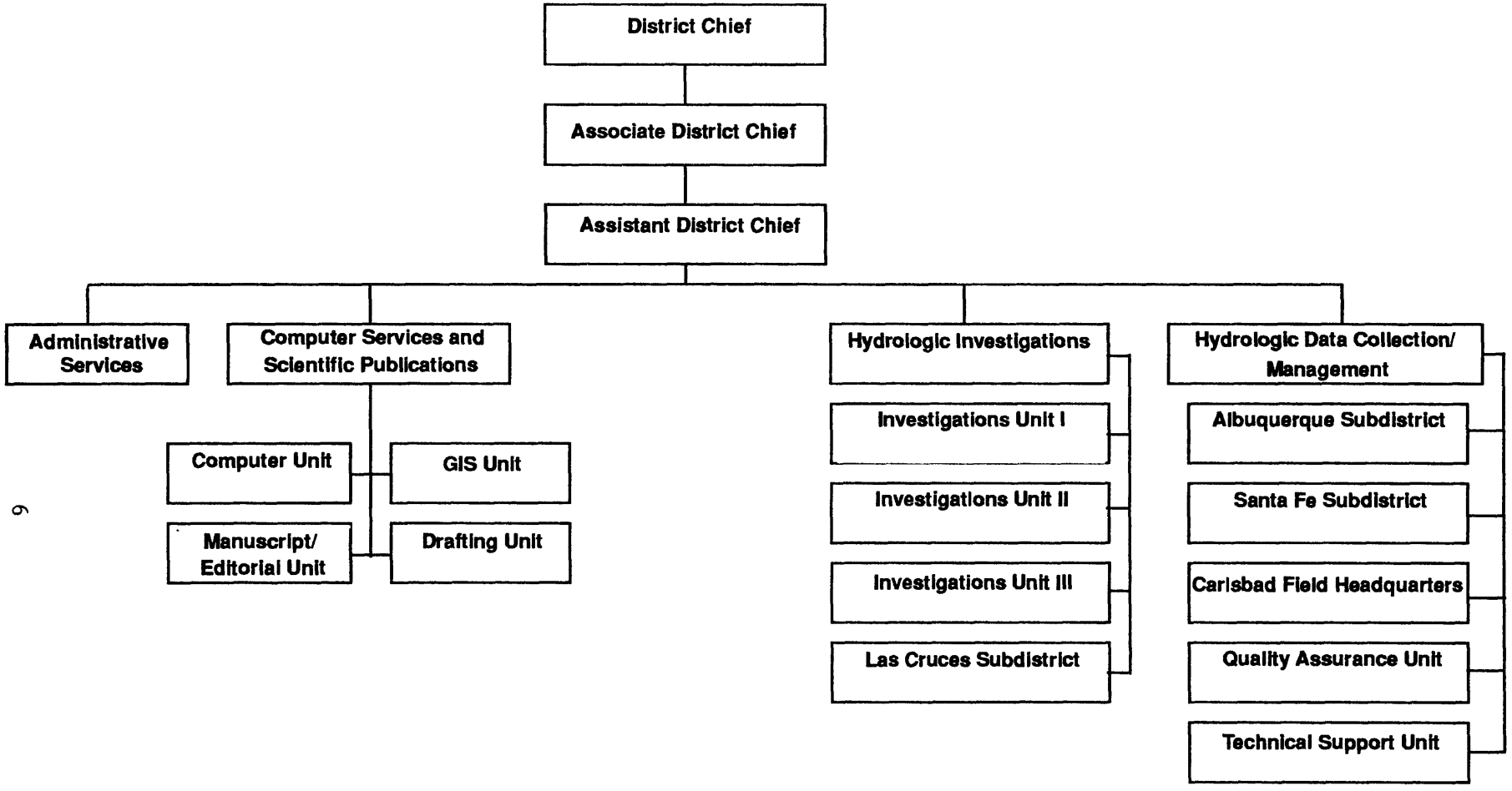
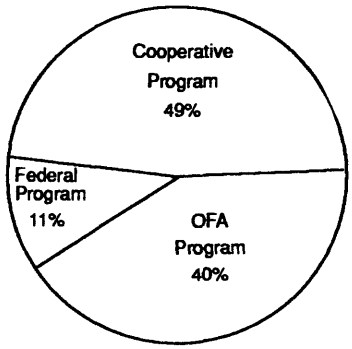


Figure 2.--Organization chart of the New Mexico District.

Sources of Funding

To support its water-resources program in New Mexico, the U.S. Geological Survey receives funding from three sources: Federal appropriations (Federal Program), reimbursements from other Federal agencies (OFA Program), and Federal/State/local cooperative programs (cooperative program). The distribution of funds among these sources for fiscal year 1990 (October 1989 through September 1990) is given in the following illustration:



Federal appropriations are provided to collect hydrologic data at selected sites that serve national water-resources interests, and to execute hydrologic investigations of national interest. Other Federal agencies, such as the Albuquerque District of the U.S. Army Corps of Engineers, the U.S. Bureau of Reclamation, the U.S. Air Force, and the White Sands Missile Range, provide funds to the U.S. Geological Survey to collect and interpret data necessary for water management and water-development planning and design. The Federal/State/local cooperative program, based on the concept that Federal, State, local, and tribal governments have mutual interests in evaluating, planning, developing, conserving, and managing the Nation's water resources, provides for Congressional appropriations to fund as much as 50 percent of the cost of water-resources activities. The following is a list of Federal, State, local, and tribal cooperators that support in part the water-resources activities of the U.S. Geological Survey, New Mexico District, during fiscal year 1990:

Other Federal Agencies

Federal Emergency Management Agency
International Boundary and Water Commission--U.S. Section
Santa Fe National Forest
U.S. Air Force
  Brooks Air Force Base
  Kirtland Air Force Base
  Holloman Air Force Base
U.S. Department of Agriculture
  Forest Service
U.S. Department of the Army
  Corps of Engineers
  Fort Bliss
  White Sands Missile Range

U.S. Department of Energy
U.S. Department of the Interior
  Bureau of Indian Affairs
  Bureau of Land Management
  Bureau of Reclamation
U.S. Department of Justice

State Agencies

Costilla Creek Compact Commission
New Mexico Bureau of Mines and Mineral Resources
New Mexico Environmental Improvement Division
New Mexico Highlands University
New Mexico State Engineer Office/Interstate Stream Commission
New Mexico State Highway Department
New Mexico State University
New Mexico State University Agricultural Experiment Station
Pecos River Commission
Rio Grande Compact Commission

Local and Tribal Agencies

Albuquerque Metropolitan Arroyo Flood Control Authority
Bernalillo County
Canadian River Municipal Water Authority
City of Albuquerque
City of Las Cruces
City of Las Vegas
City of Raton
City of Santa Rosa
El Paso Water Utilities Board
Elephant Butte Irrigation District
Middle Rio Grande Conservancy District
Navajo Nation
Pueblo of Zuni
Rio San Jose Flood Control District
Santa Fe Metropolitan Water Board
Village of Ruidoso

WATER ISSUES IN NEW MEXICO

The primary water issues facing New Mexico are problems typical of most southwestern States. Major areas of concern are:

- Water supply, particularly ground-water depletion: Although the largest cities in New Mexico use ground water for public supply, the largest user of ground water statewide is irrigated agriculture. Economic growth and rapid increases in population require additional reliable sources of ground water.

- Surface-water and ground-water rights, particularly the interstate transfer of water: All surface water is fully appropriated, and all New Mexico streams are subject to one or more of eight interstate water compacts. Water-rights litigation has resulted in additional needs for hydrologic data and ground-water assessment.

- Ground-water quality: Although New Mexico, with its generally sparse population, does not have the water-quality problems that many of the more densely populated regions of the Nation have, approximately 75 percent of New Mexico's ground water is too saline for most uses (Ong, 1988, p. 377). Land-use practices such as landfills, agriculture, military-related hazardous-waste disposal, and leaking underground storage tanks have altered the water quality of some aquifers.

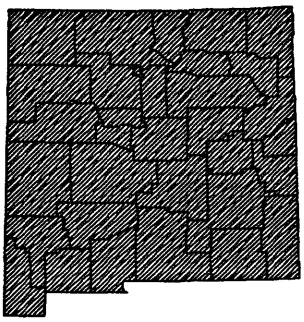
- The impacts of drought: New Mexico's semiarid climate and its diverse geology result in a wide range in the quantity and availability of surface water and ground water. Recharge to the ground-water system is derived from infiltration of precipitation, surface water, and irrigation-return flow. "More than 90 percent of New Mexico's precipitation and surface-water inflow from adjacent States returns to the atmosphere through evapotranspiration" (Garrabrant and Garn, 1990, p. 375).

The current activities of the New Mexico District address many of the State's current and potential water issues and water-information needs. These activities, as described in this report, are designed to provide the hydrologic data and appraisals necessary for the intelligent use and management of the water resources of New Mexico and the Nation.

NEW MEXICO DATA-COLLECTION PROGRAMS

The New Mexico District maintains data-collection stations throughout the State to obtain records of stream discharge and stage, reservoir and lake stage and contents, ground-water levels, and quality of surface water and ground water. Stations in this data network are added or dropped as information needs change. In addition, crest-stage data are obtained at partial-record stations for floodflow analyses, and discharge measurements are made at miscellaneous sites, generally during periods of flood or drought. Most current and historical data are stored in computer data files and are published annually in the U.S. Geological Survey Water-Data Report series entitled, "Water resources data, New Mexico, water year 19__." A water year is September through October, thereby coinciding with a fiscal year.

SURFACE-WATER STATIONS (NM001)



Period of Project: Continuous since 1930

Study Location: Statewide

Principal Investigator: J.P. Borland

Cooperating Agencies: Most of the agencies shown in the list of cooperators

Problem: Surface-water information is used in water-related fields such as water supply, hydroelectric power, flood control, irrigation, bridge and culvert design, wildlife management, pollution abatement, flood-plain management, and water-resources development. A historically complete data base is necessary to provide this information.

Objectives: To obtain and document surface-water discharge (streamflow) and stage (water level) for general hydrologic purposes such as (1) assessment of water resources, (2) forecasting, (3) areal analysis, (4) determination of long-term trends, (5) research and special studies, (6) compact and legal requirements, (7) operation of reservoirs or industries, or (8) pollution controls and disposal of wastes.

Approach: Standard methods of data collection are used as described in the series, "Techniques of water-resources investigations of the U.S. Geological Survey." Daily and partial (annual peak discharge) records are collected, computed, and prepared for publication each year in the annual report, "Water resources data, New Mexico." The following table summarizes the types of stations in operation during water year 1990.

Station classification	Number of stations
Streamflow stations:	
Continuous stage and discharge record:	
Water year (October - September)	[1]152
Seasonal	44
Low-flow	1
Annual peak discharge	108
Cumulative discharge record:	
Irrigation season total only	14
Lake and reservoir stations:	
Continuous stage and contents	[2]22
Intermittent stage and contents	[3]4
Total stations	345

[1]Records are provided by a cooperating agency for 6 stations.
[2]Records are provided by a cooperating agency for 16 stations.
[3]All records are provided by a cooperating agency.

All streamflow stations (except cumulative irrigation season stations) are described in table 1, and reservoir and lake stations are described in table 2. Figure 3 shows the locations of the stations except for those operated only during the irrigation season. As part of interpretive hydrologic investigations, streamflow sometimes is measured at temporary gaging stations and at locations other than gaging stations.

Progress and Significant Results: Discharge and stage data were collected at network sites, computed, and published.

Plans for FY 90: Continue network operated in fiscal year 1989 with minor revisions made in response to changes in information needs. The following stations were discontinued in the cooperative program from water year 1989 to water year 1990:

08330800 Tijeras Arroyo below South Diversion Channel near Albuquerque
08331140 North Pajarito Arroyo at grant boundary at Albuquerque
08361100 Cuchillo Negro Creek near Cuchillo
08484500 La Luz Creek at La Luz
08492900 Sacramento River near Sunspot
09367561 Shumway Arroyo near Waterflow
09367680 Chaco Wash at Chaco Culture National Historical Park
09387300 Zuni River near Arizona-New Mexico State line

Table 1.—Streamflow-gaging stations in operation during water year 1990

[*, some records have been collected previously; S, seasonal; P, provided record; L, low flow only. Stations are in New Mexico unless otherwise indicated]

Station number	Station name	County	Drainage area (square miles)	Period of record
07202400	Vermejo River at Vermejo Park (S)	Colfax	36.7	1985–
07202500	Eagle Trail Ditch near Maxwell	do.	—	*1975–
07203000	Vermejo River near Dawson	do.	301	*1927–
07203505	Vermejo Ditch near Colfax	do.	—	1980–
07203525	Vermejo River near Maxwell	do.	486	1983–
07204000	Moreno Creek at Eagle Nest (S)	do.	73.8	*1964–
07204500	Cieneguilla Creek near Eagle Nest (S)	do.	56.0	*1964–
07205000	Sixmile Creek near Eagle Nest (S)	do.	10.5	*1958–
07206000	Cimarron River below Eagle Nest Dam	do.	167	1950–
07207000	Cimarron River near Cimarron	do.	294	1950–
07207500	Ponil Creek near Cimarron	do.	171	1950–
07208500	Rayado Creek at Sauble Ranch near Cimarron	do.	65.0	*1927–
07211000	Cimarron River at Springer	do.	1,030	*1926–
07211500	Canadian River near Taylor Springs	do.	2,850	*1964–
07215020	La Cueva Wasteway at La Cueva	Mora	—	1956–
07215100	La Cueva Canal below La Cueva	Mora	—	*1956–
07215500	Mora River at La Cueva	Mora	173	*1931–
07218000	Coyote Creek near Golondrinas	Mora	215	*1930–
07221000	Mora River near Shoemaker	Mora	1,100	*1927–
07221500	Canadian River near Sanchez	San Miguel	6,010	*1935–
07222500	Conchas River at Variadero	San Miguel	523	1936–
07223300	Conchas Canal below Conchas Dam	San Miguel	—	*1984–
07226500	Ute Creek near Logan	Harding	2,060	*1942–
07227000	Canadian River at Logan	Quay	11,100	1959–
07227100	Revuelto Creek near Logan	Quay	786	1959–
08252500	Costilla Creek above Costilla Dam (S)	Taos	25.1	1937–
08253000	Casias Creek near Costilla (S)	Taos	16.6	1937–
08253500	Santistevan Creek near Costilla (S)	Taos	2.15	1937–
08254000	Costilla Creek below Costilla Dam	Taos	54.6	1937–
08255500	Costilla Creek near Costilla	Taos	195	1936–

Table 1.—Streamflow-gaging stations in operation during water year 1990—Continued

Station number	Station name	County	Drainage area (square miles)	Period of record
08256000	Acequia Madre at Costilla (S)	Taos	—	1944–
08258000	Cerro Canal at Costilla (S)	do.	—	1944–
08258600	Cerro Canal below Association Ditch at Costilla (S)	do.	—	1972–
08259600	Cerro Canal at State line near Jaroso, Colo. (S)	do.	—	1973–
08261000	Costilla Creek near Garcia, Colo. (S)	do.	200	1944–
08263500	Rio Grande near Cerro	do.	8,440	1948–
08265000	Red River near Questa	do.	113	*1926–
08265500	Llano Ditch near Questa	do.	—	1961–
08266000	Cabresto Creek near Questa	do.	36.7	1943–
08266820	Red River below Fish Hatchery near Questa	do.	186	*1978–
08267500	Rio Hondo near Valdez	do.	36.2	1934–
08268700	Rio Grande near Arroyo Hondo	do.	8,760	1963–
08269000	Rio Pueblo de Taos near Taos	do.	66.6	*1962–
08271000	Rio Lucero near Arroyo Seco	do.	16.6	*1962–
08275500	Rio Grande del Rancho near Talpa	do.	83	*1985–
08276300	Rio Pueblo de Taos below Los Cordovas	do.	380	1957–
08276500	Rio Grande below Taos Junction Bridge near Taos	do.	9,730	1925–
08279000	Embudo Creek at Dixon	Rio Arriba	305	*1962–
08279500	Rio Grande at Embudo	do.	10,400	1889–
08284100	Rio Chama near La Puente	do.	480	1955–
08284160	Azotea Tunnel at Outlet near Chama (P)	do.	—	1970–
08284200	Willow Creek above Heron Reservoir near Los Ojos (P)	do.	112	1962–
08284300	Horse Lake Creek above Heron Reservoir near Los Ojos (S) (P)	do.	45.0	1962–
08284520	Willow Creek below Heron Dam (P)	do.	193	1971–
08285500	Rio Chama below El Vado Dam	do.	877	*1935–
08286500	Rio Chama above Abiquiu Reservoir	do.	1,600	1961–
08287000	Rio Chama below Abiquiu Dam	do.	2,140	1961–
08289000	Rio Ojo Caliente at La Madera	do.	419	1932–
08290000	Rio Chama near Chamita	do.	3,140	1912–
08291000	Santa Cruz River near Cundiyo	Santa Fe	86.0	1930–
08291950	Santa Clara Creek below Turkey near Española (S)	Rio Arriba	—	1984–
08292000	Santa Clara Creek near Española	Rio Arriba	34.5	*1985–
08294210	Rio Nambe below Nambe Falls Dam near Nambe (P)	Santa Fe	34.1	1979–
08313000	Rio Grande at Otowi Bridge	Santa Fe	14,300	1895–
08313500	Cochiti East Side Main Canal at Cochiti	Sandoval	—	*1970–

Table 1.—Streamflow-gaging stations in operation during water year 1990—Continued

