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UNITED STATES OFR: 72-263
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Albuquerque, New Mexico

A PROPOSAL FOR A STUDY OF THE WATER RESOURCES
OF SANTA FE COUNTY, NEW MEXICO

By

Walter A. Mourant

Open-file report

Prepared by the U.S. Geological Survey, in cooperation
with the Office of the New Mexico State Engineer

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INTRODUCTION

Several land-development companies have purchased large tracts of land in Santa Fe County and have made plans for community developments (fig. 1). Water supply may be a problem in the development of these communities. A study of the water resources of the county is needed for the use of those concerned with water supply, whether for household, community, stock, irrigation, or industrial use, to provide the basis for orderly development of communities and other uses of water.

A comprehensive study, such as that needed in Santa Fe County, requires several man-years of effort and the expenditure of large sums of money. Unless planning for the study is thorough, objectives firm, and the study-completion date met, the results of the study may not become available at the time they are most needed, or may not include information expected from such a study.

In an effort to ensure that an investigation of the water resources of Santa Fe County would be adequately planned so that the scope, cost, and completion date would be properly defined, a co-operative project aimed toward this goal was agreed upon by the U.S. Geological Survey and the Office of the New Mexico State Engineer. This project "Reconnaissance of Santa Fe County, New Mexico" required an effort of about 3 man-months, and was completed during fiscal year 1971.

The reconnaissance project included a search of the literature to determine the extent of previous geologic and hydrologic investigations in the county and various types of maps available. Unpublished data in the files of the Geological Survey were examined and sorted. Sources of additional unpublished data in the files of various State and Federal agencies were determined. Field reconnaissance was made.

From the information gathered during the reconnaissance, determinations were made of the type and extent of additional data needed for a comprehensive study of the water resources. This proposal for an investigation of the water resources of Santa Fe County states the objectives, proposes a plan of study, sets a time schedule, lists the major work items and their estimated completion time and dollar cost, and presents outlines of reports that will result from the investigation.

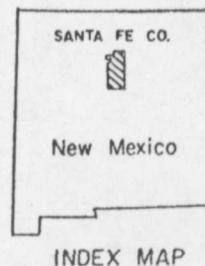
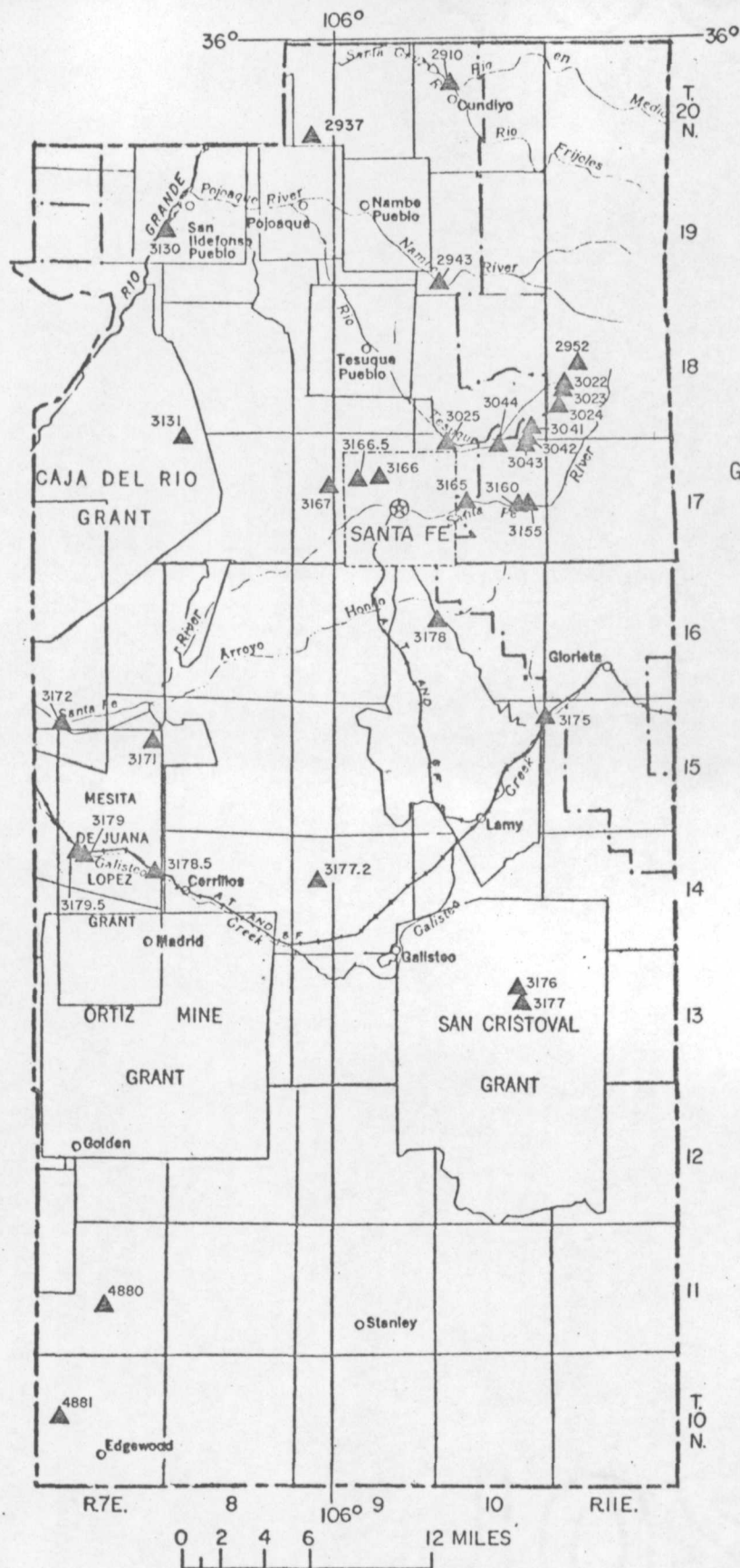
The State Engineer determined that an investigation of the water resources of Santa Fe County was needed, and that it should begin in fiscal year 1972. This comprehensive cooperative study is titled "Water resources of Santa Fe County, New Mexico." The project number is NM72-215C, and the project chief is Walter A. Mourant. Work on the project began in November 1971.