Station number	Station name	County	Drainage area (square miles)	Period of record
08314000	Sili Main Canal (at head) at Cochiti	Sandoval	—	*1970-
08316000	Santa Fe River near Santa Fe	Santa Fe	18.2	1913-
08317200	Santa Fe River above Cochiti Lake	Santa Fe	231	1970-
08317400	Rio Grande below Cochiti Dam	Sandoval	14,900	1970-
08317950	Galisteo Creek below Galisteo Dam	Santa Fe	597	1970-
08319000	Rio Grande at San Felipe	Sandoval	16,100	1925-
08321500	Jemez River below East Fork near Jemez Springs	Sandoval	173	*1981-
08323000	Rio Guadalupe at Box Canyon near Jemez	Sandoval	235	*1981-
08324000	Jemez River near Jemez	Sandoval	470	*1953-
08329000	Jemez River below Jemez Canyon Dam	Sandoval	1,030	*1943-
08329700	Campus Wash at Albuquerque (S)	Bernalillo	—	1982-
08329831	Pino Arroyo at Ventura at Albuquerque (S)	do.	—	1990-
083298314	Hoffmantown Church Outlet No. 1 at Albuquerque (S)	do.	—	1990-
083298315	Hoffmantown Church Outlet No. 2 at Albuquerque (S)	do.	—	1990-
08329832	Cherry Hills Arroyo No. 1 at Albuquerque (S)	do.	—	1990-
08329833	Cherry Hills Arroyo No. 2 at Albuquerque (S)	do.	—	1990-
08329834	Pino Arroyo at Wyoming at Albuquerque (S)	do.	—	1990-
08329835	North Floodway Channel at Albuquerque	do.	—	1982-
08329840	Hahn Arroyo at Albuquerque (S)	do.	4.35	1978-
08329860	Villa del Oso Drain at Albuquerque (S)	do.	0.05	1976-
08329865	Grant Line Arroyo at Albuquerque (S)	do.	0.053	1986-
08329880	Academy Acres Drain at Albuquerque (S)	do.	0.12	1976-
08329890	La Cueva Arroyo trib. near Albuquerque (S)	do.	0.09	1977-
08329900	North Floodway Channel near Alameda	do.	—	1968-
08329914	North Camino Arroyo trib. near Albuquerque (S)	do.	0.21	1979-
08329928	Rio Grande near Alameda	do.	17,263	1989-
08329935	Arroyo 19A at Albuquerque (S)	do.	1.42	1977-
08329936	Taylor Ranch Drain at Albuquerque (S)	do.	0.14	1978-
08329938	Ladera Arroyo at Albuquerque (S)	do.	0.87	1981-
08330000	Rio Grande at Albuquerque	do.	17,400	1941-

Table 1.—Streamflow-gaging stations in operation during water year 1990—Continued

Station number	Station name	County	Drainage area (square miles)	Period of record
08330540	Tramway Floodway Channel at Albuquerque (S)	Bernalillo	1.60	1987-
08330565	Arroyo del Coyote at Kirtland AFB at Albuquerque	do.	—	1989-
08330567	Arroyo del Coyote above Tijeras Arroyo at Kirtland AFB at Albuquerque	do.	—	1989-
08330569	Tijeras Arroyo below Arroyo del Coyote at Kirtland AFB, Albuquerque	do.	—	1987-
08330580	Tijeras Arroyo at Montessa Park at Albuquerque	do.	122	1987-
08330600	Tijeras Arroyo near Albuquerque	do.	133	*1974-
08330775	South Diversion Channel above Tijeras Arroyo near Albuquerque (S)	do.	—	1988-
08331990	Rio Grande Conveyance Channel near Bernardo	Socorro	—	*1952-
08332010	Rio Grande Floodway near Bernardo	Socorro	19,200	*1941-
08332050	Bernardo Interior Drain near Bernardo	Socorro	—	*1943-
08334000	Rio Puerco above Arroyo Chico near Guadalupe	Sandoval	420	1951-
08341300	Bluewater Creek above Bluewater Dam	Cibola	75	1989-
08341365	Cottonwood Creek near Thoreau	McKinley	—	1989-
08341500	Bluewater Creek below Bluewater Dam	Cibola	201	*1989-
08343000	Rio San Jose at Grants	do.	1,020	*1968-
08343100	Grant Canyon at Grants	do.	13.0	1961-
08343500	Rio San Jose near Grants	do.	2,300	1936-
08349800	Rio Paguate below Jackpile Mine near Laguna	do.	107	1976-
08351500	Rio San Jose at Correo	do.	3,660	1943-
08353000	Rio Puerco near Bernardo	Socorro	7,350	1939-
08354500	Socorro Main Canal North at San Acacia	do.	—	1936-
08354800	Rio Grande Conveyance Channel at San Acacia	do.	—	1960-
08354900	Rio Grande Floodway at San Acacia	do.	26,700	1936-
08358300	Rio Grande Conveyance Channel at San Marcial	do.	—	1969-
08358400	Rio Grande Floodway at San Marcial	do.	27,700	1964-
08361000	Rio Grande below Elephant Butte Dam	Sierra	29,400	1915-
08362500	Rio Grande below Caballo Dam (P)	Sierra	30,700	1938-
08377900	Rio Mora near Terrero	San Miguel	53.2	1963-
08378500	Pecos River near Pecos	San Miguel	189	1919-
08379500	Pecos River near Anton Chico	Guadalupe	1,050	*1927-

Table 1.—Streamflow-gaging stations in operation during water year 1990—Continued

Station number	Station name	County	Drainage area (square miles)	Period of record
08380500	Gallinas Creek near Montezuma	San Miguel	84.0	1916–
08382500	Gallinas River near Colonias	Guadalupe	610	1951–
08382600	Pecos River above Cañon del Uta near Colonias	do.	2,330	1976–
08382650	Pecos River above Santa Rosa Lake	do.	2,340	1976–
08382730	Los Esteros Creek above Santa Rosa Lake	do.	65.6	1973–
08382760	Los Esteros Creek trib. above Santa Rosa Lake	do.	13.7	1973–
08382830	Pecos River below Santa Rosa Lake	do.	2,430	1980–
08383000	Pecos River at Santa Rosa	do.	2,650	*1928–
08383500	Pecos River near Puerto de Luna	do.	3,970	1938–
08384500	Pecos River below Sumner Dam	De Baca	4,390	*1938–
08385000	Fort Sumner Main Canal near Fort Sumner	De Baca	—	*1954–
08386000	Pecos River near Acme	Chaves	11,300	*1937–
08387000	Rio Ruidoso at Hollywood	Lincoln	120	1953–
08387600	Eagle Creek below South Fork near Alto	Lincoln	8.14	*1988–
08390500	Rio Hondo at Diamond A Ranch near Roswell	Chaves	947	*1939–
08390800	Rio Hondo below Diamond A Dam near Roswell	Chaves	963	1963–
08393500	Rio Hondo at Roswell	Chaves	1,070	1981–
08394100	Pecos River near Hagerman (L)	Chaves	13,600	1968–
08395500	Pecos River near Lake Arthur	Chaves	14,700	1938–
08396025	Eagle Draw at Artesia	Eddy	—	1989–
08396500	Pecos River near Artesia	do.	15,300	*1909–
08398500	Rio Peñasco at Dayton	do.	1,060	1951–
08399500	Pecos River (Kaiser Channel) near Lakewood	do.	—	1950–
08401150	North Seven Rivers near Lakewood	do.	—	1989–
08401200	South Seven Rivers near Lakewood	do.	220	1963–
08401500	Pecos River below Brantley Dam near Carlsbad	do.	17,600	*1971–
08401900	Rocky Arroyo at Highway Bridge near Carlsbad	do.	285	1963–
08402000	Pecos River at Damsite 3 near Carlsbad	do.	17,900	*1944–
08403500	Carlsbad Main Canal at head near Carlsbad	do.	—	1939–
08404000	Pecos River below Avalon Dam	do.	18,000	*1951–
08405150	Dark Canyon Draw at Carlsbad	do.	451	1973–
08405200	Pecos River below Dark Canyon Draw at Carlsbad	do.	18,500	1970–
08405500	Black River above Malaga	do.	343	*1946–
08406500	Pecos River near Malaga	do.	19,100	1920–
08407000	Pecos River at Pierce Canyon Crossing	do.	19,200	*1951–

Table 1.—Streamflow-gaging stations in operation during water year 1990—Continued

Station number	Station name	County	Drainage area (square miles)	Period of record
08407500	Pecos River at Red Bluff	Eddy	19,500	1937–
08408500	Delaware River near Red Bluff	Eddy	689	*1937–
08477110	Mimbres River at Mimbres	Grant	184	1978–
08481500	Tularosa Creek near Bent	Otero	120	1947–
09355500	San Juan River near Archuleta	San Juan	3,260	1954–
09363500	Animas River near Cedar Hill	La Plata (Colo.)	1,090	1933–
09364500	Animas River at Farmington	San Juan	1,360	*1912–
09365000	San Juan River at Farmington	San Juan	7,240	*1912–
09367500	La Plata River near Farmington	San Juan	583	1938–
09367950	Chaco River near Waterflow	San Juan	4,350	*1975–
09368000	San Juan River at Shiprock	San Juan	12,900	*1927–
09371010	San Juan River at Four Corners, Colo.	Montezuma (Colo.)	14,600	1977–
09386900	Rio Nutria near Ramah	McKinley	71.4	1969–
09386950	Zuni River above Black Rock Reservoir	do.	810	1969–
09395350	Puerco River near Church Rock	do.	193	*1989–
09395381	Foster Canyon near Continental Divide	do.	16.8	1987–
09395390	Sixmile Canyon near Fort Wingate	do.	10.7	1987–
09395630	Puerco River near Manuelito	do.	—	1989–
09430500	Gila River near Gila	Grant	1,860	*1927–
09430600	Mogollon Creek near Cliff	Grant	69.0	1967–
09431500	Gila River near Redrock	Grant	2,820	*1962–
09442680	San Francisco River near Reserve	Catron	350	1959–
09442692	Tularosa River above Aragon	do.	94.0	1966–
09444000	San Francisco River near Glenwood	do.	1,650	1927–
09800100	North Side Luna Ditch near Luna (S)	do.	—	1970–
09819950	Lewis Ditch near Reserve (S)	do.	—	1990–
09820500	Kiehne Ditch near Reserve (S)	do.	—	1970–
09820600	Middle Frisco Ditch at Reserve (S)	do.	—	1970–
09820610	Parsons Ditch near Reserve (S)	do.	—	1970–
09821200	San Francisco Ditch near Reserve (S)	do.	—	1970–
09830100	Spurgeon No. 2 Ditch near Glenwood (S)	do.	—	1970–
09830200	Thomason Flat Ditch near Glenwood (S)	do.	—	1970–
09830300	West Side Ditch near Glenwood (S)	do.	—	1970–
09830400	Lower West Side Ditch near Glenwood (S)	do.	—	1970–
09831700	Fish Pond Ditch near Glenwood (S)	do.	—	1970–

Table 1.—Streamflow-gaging stations in operation during water year 1990—Concluded

Station number	Station name	County	Drainage area (square miles)	Period of record
09832200	East Pleasanton Ditch near Glenwood (S)	Catron	—	1970-
09832500	Deep Creek No. 1 near Glenwood (S)	Catron	—	1970-
09840400	Upper Gila Ditch near Gila (S)	Grant	—	1969-
09840600	Fort West Ditch near Gila (S)	Grant	—	1969-
09841200	Gila Farms Ditch near Gila (S)	Grant	—	1969-
09841500	Riverside Ditch near Gila (S)	Grant	—	1969-
09860000	Grandpa Harper Ditch near Redrock (S)	Grant	—	1969-

Table 2.—Reservoir- and lake-gaging stations in operation during water year 1990

[I, intermittent; P, provided record. *, some records have been collected previously. All stations are in New Mexico]

Station number	Station name	County	Drainage area (square miles)	Period of record
07199450	Lake Maloya near Raton	Colfax	20.8	1975-
07199550	Lake Alice near Raton (I) (P)	Colfax	29.4	1975-
07205500	Eagle Nest Lake near Eagle Nest	Colfax	167	*1950-
07223500	Conchas Lake at Conchas Dam (P)	San Miguel	7,400	1938-
07226800	Ute Reservoir near Logan	Quay	11,000	1963-
08284510	Heron Reservoir near Los Ojos (P)	Rio Arriba	193	1970-
08285000	El Vado Reservoir near Tierra Amarilla (P)	Rio Arriba	873	1935-
08286900	Abiquiu Reservoir near Abiquiu (P)	Rio Arriba	2,140	1963-
08294200	Nambe Falls Reservoir near Nambe (P)	Santa Fe	25.0	1976-
08315500	McClure Reservoir near Santa Fe	Santa Fe	17.4	*1947-
08316500	Nichols Reservoir near Santa Fe	Santa Fe	22.8	1943-
08317300	Cochiti Lake near Cochiti Pueblo (P)	Sandoval	14,900	1973-
08317900	Galisteo Reservoir near Cerrillos (P)	Santa Fe	596	1970-
08328500	Jemez Canyon Reservoir near Bernalillo (P)	Sandoval	1,030	1953-
08341400	Bluewater Lake near Bluewater	Cibola	201	*1958-
08360500	Elephant Butte Reservoir at Elephant Butte (P)	Sierra	29,400	1915-
08362000	Caballo Reservoir near Arrey (P)	Sierra	30,700	1938-
08382810	Santa Rosa Lake near Santa Rosa (P)	Guadalupe	2,430	1980-
08384000	Lake Sumner near Fort Sumner (P)	De Baca	4,390	1938-
08390600	Two Rivers Reservoir near Roswell (I) (P)	Chaves	1,020	1963-
08390610	Rio Hondo Reservoir near Roswell (I) (P)	Chaves	963	1963-
08390620	Rocky Arroyo Reservoir near Roswell (I) (P)	Chaves	64.0	1963-
08400500	Lake McMillan near Lakewood (P)	Eddy	16,900	1939-
08401450	Brantley Lake near Carlsbad (P)	Eddy	17,650	1988-
08403800	Lake Avalon near Carlsbad (P)	Eddy	18,000	1939-
09355100	Navajo Reservoir near Archuleta (P)	San Juan	3,230	1962-

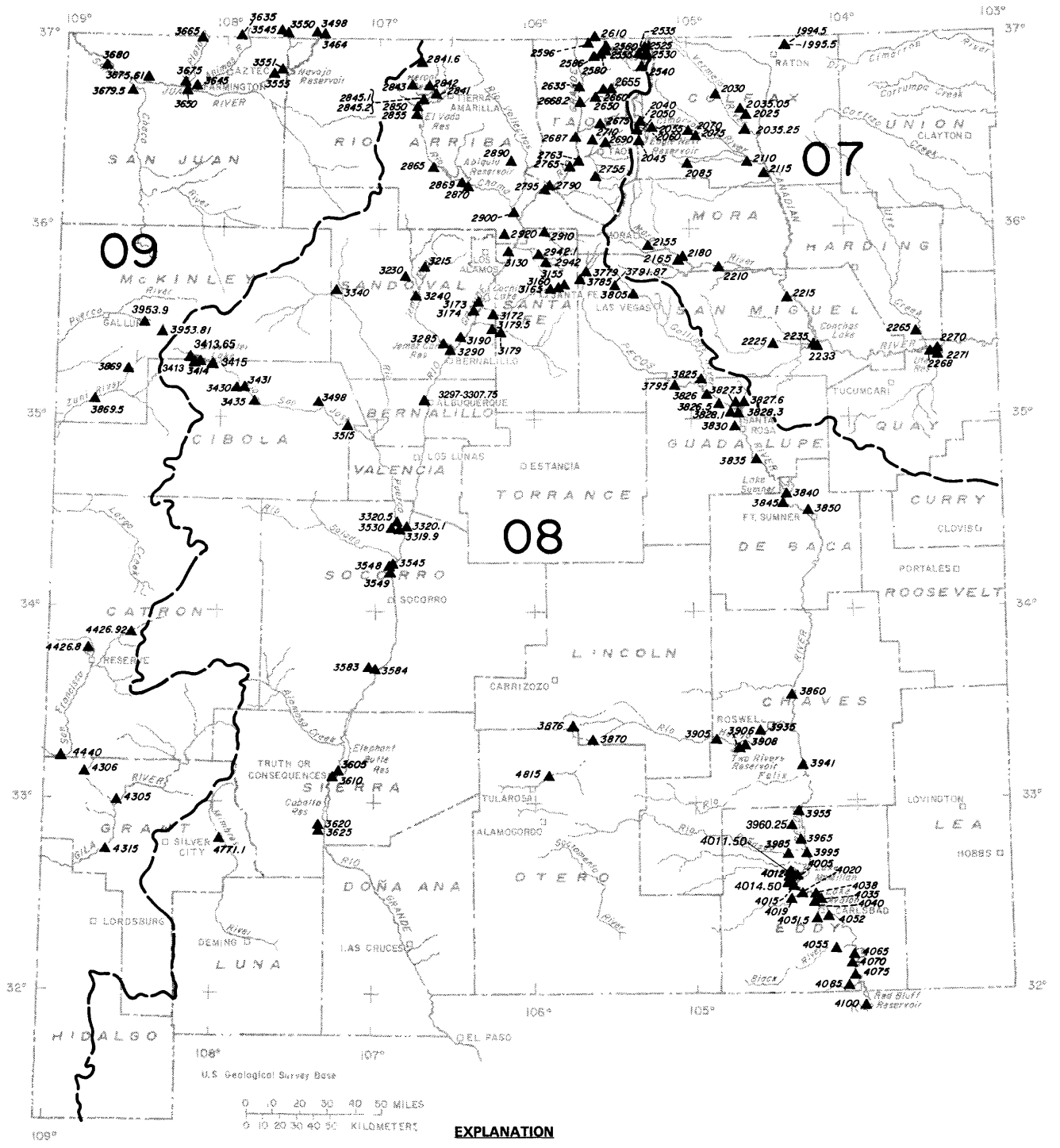


Figure 3.--Location of surface-water gaging stations.

The following stations were added to the program during water year 1990:

08329831	Pino Arroyo at Ventura at Albuquerque
083298314	Hoffmantown Church Outlet No. 1 at Albuquerque
083298315	Hoffmantown Church Outlet No. 2 at Albuquerque
08329832	Cherry Hills Arroyo No. 1 at Albuquerque
08329833	Cherry Hills Arroyo No. 2 at Albuquerque
08329834	Pino Arroyo at Wyoming at Albuquerque
08329865	Grant Line Arroyo at Albuquerque
08329928	Rio Grande near Alameda
08330540	Tramway Floodway Channel at Albuquerque
08330565	Arroyo del Coyote at Kirtland Air Force Base, Albuquerque
08330567	Arroyo del Coyote above Tijeras Arroyo at Kirtland Air Force Base, Albuquerque
08330569	Tijeras Arroyo below Arroyo del Coyote at Kirtland Air Force Base, Albuquerque
08330580	Tijeras Arroyo at Montessa Park at Albuquerque
08330775	South Diversion Channel above Tijeras Arroyo near Albuquerque
08341300	Bluewater Creek above Bluewater Dam
08341365	Cottonwood Creek near Thoreau
08341500	Bluewater Creek below Bluewater Dam
08387600	Eagle Creek below South Fork near Alto
08396025	Eagle Draw at Artesia
08401150	North Seven Rivers near Lakewood
09395350	Puerco River near Church Rock
09395630	Puerco River near Manuelito
09819950	Lewis Ditch near Reserve

Reports in Progress:

Water resources data, New Mexico, water year 1990.