PREVIOUS INVESTIGATIONS

The water resources of only about 243 square miles in the north-central part and in several other small areas of Santa Fe County have been studied. The county has an area of about 2,000 square miles; therefore about seven-eighths of the county has not been investigated.

Geologic studies have been made in about two-thirds of the county. Detailed geologic mapping has been done in about one-fourth of the county; half of it was done by graduate students for master's theses.

Surface-water flow data are available for most of the drainage areas of the county (fig. 2 and table 1). Records of discontinued stations are listed in a report of the U.S. Geological Survey (1971). The Estancia basin drainage is measured by crest-stage gages near Cedar Grove and Edgewood; a flood-hydrograph station is located near Moriarty in Torrance County. Most of the Galisteo Creek drainage is measured by gaging stations above and below Galisteo Dam, and by the reservoir gage. Additional data are provided by four crest-stage gages and one flood-hydrograph station. The Santa Fe River drainage is measured by gaging stations below McClure Reservoir and near La Bajada, and by reservoir gages on McClure and Nichols reservoirs. Four crest-stage gages supplement the data in the Santa Fe River drainage area. The Pojoaque-Nambe-Tesuque drainage system is measured by a crest-stage gage on Big Tesuque Creek, a gaging station on the Rio Nambe at Nambe Falls, and eight gaging stations in the upper basin which are used by the Forest Service for correlation of precipitation and runoff to evaluate the results of their management of the selective harvesting of trees in the upper reaches of Little Tesuque Creek. Additional data are tabulated in New Mexico State Engineer Technical Report 7 (1959) for temporary or discontinued stations in Santa Fe County.



EXPLANATION

▲ 3131
Gaging station and abbreviated number (08313100 is national station number).

See table I for type of station and period of record.

Figure 2.--Location of gaging stations.

Table 1.--Period of record of surface-water flow measurements
at gaging stations^{1/}

<u>Station number</u> ^{2/}		<u>Period of record</u>
<u>Continuous recording gage</u>		
08291000	Santa Cruz River	1930-
08294300	*Rio Nambe at Nambe Falls	1963-
08295200	Rio En Medio	1963-
08302200	North Fork Tesuque Creek	1962-
08302300	Middle Fork Tesuque Creek	1961-
08302400	South Fork Tesuque Creek	1962-
08304100	Little Tesuque Creek	1962-
08304200	Little Tesuque Creek Trib. #4	1964-
08304300	Little Tesuque Creek Trib. #3	1963-
08304400	Little Tesuque Creek Trib. #2	1962-
08313000	Rio Grande at Otowi Bridge	1895-1905, 1909-
08316000	Santa Fe River	1913-
08317200	Santa Fe River	1970-
08317850	Galisteo Creek	1970-
08317950	Galisteo Creek	1970-
08318000	Galisteo Creek	1941-71
	*Operated by USBR	
<u>Reservoir gages</u>		
08315500	McClure	1929, 1930, 1931-46, 1947-
08316500	Nichols	1943-
08317900	Galisteo	1970-
<u>Crest-stage gages</u>		
08302500	Tesuque Creek above diversions near Santa Fe (1936-51 operated as a continuous recording gage, 1953-70 as a crest-stage gage, discontinued)	
08313100	Canada Ancha trib.	1940-48 (SCS), 1952-
08316600	N. Frijoles Arroyo	1958-70
08316650	Arroyo de los Frijoles Locust Tree	1957-70
08316700	Arroyo de los Frijoles	1957-70
08317100	Arroyo Yupa trib.	1957-
08317500	Galisteo Creek	1955-56, 1959-
08317600	San Cristobal Arroyo	1955-
08317700	Tarhole Canyon	1952-
08317800	Canada de las Minas trib.	1952-
08488000	Estancia Valley trib.	1955, 1961-
08488100	Juan Tomas Canyon	1962-

Table 1.--Period of record of surface-water flow measurements

at gaging stations^{1/} - Concluded

Station number^{2/}

Period of record

Flood-hydrograph gages

08293700	Arroyo Seco trib.	1971-
08317720	Canada de la Cueva	1970-

1/ Records of discontinued stations are listed in U.S. Geol. Survey (1971).

2/ Explanation of station number. Each gaging station and partial-record station has been assigned a station number. These are in downstream order. In assigning station numbers, no distinction is made between partial-record stations and continuous-record gaging stations; therefore, the station number for a partial-record station indicates downstream order position in a list made up of both types of stations. Gaps are left in the numbers to allow for new stations that may be established; hence the numbers are not consecutive.

Conservation Service maps. 1:250,000 topographic series, New Mexico Highway Department, and Soil as of July 1971. Other maps available are the U.S. Geological Survey's were prepared in the early 1950's; others are in advance proof stage Survey are available for the entire county. Many of the quadrangle maps Topographic 7½- or 15-minute quadrangle maps of the U.S. Geological 1964, and are at various scales and directions of flight. miles. The photographs are from 12 flights flown between 1948 and in Denver for all of the county, with the exception of about 100 square Aerial photographs are available from the U.S. Geological Survey available for wells and springs in large areas of the county. resource study of Torrance County. Chemical-analysis data are not T. 10 N., R. 8-9 E., where they were collected for the ground-water concentrated in the Santa Fe and Pojoaque River areas and in available for 100 wells and springs in the county. These data are well or spring in Santa Fe County. Chemical data are presently County. Chemical analyses are not regularly determined for any and on Galisteo Creek below Galisteo Dam (08317920) in Sandoval on the Rio Grande at Otowi Station (08313000) in Santa Fe County, Chemical-quality and sediment data are collected regularly

A literature search produced an extensive selected list of hydrologic and geologic references. Additional data are known to be present in the files of the New Mexico State Engineer, Soil Conservation Service, Agricultural Stabilization and Conservation Service, Public Health Service, the U.S. Geological Survey, New Mexico State Bureau of Mines and Mineral Resources, and various other Federal and State offices. Compilation and analysis of data in these reports and offices would add much to a study of the water resources of the county.

DATA NEEDED FOR A STUDY OF THE WATER RESOURCES OF SANTA FE COUNTY

Ground-water data

A comprehensive investigation of the occurrence and characteristics of water wells and springs in Santa Fe County, and adjacent areas, is needed. During this investigation well owners, well drillers, and other persons will be contacted to obtain well logs, yield data, well-construction data, and other information pertinent to the geohydrology of the well or spring site.

As a part of the well and spring investigation the specific conductance of the water from each source visited will be determined. Wells and springs from which to collect water samples for chemical and spectrographic analysis will then be selected after examination of the specific conductance values, the areal distribution of water sources, and geohydrologic source of the water.