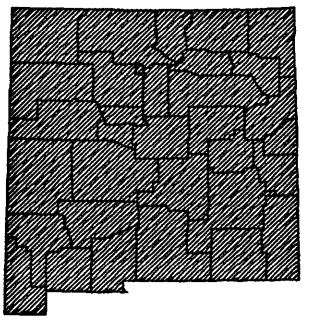
Reports Released:

Borland, J.P., and Beal, L.V., 1988 [1989], Water resources data, New Mexico, water year 1988: U.S. Geological Survey Water-Data Report NM-88-1, 490 p.

Borland, J.P., DeWees, R.K., McCracken, R.L., Lepp, R.L., Ortiz, David, and Shaull, D.A., 1990, Water resources data, New Mexico, water year 1989: U.S. Geological Survey Water-Data Report NM-89-1, 426 p. Reports on water-resources data for New Mexico are published annually.

GROUND-WATER STATIONS (NM002)

Period of Project: Continuous since 1925



Study Location: Statewide

Principal Investigator: Roy R. Cruz

Cooperating Agencies: New Mexico State Engineer Office and Federal Program

Problem: Evaluating the effects of development and of climatic variations, assisting in the prediction of future supplies, and providing data for water-resources management require long-term water-level records.

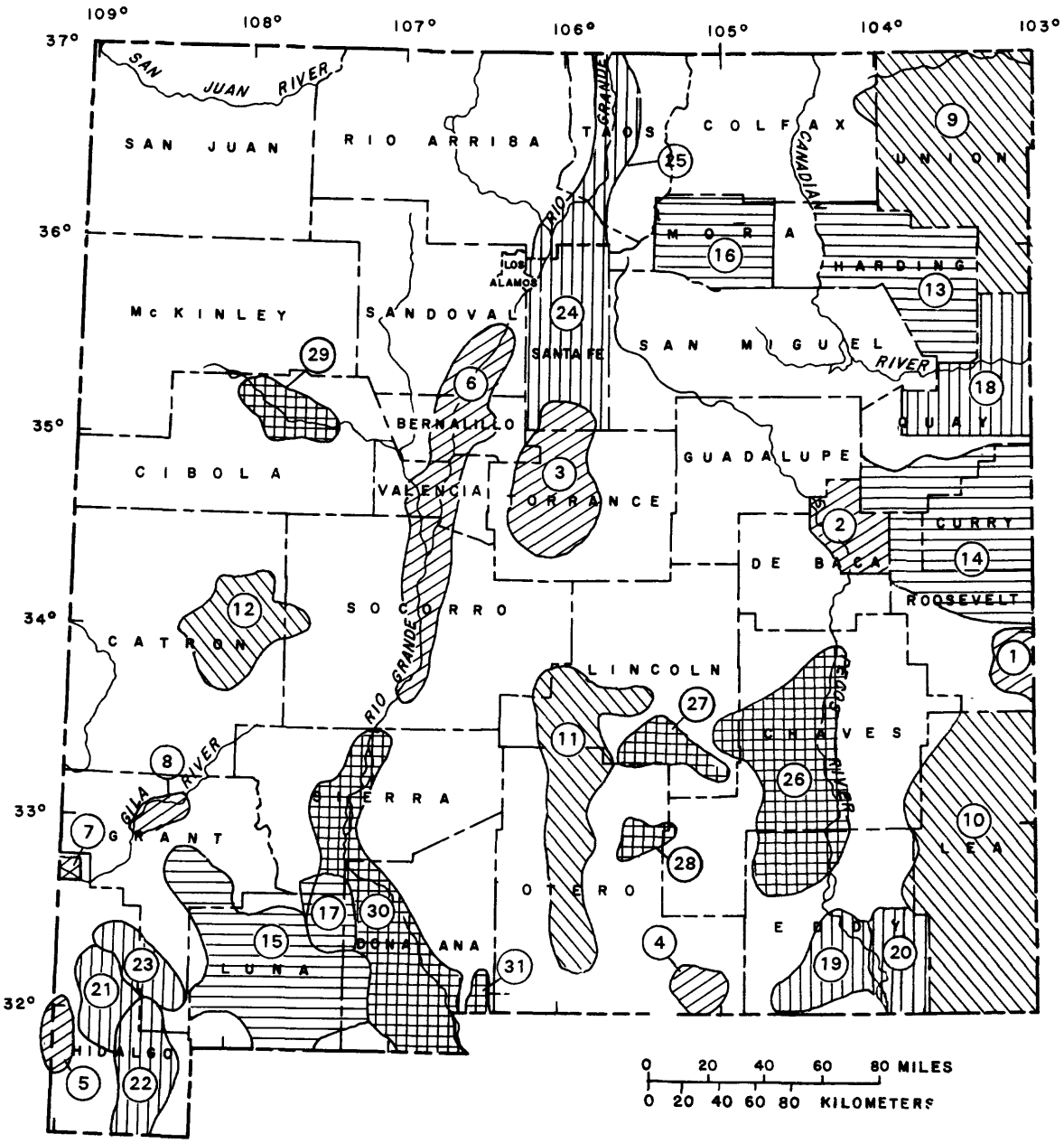
Objective: To maintain a network of ground-water observation wells to provide a long-term data base encompassing areas of ground-water development or potential development. This data base allows evaluation of the general response of the hydrologic system to natural and induced stresses and provides information against which short-term records can be analyzed.

Approach: Most areas of ground-water development in the State are scheduled for intensive water-level measurements at 5-year intervals (fig. 4). Work in an area selected for 5th-year water-level measurements includes inventory of wells and collection of data, such as depths to water, well drilling, and completion records; well yields; and water-quality analyses that are readily available. Observation wells are selected using the inventory data. Evaluation of water levels for these selected wells assures that the levels are representative of the primary aquifer. A number of wells in each major ground-water basin are selected as "key wells" (fig. 5) that are scheduled for annual water-level measurements. A special effort is made to determine well-construction and aquifer characteristics for each key well.

Progress and Significant Results: Intensive water-level measurement efforts made in six areas of the State resulted in about 2,000 water levels for inclusion in the ground-water data base. Fifth-year measurement areas included: Roswell Basin, Rio Hondo, Rio Peñasco, Grants-Bluewater, Lower Rio Grande, and Hueco areas (fig. 4).

The ground-water data base was updated and checked for errors. The additional water-level information in the six mass-measurement areas included data from approximately 200 key wells and 120 Federal observation wells, and daily values from the continuous water-level recorders.

Approximately 250 wells in the Eastern High Plains are measured annually for inclusion in the Internal Revenue Service accounting system. Four maps drawn using water-level data from those wells that show ground-water depletion in the Ogallala Formation were published. The Internal Revenue Service uses these maps to determine allowable ground-water depletion for tax purposes.



EXPLANATION

1985/1990 | 1986/1991 | 1987/1992 | 1988/1993 | 1989/1994

1. CAUSEY-LINGO
2. FT. SUMNER
3. ESTANCIA
4. SALT BASIN
5. SAN SIMON
6. MIDDLE RIO GRANDE
7. VIRDEN
8. GILA RIVER
9. N. HIGH PLAINS
10. LEA COUNTY-HIGH PLAINS, CAPITAN BASIN
11. TULAROSA BASIN
12. SAN AGUSTIN PLAINS
13. HARDING COUNTY
14. CURRY COUNTY-HOUSE-PORTALES
15. MIMBRES BASIN
16. MORA AREA
17. NUTT-HOCKETT
18. LOWER CANADIAN
19. CARLSBAD
20. CAPITAN REEF
21. ANIMAS
22. PLAYAS
23. LORDSBURG
24. SANTA FE COUNTY
25. UPPER RIO GRANDE
26. ROSWELL BASIN
27. RIO HONDO
28. RIO PEÑASCO
29. GRANTS-BLUEWATER
30. LOWER RIO GRANDE
31. HUECO

Figure 4.--Areas of 5-year ground-water-level monitoring and years measured or scheduled for measurement.

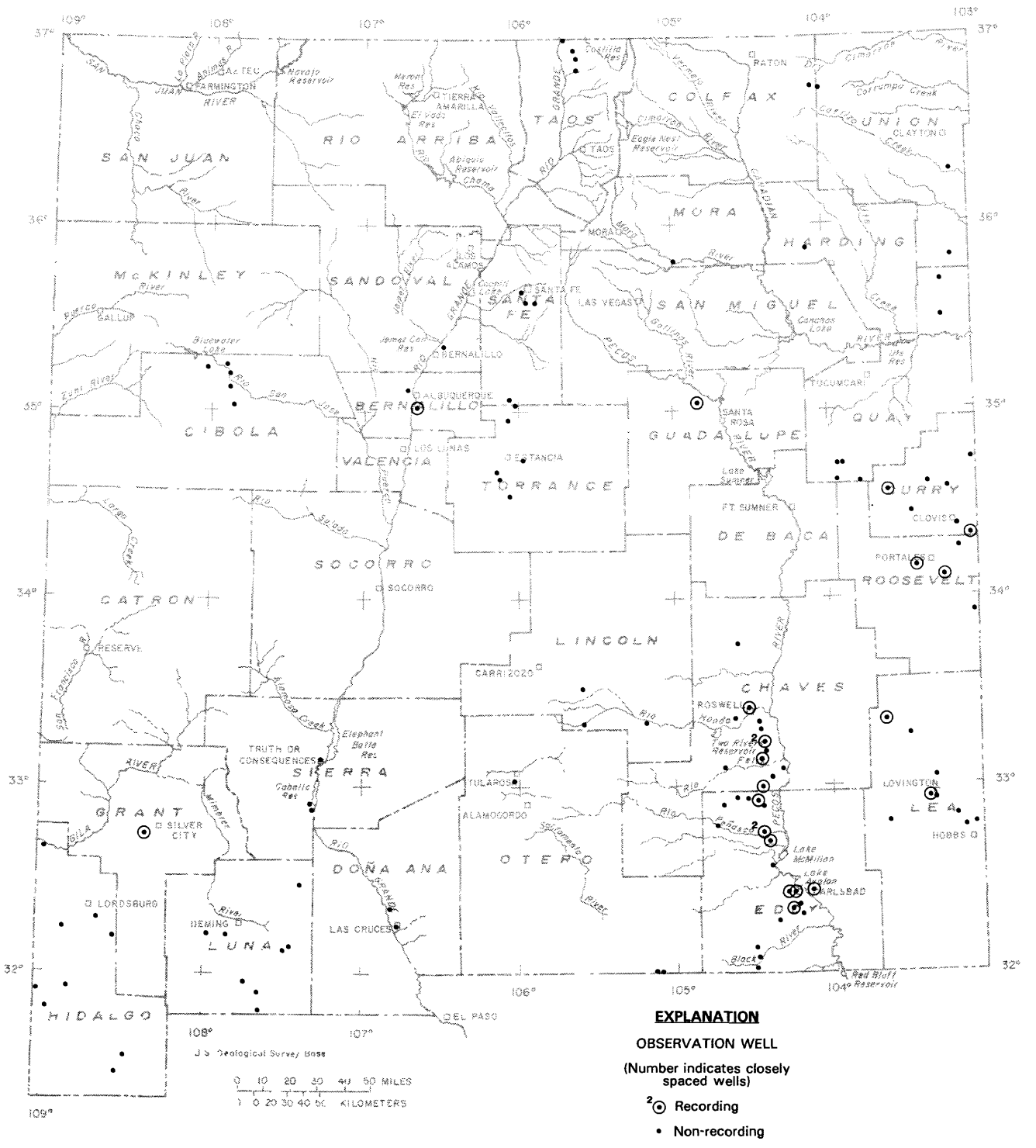


Figure 5.--Location of key observation wells.

The annual water-data report, "Water resources data, New Mexico," includes about 110 (Federal) net wells. Water levels in these wells are measured in summer and winter and the data are included in the ground-water data base. Continuous water-level recorders are maintained on 15 wells, mostly in the Roswell-Carlsbad area (fig. 5). The data base includes daily highest and lowest recorded water-level measurements for those wells.

Plans for FY 90: The schedule of 5th-year mass measurements beginning in January 1990 and scheduled to be completed by the end of March 1990 includes eight areas. These areas are: Causey-Lingo, Fort Sumner, Estancia, Salt Basin, San Simon, Middle Rio Grande, Virden, and Gila River (fig. 4). These measurements will be verified and entered into the data base along with measurements from about 200 key wells, 250 Eastern High Plains wells, and daily values from recorder wells.

The ground-water-depletion maps for the Internal Revenue Service accounting system will be completed. Base maps showing areas of mass water-level measurements, well locations, depths to water, and changes in water level since the previous measurement will be constructed for the 5-year periods 1983-88 and 1984-89.

Reports in Progress: Data from this program will continue to be published in the annual water-data report, "Water resources data, New Mexico." A new map series includes data collected in cooperation with the New Mexico State Engineer Office. Maps for the 1983-88 and 1984-89 periods for the Mimbres and Nutt-Hockett Basins are being prepared.

Reports Released:

Borland, J.P., and Beal, L.V., 1988 [1989], Water resources data, New Mexico, water year 1988: U.S. Geological Survey Water-Data Report NM-88-1, 490 p.

Borland, J.P., DeWees, R.K., McCracken, R.L., Lepp, R.L., Ortiz, David, and Shaull, D.A., 1990, Water resources data, New Mexico, water year 1989: U.S. Geological Survey Water-Data Report NM-89-1, 426 p. Reports on water-resources data for New Mexico are published annually.

Cruz, R.R., 1988, Groundwater levels, Harding County east, New Mexico, 1982-1987: New Mexico State Engineer Office Map GWL-HCE-82/87, 1 sheet.

_____1988, Groundwater levels, Harding County west, New Mexico, 1982-1987: New Mexico State Engineer Office Map GWL-HCW-82/87, 1 sheet.

_____1988, Groundwater levels, House area, New Mexico, 1982-1987: New Mexico State Engineer Office Map GWL-HA-82/87, 1 sheet.

_____1988, Groundwater levels, Mora County, New Mexico, 1982-1987: New Mexico State Engineer Office Map GWL-MC-82/87, 1 sheet.

_____1989, Groundwater levels, Clovis area, New Mexico, 1982-1987: New Mexico State Engineer Office Map GWL-CA-82/87, 1 sheet.

Cruz, R.R., 1989, Groundwater levels, Portales area, New Mexico, 1982-1987: New Mexico State Engineer Office Map GWL-PA-82/87, 1 sheet.

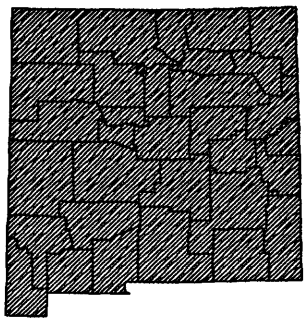
_____1990, Ground-water depletion, in feet, allowed in a part of Curry County, New Mexico, by U.S. Internal Revenue Service for calendar year 1989: New Mexico State Engineer Office Map CU-30, 1 sheet.

_____1990, Ground-water depletion, in feet, allowed in central Lea County, New Mexico, by U.S. Internal Revenue Service for calendar year 1989: New Mexico State Engineer Office Map LC-32, 1 sheet.

_____1990, Ground-water depletion, in feet, allowed in northern Lea County, New Mexico, by U.S. Internal Revenue Service for calendar year 1989: New Mexico State Engineer Office Map LN-32, 1 sheet.

_____1990, Ground-water depletion, in feet, allowed in Portales valley, Roosevelt County, New Mexico, by U.S. Internal Revenue Service for calendar year 1989: New Mexico State Engineer Office Map RO-33, 1 sheet.

WATER-QUALITY NETWORK (NM003)



Period of Project: Continuous since 1937

Study Location: Statewide

Principal Investigator: Richard Lepp

Cooperating Agencies: New Mexico State Engineer Office, U.S. Bureau of Land Management, Pecos River Commission, U.S. Bureau of Reclamation, U.S. Bureau of Indian Affairs, Canadian River Municipal Water Authority, and Federal Program

Problem: Water-resources planning and water-quality assessment require standardized information. For informed planning and assessment of water resources, the chemical, biological, and physical quality of surface water and ground water must be monitored and defined.

Objective: To provide water-quality data for Federal, State, and local planning and for management of interstate and international waters.

Approach: Operation of a network of water-quality stations provides data that describe chemical concentrations, constituent loads, and time trends. Continuous-record surface-water stations (table 3 and fig. 6) provide chemical and biological water-quality data. Information also is collected at numerous partial-record stations, miscellaneous sites, and in wells in conjunction with other projects. Approximately 11 surface-water stations also are part of the Geological Survey's nationwide network, the National Stream-Quality Accounting Network. Miscellaneous water-temperature data, recorded at the time streamflow is measured, are available from Subdistrict offices. The type of data collected and the number of continuous-record stations where those data are collected are listed in the following table:

Type of data	Number of sites
Physical data:	
Specific conductance, pH, dissolved oxygen, etc.	56
Suspended sediment	40
Chemical data:	
Major dissolved inorganic constituents	56
Chemical analyses of fluvial sediments	16
Nutrients	34
Trace elements	33
Radiochemicals	11
Organic compounds	6
Biological data:	
Bacteria	26

Table 3.--Surface-water-quality stations in operation during water year 1990

EXPLANATION

Type of data:

- B Biological (bacteria, phytoplankton, etc.)
- C Major dissolved inorganic constituents (sodium, chloride, sulfate, etc.)
- D Daily sediment
- M Chemical analyses of fluvial sediments (streambed materials or lake-bottom materials)
- N Nutrients (nitrogen and phosphorus compounds)
- O Organic compounds (insecticides, herbicides, organic carbon, etc.)
- P Physical measurements (pH, specific conductance, dissolved oxygen, etc.)
- R Radiochemicals (uranium, radium, etc.)
- S Suspended sediment (concentration and particle size)
- T Trace elements (arsenic, iron, lead, etc.)

Funding source:

- BIA - U.S. Bureau of Indian Affairs
- BLM - U.S. Bureau of Land Management
- BR - U.S. Bureau of Reclamation
- CRMWA - Canadian River Municipal Water Authority
- GS - U.S. Geological Survey
- PRC - Pecos River Commission
- SEO - New Mexico State Engineer Office/Interstate Stream Commission

Table 3.--Surface-water-quality stations in operation during water year 1990--Continued

[All stations in New Mexico unless otherwise indicated]

Station number	Station name	Type of data	Funding source	Drainage area (square miles)	Period of record (water year)
		CANADIAN RIVER BASIN			
07207000	Cimarron River near Cimarron	CNOPST	SEO	294	1979, 1981 to current year
07207500	Ponil Creek near Cimarron	CPS	SEO	171	1981 to current year
07208500	Rayado Creek at Sauble Ranch near Cimarron	CPS	SEO	65	1981 to current year
07215500	Mora River at La Cueva	CPS	SEO	173	1981 to current year
07221500	Canadian River near Sanchez	BCMNOPST	SEO	6,015	1975 to current year
07226560	Ute Reservoir at B, 0.6 mile above Ute Dam	BCMNOPST	SEO	11,140	1963 to current year
07226800	Ute Reservoir near Logan	BCMNOPST	SEO	11,140	1963 to current year
07227100	Revuelto Creek near Logan	CP	SEO, CRMWA	786	1959 to current year
		RIO GRANDE BASIN			
08251500	Rio Grande near Lobatos, Colo.	BCNPRT	GS	7,700	1969 to current year
08267500	Rio Hondo near Valdez	CNOPS	SEO	36.2	1986 to current year
08269000	Rio Pueblo de Taos near Taos	CPT	BIA	66.6	1987 to current year
08271000	Rio Lucero near Arroyo Seco	CPT	BIA	16.6	1987 to current year
08276300	Rio Pueblo de Taos below Los Cordovas	CNOPS	SEO	380	1981, 1986 to current year
08276500	Rio Grande below Taos Junction Bridge near Taos	BCMNOPST	SEO	9,730	1975 to current year
08279000	Embudo Creek at Dixon	CP	SEO	305	1970 to current year
08284100	Rio Chama near La Puente	CNOPS	SEO	480	1986 to current year
08290000	Rio Chama near Chamita	BCOPST	SEO	3,144	1948-85, 1987 to current year
08291600	Rio Grande at Santa Clara	BCOPST	BIA	--	1987 to current year
08313000	Rio Grande at Otowi Bridge	BCDMNOPRST	GS,SEO	14,300	1947 to current year

Table 3.--Surface-water-quality stations in operation during water year 1990--Continued

Station number	Station name	Type of data	Funding source	Drainage area (square miles)	Period of record (water year)
08317200	Santa Fe River above Cochiti Dam	CNOPS	SEO	231	1974-75, 1979, 1981 to current year
08317300	Cochiti Lake near Cochiti Pueblo	BCMNOPST	SEO	14,900	1981 to current year
08319000	Rio Grande at San Felipe	BCMNOPST	SEO	16,100	1975 to current year
08324000	Jemez River near Jemez	CNOPRST	SEO	470	1981 to current year
08330000	Rio Grande at Albuquerque	CD	GS,BLM, SEO	17,440	1969 to current year
08331000	Rio Grande at Isleta	BCMNOPRST	SEO	18,100	1972 to current year
08332010	Rio Grande Floodway near Bernardo	CDNOPT	SEO	19,230	1957 to current year
08334000	Rio Puerco above Arroyo Chico near Guadalupe	D	BLM	420	1948-56, 1981 to current year
08341400	Bluewater Lake near Bluewater	CPT	BIA	201	1966-69, 1987 to current year
08343500	Rio San Jose near Grants	BCMNOPRST	SEO	2,300	1980-82, 1986 to current year
08349800	Rio Paguate below Jackpile Mine near Laguna	CPRT	BIA	107	1977, 1987 to current year
08353000	Rio Puerco near Bernardo	CDPR	SEO,BLM	7,350	1947 to current year
08354800	Rio Grande Conveyance Channel at San Acacia	BCDMNOPST	SEO	--	1959 to current year
		PECOS RIVER BASIN			
08354900	Rio Grande Floodway at San Acacia	BCDMNOPST	SEO,BLM	26,770	1937-56, 1959 to current year
08358300	Rio Grande Conveyance Channel at San Marcial	BCDMNPRST	GS,SEO, BLM	--	1954 to current year

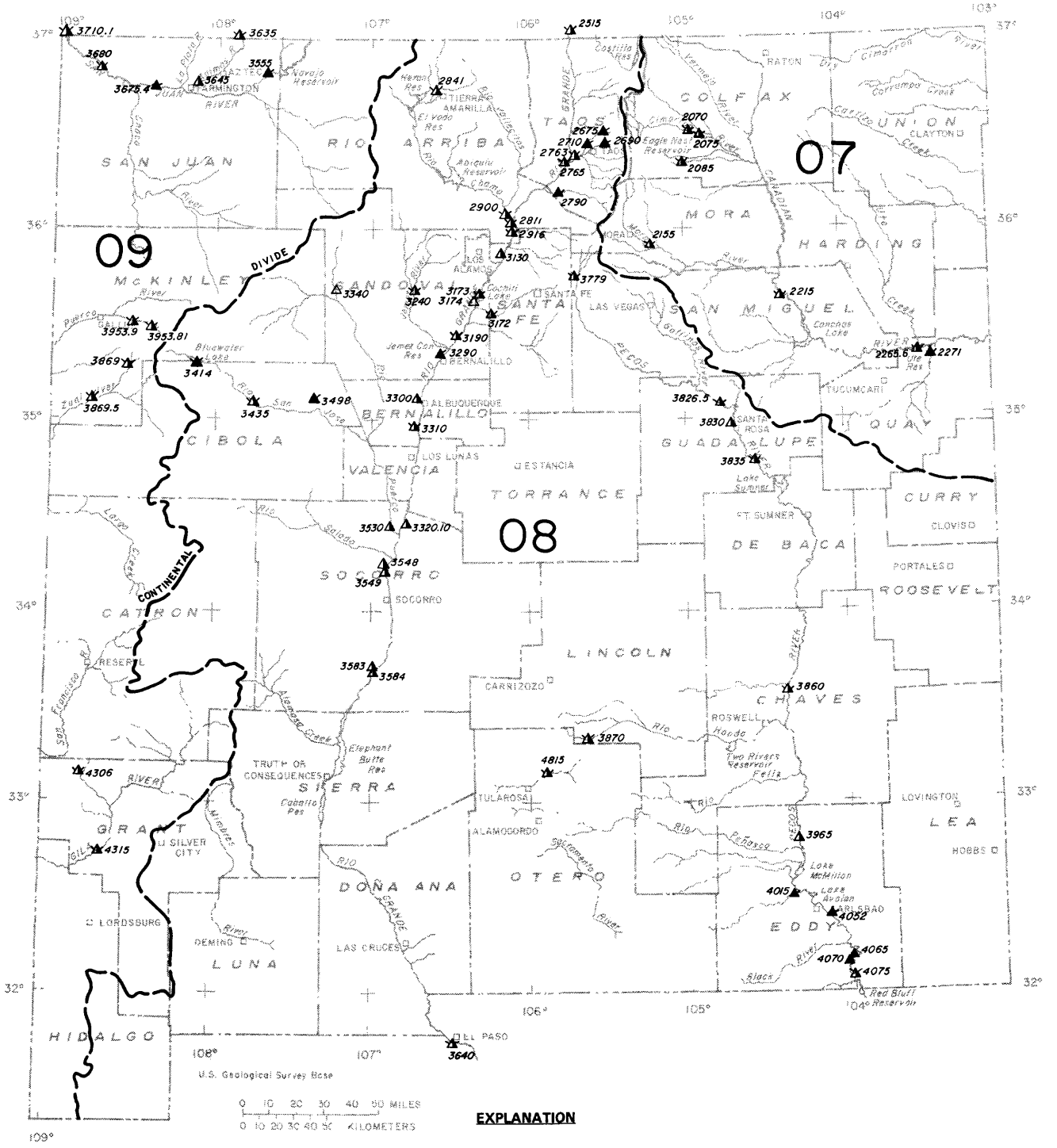
Table 3.--Surface-water-quality stations in operation during water year 1990--Continued

Station number	Station name	Type of data	Funding source	Drainage area (square miles)	Period of record (water year)
08358400	Rio Grande Floodway at San Marcial	BCDMNPRST	GS,SEO, BLM	27,700	1905-7, 1946 to current year
08364000	Rio Grande at El Paso, Tex.	BCNPST	GS	32,207	1930 to current year
08370500	Rio Grande below old Fort Quitman, Tex.	BCNPST	GS	31,944	1930 to current year
08377900	Rio Mora near Terrero	BCNPRST	GS	53.2	1963 to current year
08382650	Pecos River above Santa Rosa Lake	BCNOPST	GS,SEO	2,340	1976, 1981 to current year
08383000	Pecos River at Santa Rosa	CP	SEO	2,650	1905-7, 1959 to current year
08383500	Pecos River near Puerto de Luna	BCMNOPST	SEO	3,970	1937-66, 1972 to current year
08386000	Pecos River near Acme	CMNOPST	SEO	11,380	1937 to current year
08387000	Rio Ruidoso at Hollywood	CMNOPST	SEO	120	1963-67, 1987 to current year
08396500	Pecos River near Artesia	BCDMNOPST	SEO	15,300	1937 to current year
08401500	Pecos River below Brantley Dam near Carlsbad	CP	SEO	17,650	1960, 1962, 1978-79, 1981 to current year
08405200	Pecos River below Dark Canyon Draw at Carlsbad	CP	PRC	18,550	1972 to current year
08406500	Pecos River near Malaga	CP	PRC	19,190	1937 to current year
08407000	Pecos River at Pierce Canyon Crossing	CP	PRC	19,260	1938-41, 1952 to current year
08407500	Pecos River at Red Bluff	BCNPST	GS	19,540	1937 to current year
	TULAROSA RIVER BASIN				
08481500	Tularosa Creek near Bent	BCNOPST	GS,SEO	120	1963 to current year

Table 3.--Surface-water-quality stations in operation during water year 1990--Concluded

Station number	Station name	Type of data	Funding source	Drainage area (square miles)	Period of record (water year)
		SAN JUAN RIVER BASIN			
09355500	San Juan River near Archuleta	CP	BR	3,260	1955 to current year
09363500	Animas River near Cedar Hill	CMNOP	SEO	1,090	1943, 1945, 1958-59, 1969-73, 1975, 1987 to current year
09364500	Animas River at Farmington	BCDNPS	GS	1,360	1940 to current year
09367540	San Juan River near Fruitland	CP	BR	8,010	1978 to current year
09368000	San Juan River at Shiprock	BCMNOP[1]RST	GS,SEO	12,900	1941-45, 1951 to current year
09371010	San Juan River at Four Corners, Colo.	CP	BR	14,600	1978-81, 1985 to current year
09386900	Rio Nutria near Ramah	CPST	BIA	71.4	1978, 1980, 1987 to current year
09386950	Zuni River above Black Rock Reservoir	CPST	BIA	848	1978 to current year
09395381	Foster Canyon near Continental Divide	CNOPS	GS	16.8	1988, 1990
09395390	Sixmile Canyon near Fort Wingate	CNOPS	GS	10.7	1988, 1990
		GILA RIVER BASIN			
09430600	Mogollon Creek near Cliff	BCNPRST	GS	69	1967 to current year
09431500	Gila River near Redrock	BCNPRST	GS	2,829	1967 to current year

[1]Continuous recorder



EXPLANATION

07 LOWER MISSISSIPPI RIVER BASIN NUMBER

08 WESTERN GULF OF MEXICO BASIN NUMBER

09 COLORADO RIVER BASIN NUMBER

RIVER BASIN BOUNDARY

3953.81 ▲ STATION AND NUMBER--Number by symbol is abbreviated station number. Complete national station number is: *09 395381*

Basin number + station number

STATION AND SAMPLING FREQUENCY--

CHEMICAL QUALITY:	▲ Daily	▲ Other than daily
SUSPENDED SEDIMENT:	△ Daily	△ Other than daily
CHEMICAL QUALITY AND SUSPENDED SEDIMENT:	▲ Both daily	▲ Both other than daily
	▲ Daily chemical quality and other than daily suspended sediment	▲ Daily suspended sediment and other than daily chemical quality

Figure 6.--Location of surface-water-quality stations.

Progress and Significant Results: Chemical and biological water-quality data were obtained at 56 continuous-record surface-water stations, 15 partial-record stations, and 28 miscellaneous sites in water year 1989. Approximately 84 wells sampled in water year 1989 provided water-quality data for project activities. The water-quality data tables for water year 1989 were published in the report, "Water resources data, New Mexico, water year 1989."

Plans for FY 90: Continue the hydrologic-data network (table 3 and fig. 6) with only minor revisions from 1989.

Reports in Progress:
Water resources data, New Mexico, water year 1990.

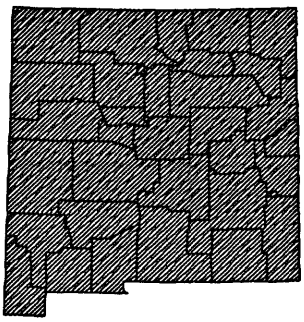
Reports Released:

Borland, J.P., and Beal, L.V., 1988 [1989], Water resources data, New Mexico, water year 1988: U.S. Geological Survey Water-Data Report NM-88-1, 490 p.

Borland, J.P., DeWees, R.K., McCracken, R.L., Lepp, R.L., Ortiz, David, and Shaull, D.A., 1990, Water resources data, New Mexico, water year 1989: U.S. Geological Survey Water-Data Report NM-89-1, 426 p. Reports on water-resources data for New Mexico are published annually.

SEDIMENT STATIONS (NM004)

Period of Project: Continuous since 1937



Study Location: Statewide

Principal Investigator: David E. Funderburg

Cooperating Agencies: New Mexico State Engineer Office, U.S. Bureau of Land Management, U.S. Bureau of Indian Affairs, and Federal Program

Problem: Water-resources planning and water-quality assessment require a data base of relatively standardized information. Sediment concentrations, sediment loads, and particle size of sediment carried in New Mexico rivers and streams need to be monitored and defined to determine the impacts of sediment loads and temporal changes.

Objective: To provide sediment data for Federal, State, and local planning needs. Information that is collected is used in the evaluation of sources of sediment, effects of changing land use, effects of water management on channel stability, and regional baseline conditions.

Approach: Establish and operate a network of sediment stations to provide spatial and temporal averages and trends of sediment concentration, sediment load, and particle size of sediment being transported in rivers and streams.

Progress and Significant Results: Collected sediment data at 55 streamflow-gaging stations in New Mexico, including continuous- and partial-record stations. Completed and published the data tables for water year 1989 in the annual water-data report, "Water resources data, New Mexico, water year 1989." Sediment stations are listed in table 3, and the locations of sediment sampling stations are shown in figure 6.

Plans for FY 90: Continue collection and analyses of sediment data in New Mexico for approximately 55 continuous- or partial-record sites.

Reports in Progress:

Water resources data, New Mexico, water year 1990.

Reports Released:

Borland, J.P., and Beal, L.V., 1988 [1989], Water resources data, New Mexico, water year 1988: U.S. Geological Survey Water-Data Report NM-88-1, 490 p.

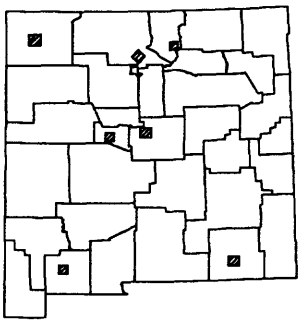
Borland, J.P., DeWees, R.K., McCracken, R.L., Lepp, R.L., Ortiz, David, and Shaull, D.A., 1990, Water resources data, New Mexico, water year 1989: U.S. Geological Survey Water-Data Report NM-89-1, 426 p. Reports on water-resources data for New Mexico are published annually.

AREAL APPRAISALS AND INTERPRETIVE STUDIES

Areal appraisals and interpretive projects undertaken in the New Mexico District are initiated for the investigation of a particular hydrologic problem or specified area. These projects may be active for several years and usually are conducted in cooperation with one or more Federal, State, tribal, or local agencies. Some projects continue for many years because of the need for long-term data collection and analysis.

FLOOD-INSURANCE STUDIES (NM006)

Period of Project: Continuous since 1983



Study Location: Rio Arriba, Taos, Eddy, Luna, and Valencia Counties; Aztec in San Juan County; and Estancia in Torrance County

Principal Investigator: H.R. Hejl

Cooperating Agency: Federal Emergency Management Agency

Problem: The National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973 provide for the operation of a flood-insurance program. The Federal Emergency Management Agency (FEMA) needs flood studies in selected areas to determine the extent of flooding for given recurrence intervals to define applicable flood-insurance-premium rates.

Objectives: (1) Conduct hydraulic analyses of selected stream reaches to determine the 100-year flood profile for those reaches. These analyses are performed as Limited Detail Studies. (2) Assist FEMA in identification of potential flood-plain encroachment violations in their Community Assistance Program.

Approach: The studies are conducted in three phases. (1) Identify unincorporated urban areas and areas within counties that need flood studies. (2) Hold community meetings to identify areas of significant growth that may be subject to flooding. (3) Study selected stream reaches to determine their 100-year flood profiles. The analyses include field determination of roughness coefficients, survey of cross sections, and computation of flood-profile altitudes.

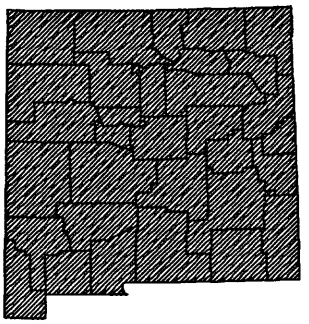
Progress and Significant Results: Limited Detail Studies have been completed for seven areas since 1983. They are: (1) Rio Arriba County, (2) Taos County, (3) Eddy County, (4) Luna County, (5) Valencia County, (6) Aztec in San Juan County, and (7) Estancia in Torrance County. Final community meetings were held for all study areas except Valencia County.

Plans for FY 90: A U.S. Geological Survey representative will attend the final community meeting for Valencia County.