A network of observation wells will be established near the start of project investigations, so as to provide the longest possible record of water-level fluctuations. Measurements of water level are now (1972) being made in 27 observation wells, concentrated mostly in the Santa Fe area and in the southern part of the county, as part of the statewide-monitoring program of water levels conducted by the Geological Survey in cooperation with the State Engineer of New Mexico. About 35 additional observation wells are needed in other areas of the county. Figure 3 shows the location of existing and proposed observation wells.

Aquifer tests using selected wells are needed to provide data on the transmissivity and storage coefficient of various aquifers in Santa Fe County. Such tests will provide data necessary for interpretations to be made during the quantitative phase of the project.

Surface-water data

The continued operation of existing gages will yield sufficient data for most of the drainage areas in the county. The establishment of a gaging station at El Rancho on the Pojoaque River, about a mile east of San Ildefonso Pueblo, is funded and will be installed in fiscal year 1972. This station will measure flood conditions in the Pojoaque River drainage. A continuous recording gage should be re-established at station 08302500 (formerly a continuous recorder gage and now a crest-stage gage) to measure the flow from the Big Tesuque Creek drainage area.

Water samples should be collected from streams at all gaging stations for chemical analysis, and at selected locations for spectrographic analysis. Frequency of sample collection is to be determined by the project chief. At gaging stations, samples should be collected that are representative of base flow, storm runoff, and snowmelt. Sediment-yield problems can be defined by collecting data on a storm-event basis for several of the drainage areas in the county.

Base map

A base map at a scale of $\frac{1}{2}$ inch per mile will be prepared using the latest topographic maps. The New Mexico coordinate system, central zone, will also be indicated on the base map. Unsurveyed map areas, such as land grants, will contain grid lines, based upon the coordinate system, at intervals of 5,000 feet.

Aerial photographs

Personnel in the New Mexico District could photograph the entire county for approximately the same cost as obtaining the photographs from the Geological Survey in Denver. Benefits would result in having photographs at a uniform scale, same direction of flight, and of major importance, recent photographs all of the same time period.

Geologic mapping

The one-third of the county covered by unpublished reconnaissance geologic mapping will be studied but not mapped in detail.

A geologic map of the county will be prepared using available maps and field data gathered during well investigations.

PROPOSED PLAN FOR THE STUDY

The study will be divided into three phases:

Phase I.--Collection and tabulation of basic data. Preparation of water-level contour map, geologic map and geologic cross sections. Interpretations of data as to what additional data will need to be collected for Phase II study.

Phase II.--Collection of data for a semi-quantitative interpretation of the water resources of the county. Prepare a semi-quantitative analysis report.

Phase III^{1/}.--Production of analog or digital models of part or all of Santa Fe County using data collected in Phases I and II.

A hydrologist will serve as project chief for the study on a full-time basis. Additional personnel needs will be from the part-time services of data coders, keypunch operators, technicians, and service groups in the district.

^{1/} Phase III is tentative. Implementation will depend upon results obtained from Phases I and II, and upon the complexity of the required models.

TIME SCHEDULE, WORK ITEMS, AND ESTIMATED COSTS

Phase I

Collection and tabulation of well, water-level, water-quality, and geologic data. Data obtained during the study will be coded using the "OMNIANA" computer format and machine-generated tables will be prepared. ("OMNIANA" is the name of the computer-based hydrogeologic data file used by the New Mexico District.)

A basic-data report will be prepared using computer-generated tables listing well data, spring data, chemical-analysis data, and well logs. Maps showing the geology, geologic cross sections, and water-level contours will be prepared.

Phase I will require about 33 man-months of effort over a period of about 2 years. Effort by full-time personnel is estimated at 10 man-months per person per year; other personnel (summer help, etc.) will be used to complete Phase I within about 2 years.

\$85,200 - Cost of Phase I

26,500 - Funded for fiscal year 1972

\$58,700 - Needs to be funded for fiscal year
1973 and part of 1974

The work items and estimated cost of each is shown in table 2. The work schedule for Phase I is shown in figure 4.