Reports in Progress: A Water Fact Sheet on the probability of flooding is in preparation.

Reports Released: Limited Detail Study reports for Rio Arriba County, Taos County, Eddy County, Luna County, Valencia County, Aztec in San Juan County, and Estancia in Torrance County, and reports identifying potential flood-plain encroachment violations in the Community Assistance Program were released to FEMA.

WATER-USE DATA-ACQUISITION AND -DISSEMINATION PROGRAM (NM007)



Period of Project: Continuous since 1978

Study Location: Statewide

Principal Investigator: Lynn A. Garrabrant

Cooperating Agency: New Mexico State Engineer Office

Problem: Management of the Nation's water resources requires information on water use. In the past, no single source for accurate, consistent, timely, and accessible water-use information was available. The New Mexico State Engineer Office had collected information on water use and source of supply at 5-year intervals since 1965. In 1977, the U.S. Congress directed the Survey to establish a National Water-Use Data Program. In 1978 State and Federal efforts were combined as part of a cooperative program to standardize a National water-use information system.

Objective: To maintain a program for the collection, computer storage, and retrieval of water-use information in New Mexico using standard methods that the program will establish and refine. The Survey will maintain water-use data for New Mexico in the Aggregated Water-Use Data System (AWUDS). The Survey also will conduct interpretive studies related to specific water-use categories that are of interest to the State Engineer and the public.

Approach: Water-use data are collected and compiled at 5-year intervals by county and hydrologic unit for 12 categories of use. The data are stored in AWUDS. Reports containing basic data or results of interpretive studies will be published at periodic intervals.

Progress and Significant Results: Measured water levels in wells throughout the State as part of the 5-year-interval intensive program. Measured discharge on two ditches in northern New Mexico as part of a conveyance loss study.

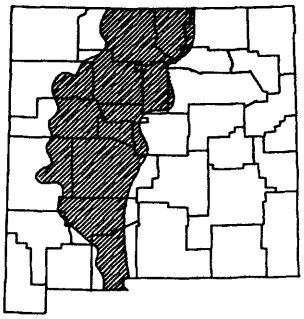
Plans for FY 90: Continue studying conveyance losses in ditches to better quantify water use as related to irrigation. Continue water-level measurements for the intensive program and data collection for a 1990 national water-use report.

Reports in Progress: None

Reports Released:

Garrabrant, L.A., 1988, Water use in New Mexico, 1985: U.S. Geological Survey Open-File Report 88-343, 1 sheet.

DUTIES OF THE RIO GRANDE COMPACT COMMISSION (NM100)



Period of Project: Continuous since 1948

Study Location: Rio Grande basin

Principal Investigator: Herbert S. Garn

Cooperating Agency: Rio Grande Compact Commission

Problem: Administration of the Rio Grande Compact requires that certain water data be collected, compiled, and presented to the Commission. The Rio Grande Compact Commission is composed of representatives from Colorado, New Mexico, and Texas. The U.S. Geological Survey acts as secretary to the Commission.

Objectives: To perform the duties of the secretary as outlined in the rules and regulations of the Rio Grande Compact Commission. The principal duties are to (1) compile monthly streamflow and storage data, (2) prepare a summary of data needed for the determination of debits and credits of water, (3) prepare and publish annual reports of the Commission, and (4) complete other tasks pertaining to the administration of the Compact.

Approach: Compile streamflow and storage data at index stations and storage facilities. Send monthly reports of reservoir contents and streamflow at Compact stations to the commissioners and other interested parties. Summarize data annually, present to the commissioners' engineer advisers, and prepare for publication in an annual report.

Progress and Significant Results: Attended the 1990 annual meeting in April. Prepared and distributed the minutes from the 1989 annual Compact meeting. Provided monthly reports of streamflow and reservoir-storage data. Prepared, published, and distributed the 1989 report of the Rio Grande Compact Commission.

Plans for FY 90: Continue secretarial duties as in previous years.

Reports in Progress:

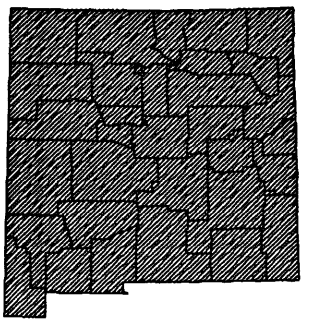
Report of the Rio Grande Compact Commission for 1990.

Reports Released:

U.S. Geological Survey, 1989, Report of the Rio Grande Compact Commission, 1988: Albuquerque, New Mexico, 55 p.

_____1990, Report of the Rio Grande Compact Commission, 1989: Albuquerque, New Mexico. Reports of the Rio Grande Compact Commission are published annually.

INFORMATION DISTRIBUTION AND PROGRAM DEVELOPMENT (NM101)



Period of Project: Continuous since 1960

Study Location: Statewide

Principal Investigator: Roy R. Cruz

Cooperating Agency: New Mexico State Engineer Office

Problem: There is a continuing need for water-resources information in New Mexico by Federal, State, and local government agencies, private industry, and the general public. This project provides support required for responding to requests for water-resources data, for special data computation required by the State Engineer Office, and for computer hardware and data-base management.

Objectives: (1) Respond to requests for data on the water resources of New Mexico. (2) Support special studies requested by the State Engineer Office.

Approach: Project coordinators in the offices of the New Mexico State Engineer and the U.S. Geological Survey handle requests made by individuals and other agencies. They provide the data requested or direct questions to other qualified staff members for response.

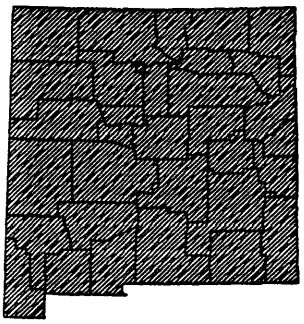
Progress and Significant Results: In fiscal year 1989, Geological Survey personnel answered 1,488 requests for information. Numerous informal requests also were answered.

Plans for FY 90: Continue responding to public information requests. Write and distribute a policy statement for responding to information requests. This project will be dropped in fiscal year 1991.

Reports in Progress: None

Reports Released: None

NEW MEXICO DISTRICT DATA BANK (NM105)



Period of Project: Continuous since 1970

Study Location: Statewide

Principal Investigator: Roy R. Cruz

Cooperating Agency: New Mexico State Engineer Office

Problem: Providing timely compilation and distribution of large quantities of hydrologic data requires efficient data-management systems. The New Mexico District computer system provides the potential for increased productivity for many projects and hydrologic applications. Effective data-base management is essential for the District to more fully utilize this potential in data processing, data dissemination, and use of personnel.

Objective: To provide project support through management, control, and maintenance of and refinements to widely used data bases such as the Ground-Water Site-Inventory (GWSI) file and the Water-Data Storage and Retrieval System.

Approach: Ground-water data are transferred from the local data base (OMNIANA) to the nationally used GWSI system.

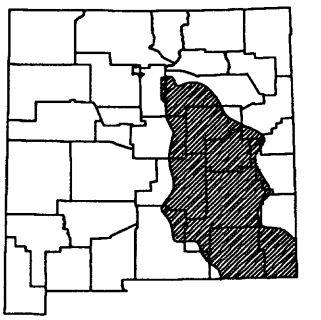
Progress and Significant Results: Ground-water and water-quality data from approximately 26,568 wells and springs are in the New Mexico District GWSI data-base file. Site-duplication checks for transfer of ground-water data from the previously used OMNIANA data base to GWSI are 75 percent complete. The GWSI data base currently is managed under the closed-system concept as part of a quality assurance program. Minimum data requirements have been established for any new sites that will be added to the GWSI data base.

Plans for FY 90: Complete site-duplication checks for OMNIANA to GWSI data-base transfer, at which time the use of OMNIANA as a data base will cease. Continue data-file cleanup and project support.

Reports in Progress: None

Reports Released: None

MISCELLANEOUS RIVER-REACH STUDIES, PECOS RIVER (NM106)



Period of Project: Continuous since 1970

Study Location: Pecos River basin

Principal Investigator: Herbert S. Garn

Cooperating Agency: Pecos River Commission

Problem: The Pecos River Commission, which administers the Pecos River Compact between New Mexico and Texas, requires that certain water data be collected, compiled, and presented to the Commission. The Commission also requests special studies about the relation of surface water, ground water, and water quality in specific reaches of the Pecos River. These data and the results of hydrologic studies are used for inflow-outflow computations to apportion water of the Pecos River equitably between New Mexico and Texas. The U.S. Geological Survey acts as secretary to the Commission.

Objectives: (1) Operate and maintain streamflow- and reservoir-gaging stations needed for the administration of the Pecos River Compact. (2) Provide administrative services to the Pecos River Commission. (3) Prepare an annual report to the Commission that summarizes special studies of surface water, ground water, and water quality in specific reaches of the Pecos River.

Approach: Collect continuous records of streamflow at stations in New Mexico and Texas for the computation of annual streamflow. Operate three water-quality stations to monitor changes between Carlsbad, New Mexico, and Red Bluff Reservoir, Texas. As secretary to the Pecos River Commission, provide administrative services including summaries of data and results of special studies, preparation of annual reports and minutes of meetings, and record keeping.

Progress and Significant Results: Completed streamflow and water-quality data-collection activities supported by the Commission for 1989. Computed the base-flow contribution in the reach of the Pecos River from Acme to Artesia and the flood inflow in the reach of the Pecos River from Carlsbad to the State line for 1989. Attended the 1990 annual meeting of the Commission in April.

Plans for FY 90: Continue routine data-collection activities supported by the Pecos River Commission and secretarial duties. Compute base-flow gain in the reach of the Pecos River from Acme to Artesia and flood inflows in the reach of the Pecos River from Carlsbad to the State line.

Reports in Progress:

Annual report to the Pecos River Commission for 1990.

Reports Released:

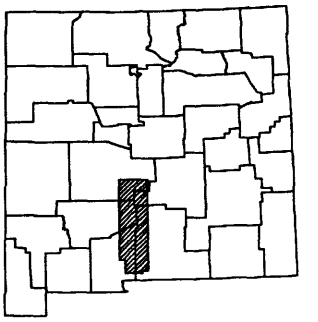
Garn, H.S., 1988, Seasonal changes in ground-water levels in the shallow aquifer near Hagerman and the Pecos River, Chaves County, New Mexico: U.S. Geological Survey Open-File Report 88-197, 19 p.

U.S. Geological Survey, 1989, Annual report to the Pecos River Commission on investigations being made in New Mexico and Texas, calendar year 1988: Albuquerque, 21 p.

U.S. Geological Survey, 1990, Annual report to the Pecos River Commission for 1989: Albuquerque, 21 p. Annual reports have been published since 1982.

Welder, G.E., 1988, Hydrologic effects of phreatophyte control, Acme-Artesia reach of the Pecos River, New Mexico, 1967-82: U.S. Geological Survey Water-Resources Investigations Report 87-4148, 46 p.

CONTINUING RECONNAISSANCE AND EVALUATION OF WATER RESOURCES ON THE WHITE SANDS MISSILE RANGE, NEW MEXICO (NM109)



Period of Project: Continuous since 1960

Study Location: South-central New Mexico

Principal Investigator: Robert G. Myers

Cooperating Agency: U.S. Department of the Army, White Sands Missile Range

Problems: (1) Because the volume of fresh ground water on the White Sands Missile Range is limited, the effects of pumpage in various well fields, such as depletion of fresh ground water and possible saline-water encroachment, need to be determined. (2) Various military projects and activities could have an environmental impact on surface water and ground water.

Objectives: (1) Collect geohydrologic information from various sites throughout the missile range and surrounding areas. (2) Obtain water-level and pumpage data so ground-water depletion can be evaluated. (3) Conduct short-term site studies where additional water supplies are needed. (4) Provide geohydrologic information to various military projects so the missile range can prepare environmental impact statements.

Approach: Monitor water levels semiannually in supply wells, test wells, and boreholes throughout the White Sands Missile Range. Monitor the chemical quality of water in selected wells throughout the missile range. Evaluate the water resources of new and existing areas. Advise and assist the missile range with geohydrological problems and projects.

Progress and Significant Results: Collected water samples from 13 wells throughout the southern range area. Prepared a plan to sample production wells in compliance with New Mexico Environmental Improvement Division's water-quality requirements for supply wells. Monitored water levels in supply wells, test wells, and boreholes and the chemical quality of water from selected test wells and supply wells throughout the missile range. Conducted field reconnaissance of selected range areas. Provided geohydrological information on request.

Plans for FY 90: Continue monitoring water levels and water quality throughout the White Sands Missile Range. Resubmit plan to sample production wells in compliance with New Mexico Environmental Improvement Division's water-quality requirements for supply wells; complete collection of water samples from all wells. Drill one monitoring well to replace the MAR-CW well and collect a water sample. Drill one test hole to as much as 1,000 feet, install one observation well, and conduct an aquifer test at the HELSTF site. Collect some surface soil samples in the vicinity of the MAR-CW well for chromium analysis. Provide geohydrological information on request.

Reports in Progress:

Basabilvazo, G.T., Myers, R.G., and Nickerson, E.L., Geohydrology of HELSTF, White Sands Missile Range, New Mexico [initial preparation].

Myers, R.G., Annual water-resources review, White Sands Missile Range, New Mexico, 1989 [initial preparation].

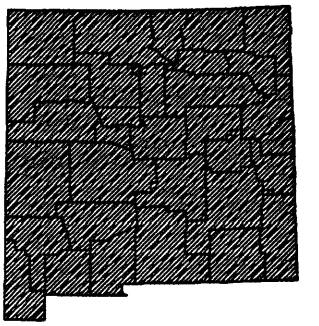
Myers, R.G., and Sharp, S.C., Annual water-resources review, White Sands Missile Range, New Mexico, 1988 [colleague review].

Reports Released:

Myers, R.G., and Sharp, S.C., 1989, Biannual water-resources review, White Sands Missile Range, New Mexico, 1986 and 1987: U.S. Geological Survey Open-File Report 89-49, 36 p.

Risser, D.W., 1988, Simulated water-level and water-quality changes in the bolson-fill aquifer, Post Headquarters area, White Sands Missile Range, New Mexico: U.S. Geological Survey Water-Resources Investigations Report 87-4152, 71 p.

INVESTIGATION AND ANALYSIS OF FLOOD DISCHARGES FOR UNREGULATED STREAMS IN NEW MEXICO (NM203)



Period of Project: August 1966 to September 1995

Study Location: Statewide

Principal Investigator: Scott D. Waltemeyer

Cooperating Agency: New Mexico State Highway Department

Problem: The State Highway Department needs data on the magnitude and frequency of floods for the design of highway structures.

Objectives: To collect, compute, and compile magnitude, volume, and flood-frequency data at gaged sites and to relate these data to basin properties that can be measured by the State Highway Department. These frequency relations are used to make hydrologic estimates at ungaged sites. Special emphasis is placed on a network that monitors sites with drainage areas of generally less than 15 square miles.

Approach: A network of 109 crest-stage gages is operated for determination of annual peak discharges for New Mexico. These data are used for regional flood-flow frequency analysis. This project is part of a regional flood-frequency study of the arid Western United States.

Progress and Significant Results: Indirect discharge measurements were completed as floods occurred. Frequency analyses for about 525 gages in the Western United States were completed. A classification was completed of anomalies found in the frequency analyses. The major anomaly found was an extraneous base discharge affecting the lower part of the frequency distribution.

Plans for FY 90: Continue measurement of annual peak discharge, which includes discharge determination by indirect means. Determine a basin measure of the 24-hour 100-year-recurrence maximum precipitation for about 1,500 streamflow-gaging stations in the regional study area. Study generalized skew coefficients of annual peak discharge. Determine regional relations from basin and climatic characteristics.

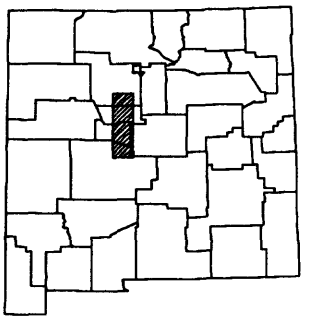
Reports in Progress: WRD Bulletin and journal articles.

Reports Released:

Thomas, R.P., and Gold, R.L., 1982, Techniques for estimating flood discharges for unregulated streams in New Mexico: U.S. Geological Survey Water-Resources Investigations 82-24, 42 p.

Waltemeyer, S.D., 1986, Techniques for estimating flood-flow frequency for unregulated streams in New Mexico: U.S. Geological Survey Water-Resources Investigations Report 86-4104, 56 p.

GROUND-WATER-LEVEL MONITORING IN THE ALBUQUERQUE-BELEN BASIN, NEW MEXICO (NM240)



Period of Project: Continuous since 1982

Study Location: Albuquerque-Belen Basin

Principal Investigator: Dale Rankin

Cooperating Agency: City of Albuquerque

Problem: Ground water is used for all domestic and industrial purposes in the basin. A population increase of approximately 100 percent from 1960 to 1980 has increased the demand for ground water, increasing the stress on the ground-water system. Stress on the aquifer cannot be quantified without knowledge of water-level changes.

Objectives: (1) Develop a ground-water data base to document the basin's hydrologic system. (2) Monitor changes in ground-water levels as the system responds to increased stresses.

Approach: Establish a water-level-monitoring network using available wells. Equip several wells with continuous-recording equipment and measure other wells at regular intervals.

Progress and Significant Results: Continued water-level data collection and network evaluation. Entered data into GWSI computer files. Published a data report summarizing water-level data through water year 1985. Prepared a data report for the cooperator summarizing water-level data for each subsequent year.

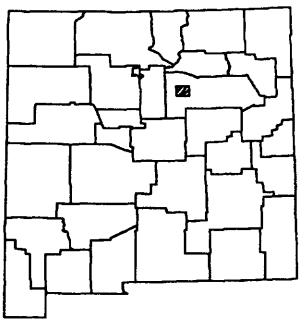
Plans for FY 90: Continue water-level data collection and network evaluation. Prepare a data report for the cooperator for water years 1985-90.

Reports in Progress: Progress report for the City of Albuquerque.

Reports Released:

Kues, G.E., 1987, Ground-water-level data for the Albuquerque-Belen Basin, New Mexico, through water year 1985: U.S. Geological Survey Open-File Report 87-116, 51 p.