Table 2.--Work items and estimated costs for Phase I

	<u>Man-months</u>	<u>Cost</u>
1. Aerial photography	--	\$ 2,000
2. Prepare base map	1	2,300
3. Establish observation wells	2	4,600
4. Investigate wells and springs, collect logs and water samples, make geologic observations	20	46,000
5. Water analyses - surface and ground water 100 samples @ \$50.00 each	--	5,000
6. Code existing data	1	2,300
7. Prepare water-level contour maps	2	4,600
8. Prepare geologic map	2	4,600
9. Prepare geologic cross sections	2	4,600
10. Report preparation	3	6,900
11. Review and administrative costs	--	2,300
	<hr/>	<hr/>
Total	33	\$85,200

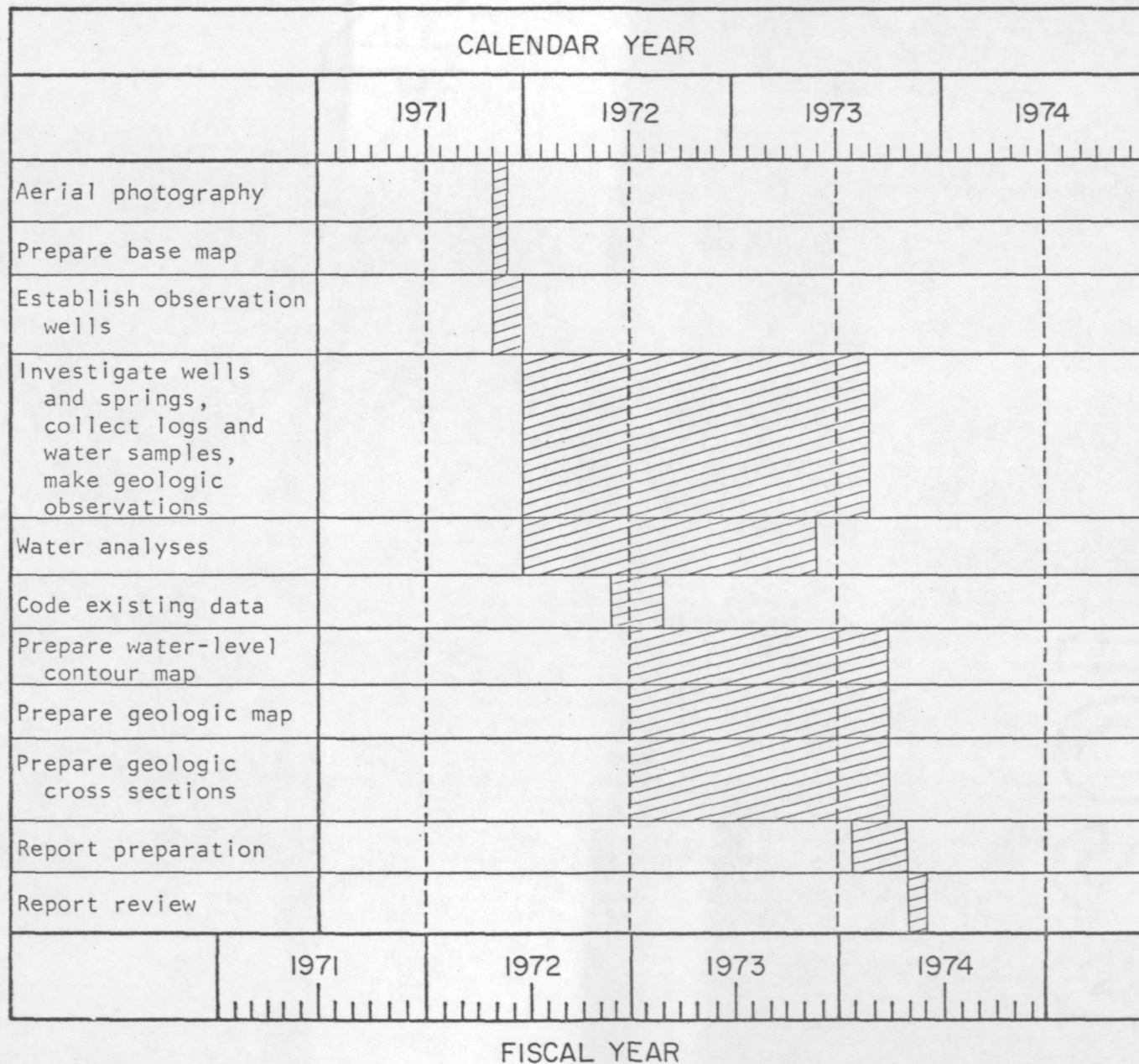


Figure 4.--Work schedule for Phase I of proposed study of water resources.

Phase II

Data will be collected in order to evaluate the yields obtainable from the various aquifers, to define the relation between surface and ground water, and to prepare a semi-quantitative analysis of the water resources of Santa Fe County. Data to be obtained probably will include aquifer tests, geophysical surveys, chemical analyses, and water-level measurements in observation wells.