EFFECTS OF FOREST MANAGEMENT PRACTICES ON WATER QUALITY OF A HIGH MOUNTAIN STREAM IN THE SOUTHERN ROCKY MOUNTAINS OF NEW MEXICO (NM260)



Period of Project: April 1987 to September 1992

Study Location: Northwestern San Miguel County

Principal Investigator: Herbert S. Garn

Cooperating Agencies: New Mexico Environmental Improvement Division; City of Las Vegas, New Mexico; and New Mexico Highlands University

Problem: Hydrologic studies are needed to determine the effects on water quality from forest harvesting activities in New Mexico and the Southwest. Such information can be used to evaluate the effectiveness of water-quality management plans and to develop the best silvicultural management practices to control nonpoint-source pollution.

Objectives: (1) Establish baseline water-quality data to evaluate the effects of forest harvesting practices and road construction activities on the chemical and biotic characteristics of a mountain stream. (2) Compare the changes, if any, in stream quality to water-quality standards and the designated uses of the stream. (3) Relate these changes in stream quality to land-use practices.

Approach: Paired upstream and downstream water-quality stations in a municipal water-supply watershed (Gallinas Creek) and a watershed to be logged (Tecolote Creek) will be used to establish baseline water-quality data and to monitor the effects of timber harvesting and road construction activities. Stations will be operated seasonally to coincide with runoff from snowmelt and summer thunderstorms, which produce the bulk of the annual precipitation. Water characteristics and constituents to be analyzed include suspended sediment and other physical characteristics, and chemical (major ions and nutrients) and biological (aquatic invertebrates) attributes.

Progress and Significant Results: Collected water-quality data at five sampling sites on Gallinas Creek and five sampling sites on Tecolote Creek and continuous streamflow data at three of the five sites on Tecolote Creek. Collected 85 water-quality samples at all sites in addition to samples collected by automatic water samplers during five storms. Collected two sets of aquatic invertebrate samples at each site. Data for 1989 were included in the annual data report, "Water resources data, New Mexico."

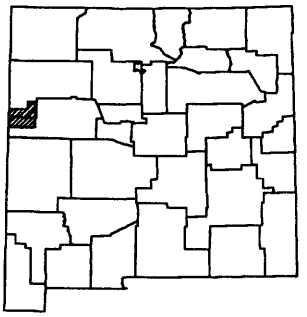
Plans for FY 90: Continue data collection during the frost-free season to monitor water-quality characteristics. Compute records and prepare 1990 data for publication in the annual data report, "Water resources data, New Mexico." Analyze and summarize water-quality data for Gallinas Creek.

Reports in Progress: None

Reports Released:

Garn, H.S., Piatt, Jim, and Sims, Bruce, 1989, Water-quality monitoring to evaluate best management practices of timber harvesting activities, Tecolote Creek watershed, New Mexico [abs.]: American Water Resources Association, Conference on Advances in Management of Southwestern Watersheds, Socorro, New Mexico, 1989, Proceedings.

TEST DRILLING AND HYDROLOGIC INVESTIGATIONS ON THE PUEBLO OF ZUNI, NEW MEXICO (NM261)



Period of Project: October 1987 to September 1991

Study Location: Cibola and McKinley Counties, west-central New Mexico

Principal Investigator: Thomas M. Crouch

Cooperating Agency: Pueblo of Zuni

Problem: Economic growth and development on the Pueblo of Zuni are dependent partly on the availability of adequate supplies of good-quality water for agriculture and industry. Recent water-rights litigation has created a need to evaluate the quality and availability of surface water and ground water on the pueblo to ensure its protection. Hydrologic information is needed in selected areas to plan for the pueblo's future water supplies and to protect its water resources.

Objective: To obtain quantitative information on aquifer properties, streamflow, water-level fluctuations, and water quality on selected areas of the Pueblo of Zuni where such information is lacking, as identified in previous studies.

Approach: Drill test and observation wells in areas of interest. Conduct one- or two-well aquifer tests, using new and existing wells, to determine aquifer properties. Collect water samples and test water quality. Install a streamflow-gaging station on the Zuni River near Arizona to monitor river stage for about 2 years and to collect water-quality samples. Evaluate Zuni River discharge from records obtained at this new station (outflow) and the existing gaging station near Black Rock (inflow). Install recorders and monitor water levels in as many as seven wells. Evaluate natural and human-induced water-level fluctuations.

Progress and Significant Results: Constructed a large-capacity test well (ZS-3) and observation wells in the San Andres-Glorieta aquifer. Conducted an aquifer test by pumping for 10 days at 2,600 gallons per minute and recording measurements in wells and springs. Operated recorders on four San Andres-Glorieta wells. Drilled a test well (ZNE-1) 2,840 feet deep into the San Andres-Glorieta aquifer northeast of Black Rock. Operated three gaging stations on the Zuni River and a tributary.

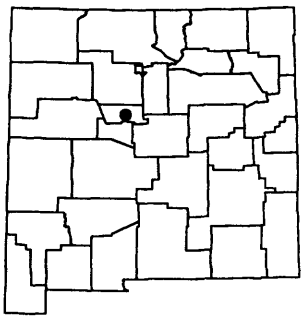
Plans for FY 90: Complete a report on the results of the aquifer test at well ZS-3. Develop and test well ZNE-1 and install a water-level recorder. Operate water-level recorders on four other San Andres-Glorieta wells. Continue Zuni River monitoring and sampling.

Reports in Progress:

Crouch, T.M., Evaluation of the Bidahochi and San Andres-Glorieta aquifers on parts of the Zuni Indian Reservation, McKinley and Cibola Counties, New Mexico: U.S. Geological Survey Water-Resources Investigations Report 89-4192 [in press].

Reports Released: None

SIMULATION OF THE EFFECTS OF URBANIZATION IN A DESERT PLATEAU ENVIRONMENT THROUGH THE USE OF KINEMATIC MODELING IN ALBUQUERQUE (NM262)



Period of Project: October 1986 to September 1990

Study Location: Albuquerque

Principal Investigator: Richard P. Thomas

Cooperating Agencies: Albuquerque Metropolitan Arroyo Flood Control Authority and the City of Albuquerque

Problem: The Albuquerque Metropolitan Arroyo Flood Control Authority and the City of Albuquerque require information that will allow them to design engineering works that will accommodate expected increases in runoff peaks and volumes. The relation between urbanization and runoff characteristics in the desert plateau environment of Albuquerque needs to be defined, and the changes in runoff characteristics relative to changes in urbanization need to be defined.

Objective: To develop a single calibrated watershed model for the Albuquerque area where differences between individual watersheds will be modeled by deterministic changes to specific, physically based properties.

Approach: (1) Segment each of the basins using ARC/INFO[1] geographic information system software. (2) Calibrate the Geological Survey's Distributed Routing Rainfall-Runoff (DR3M) Watershed Model for each of the nine watersheds within the Albuquerque Urban Hydrology Program. (3) Combine individual calibrations into a single calibrated model with deterministic variables defining the differences between watersheds. (4) Use long-term Albuquerque rainfall data to compute a series of runoff characteristics that would be expected to occur as undeveloped watersheds begin to be developed.

Progress and Significant Results: The DR3M model was calibrated for Academy Acres Drain, Taylor Ranch Drain, and Grant Line Arroyo at Villa del Oso. ARC/INFO was used to segment the basins for six of the nine watersheds and to determine basin area, subbasin areas, and channel lengths. A procedure was developed to compute surface slopes for the basins and subbasins. Rainfall and runoff data are in Watershed Data Management files for use with the model.

Plans for FY 90: Finish calibration at all watersheds and write report.

[1]Use of trade names in this report is for identification purposes only and does not constitute endorsement by the U.S. Geological Survey.

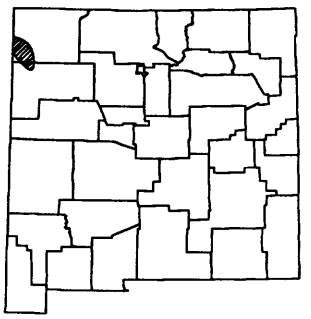
Reports in Progress: A journal report, "Application of the watershed model (DR3M) on a small urban watershed," has been completed and submitted for consideration for publication in the AWRA Water Resources Bulletin.

Metzker, K.D., Thomas, R.P., and Ortiz, David, Rainfall and runoff data for the Albuquerque, New Mexico, metropolitan area, 1984-88: U.S. Geological Survey Open-File Report [colleague review].

Reports Released:

Fischer, E.E., Rote, J.J., and Borland, J.P., 1984, Rainfall-runoff data in the Albuquerque, New Mexico, metropolitan area, 1976-83: U.S. Geological Survey Open-File Report 84-48, 306 p.

ASSESSMENT OF THE SENSITIVITY OF CHUSKA MOUNTAIN LAKES TO ATMOSPHERIC DEPOSITION (NM264)



Period of Project: March 1987 to September 1992

Study Location: Northwestern New Mexico

Principal Investigator: Scott K. Anderholm

Cooperating Agency: Navajo Nation

Problem: High mountain watersheds in New Mexico may be susceptible to the effects of atmospheric deposition from point-source emissions of sulfur dioxide (SO_2) and nitrogen compounds (NO(x)), acid precursors. Baseline data necessary to assess the sensitivity of lakes in the Chuska Mountains to atmospheric deposition are not available. Most baseline limnological data in New Mexico indicate that lakes at altitudes below 10,000 feet above sea level are relatively insensitive to changes in atmospheric chemistry. However, it has been hypothesized that in some New Mexico lakes, large concentrations of cadmium, chromium, mercury, and zinc have resulted from atmospheric pollution or leaching by precipitation.

Objectives: (1) Assess the precipitation chemistry, including trace elements, in the Chuska Mountains. (2) Characterize and evaluate the chemistry of selected lakes in the mountains.

Approach: Establish an atmospheric-deposition station in the Chuska Mountains for biweekly sampling. Select several lakes for water-quality sampling. Survey those selected lakes to be sampled to determine depths and the occurrence, if any, of vertical stratification.

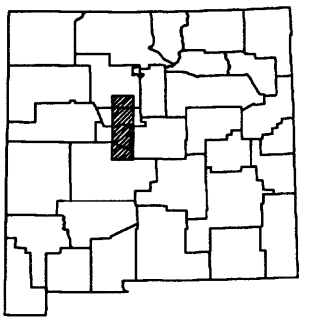
Progress and Significant Results: Operated an atmospheric-deposition station in the Chuska Mountains from September 1987 to September 1988. Sampled six lakes (Asaayi Lake, Long Lake, Whiskey Lake, Berland Lake, Toadlena Lake, and Tsaile Lake) in fall 1987 and spring 1988. Funding was discontinued in fiscal year 1989 so no additional work was done in fiscal year 1989.

Plans for FY 90: Funding for the project will start again in May 1990. The atmospheric-deposition station will be reestablished and operated for approximately 1 year and the six lakes sampled earlier will be resampled in fall 1990.

Reports in Progress: None

Reports Released: None

WATER-RESOURCES INVESTIGATIONS IN THE ALBUQUERQUE BASIN (NM265)



Period of Project: July 1987 to September 1990

Study Location: Parts of Sandoval, Bernalillo, and Valencia Counties

Principal Investigator: Dave W. Wilkins

Cooperating Agency: City of Albuquerque

Problem: Albuquerque is the largest single user of ground water in the Albuquerque Basin. As the prime consumer of water from the Santa Fe Group, the City recognizes its responsibility to take the lead in understanding this resource and using it wisely. As a result, the City of Albuquerque and the U.S. Geological Survey are participating in a program to identify and quantify hydrologic aspects of the interconnected ground-water and surface-water systems.

The short-term component of the program is to conduct water studies to help determine the siting of new city wells. The long-term components are to collect, compile, and interpret geohydrologic information regarding the city's long-term water supply.

Objectives: To develop basinwide information about the water resources that will assist in developing an adequate supply of good-quality water for many years to come. The following are considered in this program:

(1) Evaluation of ground-water and surface-water resources of the study area.
(2) Estimates of the effect of present and projected water demands on the surface-water/ground-water relation.
(3) Evaluation of the potential for augmenting the city's ground-water supply.

Approach: Compile and collect geophysical-log data from wells, evaluate ground-water resources in the Rio Grande flood plain, evaluate ground-water quantity and ground-water quality, and evaluate potential for ground-water recharge.

Progress and Significant Results: Published a basin sediments lithologic report. Added more than 250 geophysical well logs to a geophysical-log data base. Entered about 3,000 water-quality analyses into a data base that was established to store non-Survey water-chemical data. In a water-budget study of the Rio Grande flood plain, collected more than 1 year of surface-water data, and began compilation of evapotranspiration data in a reach of the Rio Grande within the Albuquerque city limits. Collected streamflow, soil-moisture-potential, and evapotranspiration data from two sites in the eastern part of the city to determine aquifer recharge from arroyo channels.

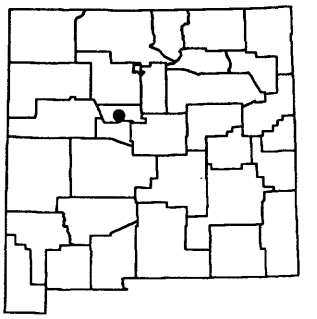
Plans for FY 90: Continue adding data to the geophysical data base and investigate different interpretation techniques using different logs. Add data to the water-quality data base. Continue collecting streamflow data for the Rio Grande budget study, and estimate water use by riparian vegetation using previous studies of the flood plain and published values of water use for those vegetation types present. Continue collecting evapotranspiration and soil-moisture data and make preliminary estimates of recharge to alluvial aquifers around Albuquerque.

Reports in Progress: Reports concerning a water budget of the Rio Grande flood plain near Albuquerque, New Mexico, and potential recharge through arroyo channels in the Albuquerque area are in preparation.

Reports Released:

Kaehler, C.A., 1990, Lithology of basin-fill deposits in the Albuquerque-Belen Basin, New Mexico: U.S. Geological Survey Water-Resources Investigations Report 89-4162, 14 p.

DEVELOPMENT OF AN ALGORITHM FOR CHANNEL TRANSMISSION LOSS AND PEAK-FLOW ATTENUATION IN EPHEMERAL STREAMS IN NEW MEXICO (NM266)



Period of Project: October 1987 to September 1991

Study Location: Albuquerque metropolitan area

Principal Investigator: Richard P. Thomas

Cooperating Agencies: Albuquerque Metropolitan Arroyo Flood Control Authority and the City of Albuquerque

Problem: Substantial volumes of water can be lost into a channel bed as a flood wave moves down an ephemeral stream. Peak discharges can also be significantly attenuated. These hydrographic changes need to be quantified to allow a more precise estimation of peak discharges and to enable the modeling of water losses and attenuation in ephemeral channels.

Objective: To develop an algorithm for incremental transmission loss and peak attenuation that can be applied in the Geological Survey's DR3M Watershed Model.

Approach: (1) Review literature and previous studies and evaluate developed equations for transferability. (2) Develop equations that will compute increments of loss and attenuation. (3) Verify equations using data collected from New Mexico study sites. (4) Develop algorithm using final equation. (5) Apply algorithm to DR3M and install in the ANNIE watershed model management system.

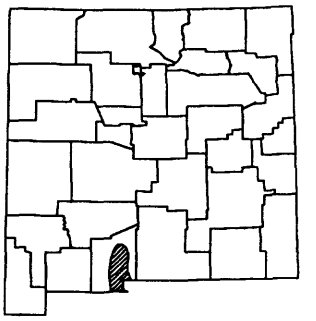
Progress and Significant Results: Literature and previous study results were collected and are being reviewed. Streamflow-gaging stations were installed at four reaches of Grant Line Arroyo, Tijeras Arroyo, and Coyote Arroyo in the Albuquerque area of data collection.

Plans for FY 90: Continue review of literature and previous studies, and evaluate published equations. Continue data collection at existing reaches and begin collation of data.

Reports in Progress: None

Reports Released: None

MONITORING NETWORK OF THE GROUND-WATER FLOW SYSTEM IN THE MESILLA BASIN, SOUTH-CENTRAL NEW MEXICO (NM267)



Period of Project: October 1987 to September 1992

Study Location: Mesilla Basin in Doña Ana County, New Mexico, and El Paso County, Texas

Principal Investigator: Edward L. Nickerson

Cooperating Agencies: New Mexico State Engineer Office, Elephant Butte Irrigation District, City of Las Cruces, and New Mexico State University

Problem: Urban growth within the Mesilla Basin and adjacent areas has resulted in a significant increase in ground-water withdrawals. Historically, ground-water data within the basin have been obtained on a nonrecurring and unsystematic basis. Economic and efficient management of the surface-water and ground-water resources of the Mesilla Basin requires monitoring the magnitudes and rates of water-level changes in wells throughout the basin and their relation to the surface-water system.

Objectives: (1) Document changing hydrologic conditions within the Mesilla ground-water basin. (2) Establish a continuous, long-term ground-water data base that will permit quantitative evaluation of the surface-water and ground-water flow systems.

Approach: Annual water-level measurements will be made in the wells currently in the Mesilla Basin observation-well network. These network wells are completed in the Rio Grande flood-plain alluvium/Santa Fe Group aquifer system.

Continuous hydrologic data will be collected at three Mesilla Valley hydrologic sections located at Las Cruces, near Mesquite, and near Cañutillo. Each hydrologic section consists of a river-stage station and several observation-well groups aligned perpendicular to the Rio Grande at depth intervals from 35 to 801 feet. The hydrologic sections consist of a total of 3 river-stage stations and 34 observation wells equipped with water-level recorders to collect continuous water-level data.

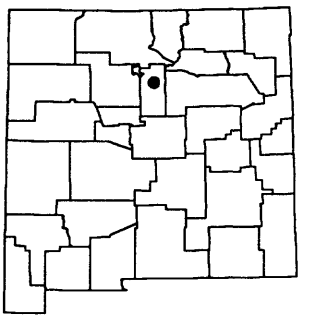
Progress and Significant Results: Made annual water-level measurements in 162 wells in the Mesilla Basin observation-well network. Collected continuous water-level data from 3 river-stage stations and 34 wells at the Mesilla Valley hydrologic sections.

Plans for FY 90: Measure water levels in 162 network observation wells. Continue operation and maintenance of the Mesilla Valley hydrologic sections. Approximately 14 of 34 recorder wells were discontinued in February 1990.

Reports in Progress: None

Reports Released: None

RECHARGE STUDY IN THE SANTA FE AREA (NM268)



Period of Project: July 1987 to September 1990

Study Location: North-central New Mexico

Principal Investigator: Scott K. Anderholm

Cooperating Agencies: Santa Fe Metropolitan Water Board and New Mexico State Engineer Office

Problem: Because of increases in population and the subsequent increase in water use in the Santa Fe area, planners and managers have expressed interest in a more detailed understanding of the ground-water flow system. Identification of sources and volumes of recharge to an aquifer is important in the understanding of the ground-water system.

Objectives: (1) Determine sources and volumes of recharge to the basin-fill aquifer in the vicinity of Santa Fe. (2) Estimate the percentages of potential recharge lost to evapotranspiration and evaporation.

Approach: The approach is based on the premise that various sources of recharge water have unique chemical properties that can be used to examine the amount of recharge that occurs and the movement of ground water from recharge areas to discharge areas. Samples from various sources of recharge, such as precipitation, snowmelt, and summer thunderstorm runoff from adjacent mountainous areas, will be collected and the stable isotopic composition will be measured. The areal distribution of the stable isotopic composition of ground water will be compared with the isotopic composition of the sources of recharge to evaluate the relative significance of the various sources of recharge. A mass balance method using chloride concentrations of precipitation and water in the unsaturated and saturated zones will be used to estimate the percentages of recharge lost to evapotranspiration and evaporation.

Progress and Significant Results: Estimated direct and mountain-front recharge for several areas near Santa Fe. Submitted for colleague review a report documenting the techniques used and the results.

Plans for FY 90: Have the subject report approved and published.

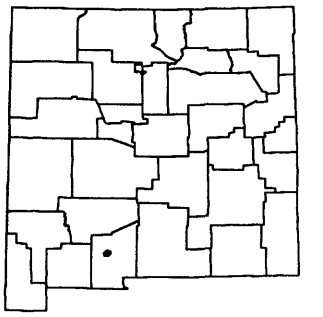
Reports in Progress:

Anderholm, S.K., Ground-water recharge near Santa Fe, north-central New Mexico: U.S. Geological Survey Water-Resources Investigations Report [colleague review].

Wasiolek, Maryann, Calculation of subsurface recharge along the western side of the Sangre de Cristo Mountains from selected drainage basins near Santa Fe, New Mexico: U.S. Geological Survey Water-Resources Investigations Report [colleague review].

Reports Released: None

DETERMINATION OF INCISED, BURIED ARROYO CHANNELS IN THE HORST SEPARATING THE SOUTHERN JORNADA DEL MUERTO GROUND-WATER BASIN AND MESILLA GROUND-WATER BASIN, DOÑA ANA COUNTY, NEW MEXICO (NM269)



Period of Project: October 1988 to September 1993

Study Location: South-central New Mexico

Principal Investigator: Robert G. Myers

Cooperating Agencies: New Mexico State Engineer Office and City of Las Cruces

Problem: Geohydrologic data indicate that ground water in the Jornada del Muerto Basin moves north and some water moves west over a horst separating the Jornada del Muerto ground-water basin from the Mesilla ground-water basin; in some areas, however, the sediments overlying the horst are dry. Incised, buried arroyo channels through the horst may transmit ground water from the Jornada del Muerto ground-water basin to the Mesilla ground-water basin.

Objective: To locate incised, buried arroyo channels in the horst separating the southern Jornada del Muerto ground-water basin from the Mesilla ground-water basin.

Approach: Three seismic-reflection lines perpendicular to the horst will be used to locate the axis of the horst. One seismic-reflection line, about 8 miles long, will be run parallel to the axis of the horst to determine the possible locations of incised, buried arroyo channels. One well will be drilled in a buried channel to collect geohydrologic information.

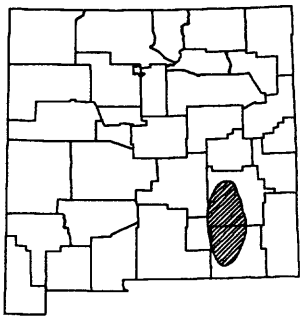
Progress and Significant Results: Completed data collection for three seismic-reflection lines perpendicular to the horst for a total of 9.5 miles, and one line parallel to the axis of the horst 1.75 miles long south of U.S. Highway 70.

Plans for FY 90: Obtain a report from the contractor of interpretation of data collected in fiscal years 1988 and 1989. Because of funding problems the project was suspended for fiscal year 1990. If funding later becomes available, continue with seismic-reflection line parallel to the axis of the horst south of U.S. Highway 70 and select a test-hole site.

Reports in Progress: None

Reports Released: None

SIMULATION OF GROUND-WATER FLOW IN THE ROSWELL BASIN, CHAVES AND EDDY COUNTIES, NEW MEXICO (NM271)



Period of Project: January 1988 to December 1997

Study Location: Southeastern New Mexico

Principal Investigator: Douglas P. McAda

Cooperating Agency: New Mexico State Engineer Office

Problem: Large-scale uses of ground water in the Roswell Basin have resulted in diminution of streamflow in the Pecos River and its tributaries, deterioration of the chemical quality of the surface waters, loss of hydraulic head in the major aquifers, and deterioration of the chemical quality of ground water in the vicinity of the city of Roswell and areas north of Roswell. Particular aspects of the general problem have been studied individually. However, it has not been possible to quantitatively correlate the findings of all studies in order to formulate, with a large degree of assurance, a basinwide program that will result in optimum distribution and use of the available water resources.

Objectives: (1) Gain a better understanding of the interaction between the confined aquifer, water-table aquifer, Pecos River, and other major hydrologic components of the basin. (2) Demonstrate the effects of ground-water withdrawals on streamflow in the Pecos River. (3) Develop a water-management tool that can be used to determine the effects on streamflow in the Pecos River by changing ground-water withdrawals from different areas of the basin.

Approach: Compile information describing the geologic framework, aquifer characteristics, recharge, irrigated acreage, ground-water withdrawal, and surface-water diversions into computerized format for future use in constructing and calibrating a ground-water flow model of the Roswell Basin. A geographic information system (GIS) will be used to manipulate this spatial data. The GIS will be used to construct a geohydrologic data base that can be used to generate additional models for specific water-management applications.

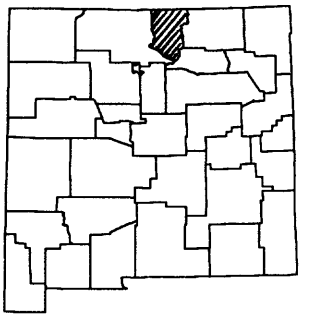
Progress and Significant Results: Work continued on compilation of the geohydrologic data base.

Plans for FY 90: Continue compilation of the geohydrologic data base.

Reports in Progress: None

Reports Released: None

WATER RESOURCES OF TAOS COUNTY, NEW MEXICO (NM272)



Period of Project: October 1987 to September 1990

Study Location: North-central New Mexico

Principal Investigator: Lynn A. Garrabrant

Cooperating Agencies: New Mexico State Engineer Office, New Mexico Bureau of Mines and Mineral Resources, and New Mexico Environmental Improvement Division

Problem: The surface waters of Taos County are fully appropriated and may be insufficient to meet all future demands. Ground water is the main source of water for domestic use, but little is known about the extent of ground-water supplies.

Objective: To make a general assessment of the quantity and quality of ground water and surface water in Taos County.

Approach: Assemble all available hydrologic data for Taos County, and collect new data where needed. Review the ground-water data-collection network and add new stations as needed.

Progress and Significant Results: Reviewed literature about the area and compiled an extensive bibliography. Reviewed all data in the Survey's data bases and some data collected and reported by State agencies and private consultants. Inventoried and added to the existing ground-water data-collection network several new ground-water sites. Completed field work, gathered additional ground-water data, and entered the additional data into the data base. Collected and analyzed water samples from wells throughout the county to supplement existing ground-water-quality data. Studied the relation between surface water and ground water using data from 12 streamflow-gaging stations currently operating. Collected water-use data from various sources. Compiled data for tables and illustrations for the report.

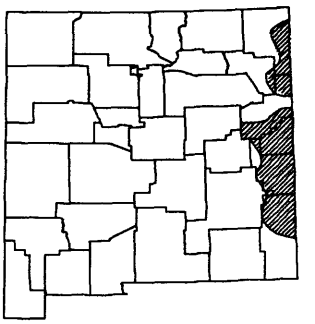
Plans for FY 90: Prepare report for review and approval.

Reports in Progress:

Garrabrant, L.A., Water resources of Taos County, New Mexico: U.S. Geological Survey Water-Resources Investigations Report [initial preparation].

Reports Released: None

WATER-LEVEL MONITORING IN THE HIGH PLAINS OF NEW MEXICO (NM273)



Period of Project: March 1988 to September 1993

Study Location: Eastern New Mexico

Principal Investigator: Roy R. Cruz

Cooperating Agency: New Mexico State Engineer Office

Problem: The distribution of observation wells in the High Plains area is not adequate to characterize satisfactorily the water-level changes in the aquifer. The present monitoring system neither provides adequate data on seasonal water-level fluctuations nor makes these data readily available to interested parties.

Objectives: (1) Enter existing and newly collected water-level data into a data base in which the data may be retrieved and plotted using computer techniques. (2) Add additional monitoring wells to the water-level monitoring network and install recorders to monitor daily fluctuations, thus allowing more detailed analysis of water-level changes shown by annual water-level measurements.

Approach: Water-level data in the data base will initially be located by latitude and longitude. Approximately 17 new wells will be selected for water-level monitoring on a quarterly basis, four in the House area and the remainder in northeastern New Mexico. Four recorders have been installed on wells in the Clovis-Portales area and one in the Lovington area. In the Clovis-Portales area, two wells with recorders will be in major pumpage centers to measure aquifer stress, and two will be away from the pumpage centers to monitor stress that may not be directly related to agricultural activities of the area.

Progress and Significant Results: Formulated a work plan and entered water levels and locations of wells into a data base. Measured quarterly water levels in 17 new wells. Obtained continuous water-level data from recorders.

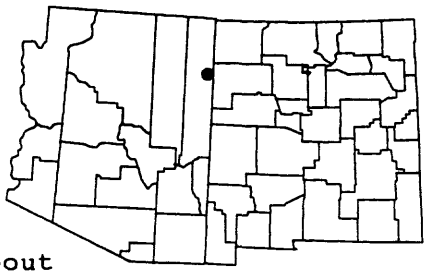
Plans for FY 90: Measure water levels quarterly and service the recorders. Update water-level data base.

Reports in Progress: None

Reports Released:

Kastner, W.M., Schild, D.E., and Spahr, D.S., 1989, Water-level changes in the High Plains aquifer underlying parts of South Dakota, Wyoming, Nebraska, Colorado, Kansas, New Mexico, Oklahoma, and Texas--Predevelopment through nonirrigation season 1987-88: U.S. Geological Survey Water-Resources Investigations Report 89-4073, 61 p.

WATER USE OF SAGEBRUSH AND REPLACEMENT GRASS IN NORTHEASTERN ARIZONA (NM274)



Period of Project: May 1988 to September 1991

Study Location: Northeastern Arizona

Principal Investigator: Carole L. Goetz

Cooperating Agency: Navajo Nation

Problem: Little information is available about evapotranspiration, precipitation, and infiltration of precipitation in the lower areas of the Chuska Mountains. To manage these areas for grazing, evapotranspiration rates of sagebrush need to be determined as guidelines for selecting replacement grasses that have similar evapotranspiration rates. Evapotranspiration from pasture grass and infiltration characteristics of precipitation into a grass ground cover are not known.

Objectives: (1) Determine the evapotranspiration rates of sagebrush and replacement grass in lower areas of the Chuska Mountains. (2) Determine the depth of precipitation infiltration for sagebrush and replacement grass.

Approach: Two sites that have sagebrush cover will be selected. Bowen-ratio evapotranspiration data-collection equipment, using chilled-mirror technology, will be installed to determine water use by sagebrush. Soil-matric-potential and temperature sensors connected to data loggers will be installed. The sensors will be at depths of 6, 12, and 24 inches. The character of the soil column will be described and precipitation gages will be installed. The sagebrush cover at one site will be removed after the first year of data collection and grass seeded at the selected area. The same data will be collected for the grass cover as for the sagebrush covers.

Progress and Significant Results: Two evapotranspiration stations installed over sagebrush about 6 miles north of Fort Defiance, Arizona, show that evapotranspiration rates during May through November generally are less than 1 millimeter per day. After rainfall, evapotranspiration rates increase to 1 to 3 millimeters per day. Rainfall received from April through November is entirely consumed as evapotranspiration.

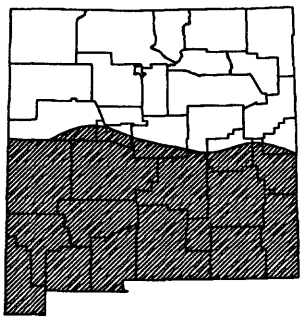
Soil-matric-potential and temperature sensors indicate a wetter soil condition and slightly cooler temperatures at the southern station. Sagebrush was cleared from this station.

Plans for FY 90: Plant a mixture of grasses, including Indian ricegrass, four-wing saltbrush, winter fat, blue grama grass, and side oats grama grass, at the southern evapotranspiration site. Continue data collection at the two sites.

Reports in Progress: None

Reports Released: None

ESTIMATING POTENTIAL RECHARGE TO ALLUVIAL AQUIFERS IN SOUTHERN NEW MEXICO (NM276)



Period of Project: December 1988 to September 1991

Study Location: Southern New Mexico

Principal Investigator: Scott D. Waltemeyer

Cooperating Agency: New Mexico State Engineer Office

Problem: Data concerning the amount of recharge to alluvial-basin aquifers in the arid Southwest are needed for use in hydrologic models. Mountain-front recharge, the amount of stream discharge occurring at the bedrock/alluvium contact of a relatively impermeable mountainous watershed, is thought to be the primary mechanism for recharge to alluvial-basin aquifers in much of the arid Southwest. Stream-discharge data are lacking at mountain fronts in southwestern New Mexico.

Objectives: To collect, compute, and compile streamflow data at mountain fronts and relate these data to basin and climatic characteristics in order to estimate annual streamflow at ungaged sites. Correlation techniques using data from miscellaneous discharge-measurement sites may provide additional information for the network.

Approach: Establish a network of miscellaneous-discharge measurement sites in the drainage basins of the San Andres Mountains, Sacramento Mountains, and the Black Range. Data from these stations will supplement data from already established stations in the southern part of the State. Use channel-geomorphology techniques to determine the mean annual discharge of streams in the area.

Progress and Significant Results: Made channel-geometry measurements of active-channel width to establish a correlation with mean annual discharge for streamflow-gaging stations in southern New Mexico. Additionally, made channel-geometry measurements at 23 ungaged sites. Developed an equation to estimate mean annual discharge for ungaged sites.

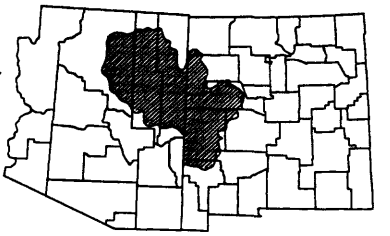
Plans for FY 90: Develop a regional relation of mean annual discharge to drainage area and mean annual precipitation.

Reports in Progress:

Waltemeyer, S.D., Methods for estimating mountain-front recharge to alluvial-basin aquifers in southern New Mexico: U.S. Geological Survey Water-Resources Investigations Report [initial preparation].

Reports Released: None

OCCURRENCE AND MOVEMENT OF RADIONUCLIDES AND OTHER TRACE ELEMENTS IN THE PUERCO RIVER AND LITTLE COLORADO RIVER BASINS, ARIZONA AND NEW MEXICO (NM277)



Period of Project: July 1988 through July 1993

Study Location: Puerco River basin, west-central New Mexico; and the Little Colorado River basin, east-central Arizona

Principal Investigators: Dale Rankin, New Mexico District; John Gray, Arizona District

Cooperating Agencies: Navajo-Hopi Relocation Committee, New Mexico Environmental Improvement Division, U.S. Bureau of Indian Affairs, Arizona Department of Resources, Arizona Department of Environmental Quality, and the Navajo Nation

Problem: In July 1979, approximately 100 million gallons of contaminated water and sediment were released into the Puerco River when a tailings pond failed. Several radioactive isotopes and heavy metals entered the Puerco River near Church Rock, New Mexico, contaminating surface and ground waters. These waters are used for agricultural, livestock, and domestic purposes.

Objectives: (1) Describe the temporal variations in suspended sediment and contaminant concentrations. (2) Collect suspended-sediment and water-quality samples at nine streamflow gages in the Puerco River and Little Colorado River basins for analysis. (3) Monitor the extent and magnitude of contamination in surface water and ground water and develop a health risk assessment.

Approach: Establish a monitoring network consisting of nine surface-water gages along the Puerco River, Zuni River, and Little Colorado River. Sample runoff discharge at these sites via automatic and manual collection of water samples. Establish a monitoring network of observation wells at selected locations for collection of ground-water samples.

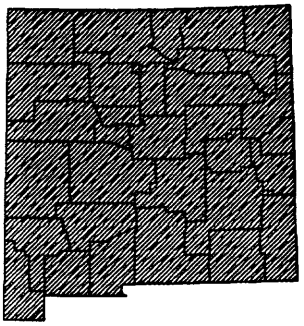
Progress and Significant Results: Analyses of surface-water and ground-water samples indicate an increased level of contaminants within the study area.

Plans for FY 90: Continue data collection and network evaluation.

Reports in Progress: A water-quality data report summarizing results of analyses of water samples collected during water years 1988 and 1989 by Greg Fisk (Arizona District) and Dale Rankin (New Mexico District) is in preparation. The Arizona District is compiling a report containing historical data.

Reports Released: None

ALLUVIAL BASINS GROUND-WATER ASSESSMENT (NM278)



Period of Project: October 1989 to June 1993

Study Location: Statewide

Principal Investigator: Charles Heywood

Cooperating Agency: New Mexico State Engineer Office

Problem: Information about ground water in storage in alluvial basins and changes in storage due to withdrawals is needed to assess the current status of the water resources in New Mexico. There is concern about the effects of ground-water mining on aquifer-system properties and associated aquifer compaction resulting in land-surface subsidence.

Objective: To quantify usable ground water in storage in alluvial-basin aquifers of selected ground-water basins.

Approach: Use gravitational anomalies to model the thickness of the alluvial sediments in the basins. Use aeromagnetic data to map the extent of intrabasin volcanic rocks, which may act as confining layers, to help constrain gravity models. Use any existing geophysical well logs to constrain the gravity models and to estimate the distribution of porosity with depth. Use water-level data to map the water-table depth and changes in that depth. Establishment of high precision geodetic-control lines with the Global Positioning System (GPS) will enable future calculations of land-surface subsidence. Installation of vertical extensometers (currently not funded) would enable in situ measurement of aquifer mechanical properties needed to predict aquifer-system compaction associated with fluid withdrawal.

Progress and Significant Results: A new isostatic residual gravity-anomaly map for New Mexico and a 45-minute surrounding halo were completed. The associated digital-data set is being used for gravity modeling of basin structure and alluvial-aquifer thickness. Aeromagnetic data for the Lordsburg and western Mimbres Basins have been transformed to a pseudo-gravity potential field. The maxima of the horizontal gradient of this field are being used to define the subsurface lateral extent of intrabasin volcanic units. Geodetic-control networks in the Albuquerque and Mimbres Basins have been planned cooperatively with the National Geodetic Survey and the State Highway Department, and initial surveying and data reduction will begin soon.

Plans for FY 90: Begin modeling and storage estimates for the Mimbres, Lordsburg, Playas, and Animas Basins. Begin assessment for the Albuquerque Basin. Install vertical extensometers if adequate funding is obtained.

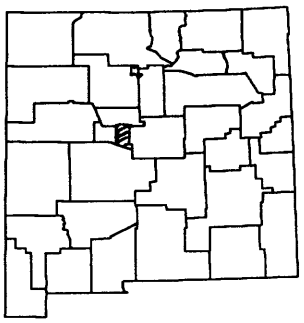
Reports in Progress: An abstract, "Use of a Geographic Information System in the analysis of geophysical and geologic data for ground-water basin studies in New Mexico," has been completed and submitted for consideration for publication in EOS.

Heywood, C.E., Ground-water storage in the Mimbres, Playas, Lordsburg, and Animas Basins, southwest New Mexico [initial preparation].

_____Isostatic residual gravity anomalies of New Mexico: U.S. Geological Survey Water-Resources Investigations Report [in press].

Reports Released: None

GROUND-WATER CONTAMINATION, LAND USE, AND AQUIFER VULNERABILITY IN EASTERN BERNALILLO COUNTY, NEW MEXICO (NM279)



Period of Project: July 1989 to June 1992

Study Location: Eastern Bernalillo County

Principal Investigator: Georgianna E. Kues

Cooperating Agency: Bernalillo County Commission

Problem: The residents of eastern Bernalillo County are concerned about the current quality of ground water, their sole water supply, and its vulnerability to contamination. Sewage disposal is primarily onsite. As of June 1988, 331 of 606 septic systems permitted in Bernalillo County were in this area east of the Sandia Mountains. The concentration of nitrate in ground water exceeds the maximum contaminant level of 10 milligrams per liter in some parts of eastern Bernalillo County. Organic compounds, including benzene, toluene, and explosives, also have been found.

Objectives: (1) Map approximate extent of ground water contaminated by nitrates and volatile organic compounds. (2) Determine rate of changes in water chemistry and whether areas of degradation are expanding. (3) Map historical changes in land use--in particular, density and age of onsite sewage disposal. (4) Map relative vulnerability of major aquifers using criteria such as depth to water, soil type, aquifer properties, recharge, and topography. (5) Describe current ground-water quality and relation to land use, onsite sewage disposal, and aquifer vulnerability.

Approach: Conduct a literature search on the subject of ground-water contamination by onsite sewage disposal, particularly in limestone terrains. Compile existing water analyses and collect and analyze new water samples.

Progress and Significant Results: Held meetings with State officials to plan and coordinate data collection. Set up a ground-water-quality monitoring network of 20 wells to be sampled monthly. Collected 100 additional water-quality samples at sites throughout the area.

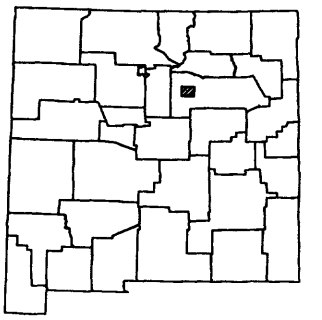
Plans for FY 90: Complete the literature search. Enter water-quality data from State agencies in the data base. Continue water-quality sampling, primarily for nitrates.

Reports in Progress:

Kues, G.E., Relation of onsite sewage disposal and ground-water contamination, eastern Bernalillo County, New Mexico: U.S. Geological Survey Water-Resources Investigations Report [initial preparation].

Reports Released: None

EFFECTS OF FOREST MANAGEMENT PRACTICES ON SEDIMENTATION OF A HIGH MOUNTAIN STREAM IN THE SOUTHERN ROCKY MOUNTAINS OF NEW MEXICO (NM352)



Period of Project: April 1987 to September 1992

Study Location: Northwestern San Miguel County

Principal Investigator: Herbert S. Garn

Cooperating Agency: U.S. Forest Service

Problem: Very little information is available about the effects on stream sediment from forest harvesting activities in New Mexico and the Southwest. Such information is needed to evaluate the effectiveness of sediment-control plans and to develop the best silvicultural management practices to control nonpoint-source pollution.

Objectives: (1) Evaluate the effects of forest harvesting practices and road construction activities on the suspended-sediment characteristics of a mountain stream. (2) Compare changes in stream sediment loads to land-use practices and relate these changes to water-quality standards.

Approach: Paired upstream and downstream water-quality stations will monitor the effects of timber harvesting and road construction activities. Emphasis will be placed on monitoring stream sediment loads during runoff. Stations will be operated seasonally to coincide with snowmelt runoff and summer thunderstorm runoff, which result in the bulk of the annual sedimentation. Suspended sediment and physical properties will be analyzed.

Progress and Significant Results: Five water-quality sampling sites were operated in the Tecolote Creek basin containing areas planned for timber harvesting in 1990. The sampling sites include three recording streamflow-gaging stations and five automatic water samplers. Ten sets of water-quality samples were collected at each site during site visits in addition to two storms in which samples were collected by the automatic samplers. Two sets of benthic invertebrates were collected at each site. Data for 1989 were published in the annual data report, "Water resources data, New Mexico."

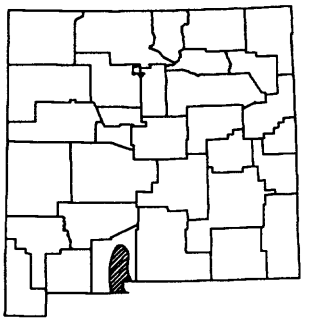
Plans for FY 90: Continue data collection during the frost-free season to establish prelogging sediment loads at the five stations. Compute records and prepare 1990 data for publication in the annual data report, "Water resources data, New Mexico."

Reports in Progress: None

Reports Released:

Garn, H.S., Piatt, Jim, and Sims, Bruce, 1989, Water-quality monitoring to evaluate best management practices of timber harvesting activities, Tecolote Creek watershed, New Mexico [abs.]: American Water Resources Association, Conference on Advances in Management of Southwestern Watersheds, Socorro, New Mexico, 1989, Proceedings.

MONITORING OF THE GROUND-WATER/SURFACE-WATER RELATIONS IN THE MESILLA BASIN, SOUTH-CENTRAL NEW MEXICO (NM356)



Period of Project: October 1987 to September 1992

Study Location: Mesilla Basin in Doña Ana County, New Mexico, and El Paso County, Texas

Principal Investigator: Edward L. Nickerson

Cooperating Agency: U.S. Bureau of Reclamation and the International Boundary and Water Commission--U.S. Section

Problem: Large increases in population in and adjacent to the Mesilla Basin have resulted in increased withdrawals of ground water. A significant hydraulic connection exists between the ground-water flow system and the Rio Grande. Long-term hydrologic data are needed to monitor changing hydrologic conditions within the ground-water/surface-water system in the Mesilla Basin.

Objectives: (1) Expand the observation-well network in areas where data are inadequate. (2) Conduct seepage investigations on the Rio Grande. (3) Monitor ground-water and surface-water levels within the Mesilla Basin.

Approach: Expand the monitoring network by construction of approximately 20 wells in the flood-plain alluvium. Conduct an inventory on about 20 existing wells completed in the Santa Fe Group for inclusion in the network. Conduct seepage investigations on the Rio Grande to include monitoring of ground-water levels and chemical analyses of water samples collected from the Rio Grande at selected sites.

Progress and Significant Results: Conducted seepage investigations on the Rio Grande along a 62-mile reach downstream from Leasburg Dam near Radium Springs, New Mexico, to El Paso, Texas, on January 5-6, 1988, and January 10-11, 1989. The seepage investigations included streamflow measurements at 33 sites, monitoring of ground-water levels in the Rio Grande flood-plain alluvium, and chemical analyses of water samples collected from the Rio Grande at six sites. Completed construction of 19 shallow observation wells in the Rio Grande flood-plain alluvium at depths ranging from 21 to 35 feet below land surface. Conducted ground-water site inventory of eight wells completed in the Santa Fe Group in the vicinity of Las Cruces, New Mexico.

Plans for FY 90: Conduct a seepage investigation of the Rio Grande downstream from Leasburg Dam near Radium Springs, New Mexico, to El Paso, Texas. Assist in maintenance of continuous water-level records at the Mesilla Valley hydrologic sections (Project NM267). Compile all geohydrologic data collected in the Mesilla Basin (Projects NM356, NM267) during water year 1990 for distribution to cooperating agencies.

Reports in Progress: None

Reports Released: None

INTERNATIONAL HYDROLOGIC EVALUATIONS AND DEVELOPMENT OF AN INTERNATIONAL, WATER-RESOURCES DATA BASE IN SUPPORT OF THE ENGINEER TOPOGRAPHIC LABORATORY, TERRAIN ANALYSIS CENTER (NM359)

Period of Project: Continuous since 1985

Principal Investigator: Cynthia G. Abeyta

Cooperating Agency: U.S. Army Corps of Engineers, Engineer Topographic Laboratories, Terrain Analysis Center, Fort Belvoir, Virginia

Problem: In the past, most United States military deployments have been in nonarid areas of the world where freshwater supplies were relatively accessible. Recently U.S. military planners have recognized a need for water-support planning in parts of the world where water resources are limited and difficult to access.

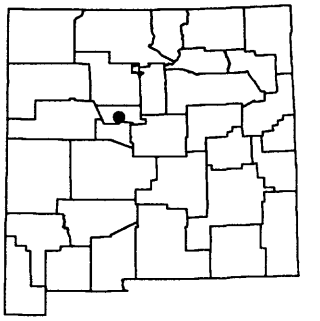
Objective: To determine distribution and availability of surface water and ground water in various parts of the world.

Approach: Compile hydrologic and geologic data to be incorporated into a worldwide water-resources data base. Analyze and interpret compiled water-resources information. Use results to prepare hydrologic maps and administrative reports of the study areas.

Progress and Significant Results: In fiscal years 1988-90, hydrologic investigations were completed for specified areas in Honduras, Bahrain, Iran, Kuwait, Iraq, and Saudi Arabia. In addition, hydrologic investigations have begun for Qatar and Saudi Arabia.

Plans for FY 90: Continue hydrologic investigations of countries in the Persian Gulf area.

INVESTIGATION OF POSSIBLE GROUND-WATER CONTAMINATION AT KIRTLAND AIR FORCE BASE, NEW MEXICO (NM360)



Period of Project: October 1988 to September 1991

Study Location: Albuquerque

Principal Investigator: Ralph Wilcox

Cooperating Agency: U.S. Air Force

Problem: Ten sites on Kirtland Air Force Base have been identified where past or present activities may have contaminated ground water. These sites include: three inactive landfills, a fire training area, an explosive ordnance disposal area, a ranch where cratering was tested with explosives, the arroyo (Tijeras Arroyo) that drains the base, a sewage lagoon, a golf course, and a golf course pond.

Objectives: To determine the presence, extent, and movement of contaminants at the sites.

Approach: Collect shallow soil, sediment, and sludge samples at a number of sites, deep soil samples (5 to 100 feet) at well sites, and surface-water samples at several sites and analyze for nutrients, metals, volatile organic compounds, semivolatile organic compounds, and explosives. Install 10 monitoring wells. Collect ground-water samples from the wells and analyze for similar compounds. Conduct aquifer tests in the monitoring wells to determine the hydrologic properties of the uppermost aquifer. Conduct an electromagnetic and a magnetometer surface-geophysical survey at one site and a soil gas survey at one site. Use the results of the laboratory analyses and the surveys to determine the presence, extent, and movement of any contaminants that may be discovered.

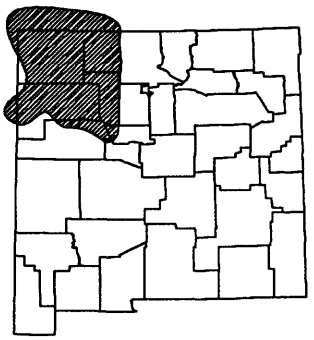
Progress and Significant Results: Completed all field tasks, except aquifer tests. Received all analytical results from soil samples. No significant contamination has been discovered.

Plans for FY 90: Begin the compilation and interpretation of analytical data. Complete hydrologic-data report, computer-formatted report, and final technical report to be submitted to the Air Force.

Reports in Progress: None

Reports Released: None

SAN JUAN STRUCTURAL BASIN REGIONAL AQUIFER-SYSTEM ANALYSIS, NEW MEXICO, COLORADO, ARIZONA, AND UTAH (NM423)



Period of Project: October 1984 to September 1990

Study Location: Northwestern New Mexico, southwestern Colorado, northeastern Arizona, and southeastern Utah

Principal Investigator: Gary W. Levings

Cooperating Agency: Federal Program

Problem: Competition for limited ground-water supplies in the San Juan Basin among mining, electric-power, and other companies, municipalities, and Indian communities is increasing. Surface waters are fully appropriated, and ground-water use is projected to triple in the next 20 years. The quantity, quality, and availability of ground water are not well known, and aquifer systems are not well defined.

Objectives: (1) Define the regional hydrogeologic systems. (2) Define quantitatively the individual aquifer-flow systems. (3) Assess the effects of past, present, and future ground-water use on aquifers and streams.

Approach: Assemble and evaluate existing hydrologic data. Determine the need for and collect additional data. Determine the availability of ground water for each pertinent water-yielding unit by analyzing the geohydrologic data, constructing hydrologic maps, and describing the geohydrologic framework. Simulate the hydrologic system with a digital model. Assess the possible effects of ground-water development on the system.

Progress and Significant Results: Hydrologic Investigations Atlases for 10 aquifers were approved and six atlases have been published. Compilation of the digital model has continued as these atlases have been prepared.

Plans for FY 90: Professional Paper chapters concerning the geologic framework, geochemistry of three sandstone aquifers, digital model, and summary of the Regional Aquifer-System Analysis are being prepared.

Reports in Progress:

Craigg, S.D., Geologic framework of the San Juan structural basin of New Mexico, Colorado, Arizona, and Utah: U.S. Geological Survey Professional Paper 1420-B [Region review].

Dam, W.L., Geochemistry of ground water in three sandstone aquifers, San Juan Basin, New Mexico: U.S. Geological Survey Professional Paper 1420-D [initial preparation].

Dam, W.L., Kernodle, J.M., Thorn, C.R., Levings, G.W., and Craigg, S.D., Hydrogeology of the Pictured Cliffs Sandstone in the San Juan structural basin, New Mexico, Colorado, Arizona, and Utah: U.S. Geological Survey Hydrologic Investigations Atlas 720-D [in press].

Levings, G.W., Craigg, S.D., Dam, W.L., Kernodle, J.M., and Thorn, C.R., Hydrogeology of the San Jose, Nacimiento, and Animas Formations in the San Juan structural basin, New Mexico, Colorado, Arizona, and Utah: U.S. Geological Survey Hydrologic Investigations Atlas 720-A [in press].

Thorn, C.R., Levings, G.W., Craigg, S.D., Dam, W.L., and Kernodle, J.M., Hydrogeology of the Ojo Alamo Sandstone in the San Juan structural basin, New Mexico, Colorado, Arizona, and Utah: U.S. Geological Survey Hydrologic Investigations Atlas 720-B [in press].

Reports Released:

Craigg, S.D., 1988, Analysis of spatial geologic data using surface modeling and geographic information system software--Applications to regional geologic mapping, San Juan structural basin, New Mexico, Colorado, Arizona, and Utah [abs.], in Integrating technology and geoscience applications: GIS Symposium, Denver, Colo., 1988, p. 9.

_____1989, Analysis of spatial geologic data using surface modeling and geographic information system software--Applications to regional geologic mapping, San Juan structural basin, New Mexico, Colorado, Arizona, and Utah, in American Association of Petroleum Geologists-SEPM-Energy Minerals Division, Rocky Mountain Section Meeting, October 1-4, 1989, Proceedings, p. 40-41.

Craigg, S.D., Dam, W.L., Kernodle, J.M., and Levings, G.W., 1989, Hydrogeology of the Dakota Sandstone in the San Juan structural basin, New Mexico, Colorado, Arizona, and Utah: U.S. Geological Survey Hydrologic Investigations Atlas 720-I, 2 sheets.

Craigg, S.D., Dam, W.L., Kernodle, J.M., Thorn, C.R., and Levings, G.W., 1990, Hydrogeology of the Point Lookout Sandstone in the San Juan structural basin, New Mexico, Colorado, Arizona, and Utah: U.S. Geological Survey Hydrologic Investigations Atlas 720-G, 2 sheets.

Dam, W.L., 1989, Methods and preliminary results of geochemical sampling, San Juan Basin, New Mexico, Colorado, Arizona, and Utah, in Regional aquifer systems of the United States--Aquifers of the western mountain area: American Water Resources Association Monograph Series 14, p. 203-217.

Dam, W.L., Kernodle, J.M., Levings, G.W., and Craigg, S.D., 1990, Hydrogeology of the Morrison Formation in the San Juan structural basin, New Mexico, Colorado, Arizona, and Utah: U.S. Geological Survey Hydrologic Investigations Atlas 720-J, 2 sheets.

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