The geologic and hydrologic data will be interpreted and a semi-quantitative report prepared.

Phase II will require about 23 man-months of effort over a period of about 2½ years, at a cost of \$59,400.

The work items and estimatee cost of each are shown in table 3. The work schedule for Phase II is shown in figure 5.

Table 3.--Work items and estimated costs for Phase II

	<u>Man-months</u>	<u>Cost</u>
1. Prepare plans for data collection required under Phase II	1	\$ 2,300
2. Obtain quantitative data, including aquifer tests, geophysical surveys, chemical analyses, and water-level measurements in observation wells	6	13,800
3. Water analyses; 50 samples @ \$50.00 each	--	2,500
4. Preparation of report and illustrations	16	36,800
5. Review and administrative costs	--	<u>4,000</u>
Total	23	\$59,400

Figure 5.--Work schedule for Phase II of proposed study of water resources.

Phase III

To evaluate the effects of water-use developments in Santa Fe County, analog and (or) digital models of part, or all, of the area should be developed. The models would use data collected in Phases I and II, and could be used for future planning in optimizing the use of the water resources of the county. The cost and man-months of effort required for Phase III will depend upon the complexity of the models. This phase of the study is tentative and will be discussed by State Engineer Office and Geological Survey personnel as the results of Phases I and II become apparent.

REPORT OUTLINES

The data collected during Phase I will be prepared as a U.S. Geological Survey open-file report, or as a State Engineer Basic-Data report.

The interpretations resulting from Phase II will be prepared as a State Engineer Technical report. Preliminary outlines of these two reports are listed below.

Phase I

PROGRESS REPORT ON THE WATER RESOURCES OF SANTA FE COUNTY, NEW MEXICO

Introduction:

Purpose

Well-numbering system

Use of maps and tables

Sources of data

Interpretation of what additional data will
need to be collected for Phase II study

Illustrations:

Figure 1. Index map

2. Numbering system for wells and springs
3. Well-location and water-level contour map
4. Reconnaissance geologic map
5. Geologic cross sections
6. Specific conductance of water-samples contour map

Tables:

Table 1. Records of wells

2. Records of springs
3. Chemical analyses of water from wells and springs
4. Common chemical constituents and properties of
water and summary of analyses of water
5. Logs of selected wells

Phase II

WATER RESOURCES OF SANTA FE COUNTY, NEW MEXICO

Abstract

Introduction:

Purpose and scope of investigation

Location of area

Previous investigations

Well-numbering system

Acknowledgments

Geography:

Physiography

Regional setting

Physiographic units

Drainage

Climate

Vegetation

Population

Economy

Geology:

Stratigraphy

Precambrian

Paleozoic

Mesozoic

Cenozoic

Pre-Santa Fe rocks

Santa Fe Group

Post Santa Fe rocks

Phase II - Continued

WATER RESOURCES OF SANTA FE COUNTY, NEW MEXICO - Continued

Geology - Continued

Structure

Geologic history

Water resources:

Hydrologic cycle

Evaporation

Precipitation

Surface water

Streams

Lakes and ponds

Ground water

Transpiration

Surface water

Rio Grande

Santa Cruz River

Pojoaque-Nambe-Tesuque system

Santa Fe River

Galisteo Creek

Other

Estancia basin drainage

Pecos River tributaries

Ground water

Geologic formations and their water-bearing properties

Precambrian

Phase II - Continued

WATER RESOURCES OF SANTA FE COUNTY, NEW MEXICO - Continued

Ground water - Continued

Geologic formations and their water-bearing properties - Continued

Paleozoic Era

Magdalena Group

Permian System

Mesozoic Era

Triassic System

Jurassic System

Cretaceous System

Cenozoic Era

Tertiary System

Pre-Santa Fe rocks

Santa Fe Group

Quaternary System

Chemical quality of water

Surface water

Ground water

Depth to water

Water-level fluctuations

Water utilization

Surface water

Ground water

Phase II - Concluded

WATER RESOURCES OF SANTA FE COUNTY, NEW MEXICO - Concluded

Ground water - Concluded

Future development

Surface water

Ground water

Glossary

References

Illustrations:

Figure 1.--Index map

2.--Numbering system for wells and springs

3.--Precipitation graphs

4.--Well-location and water-level contour map

5.--Geologic map

6.--Geologic cross sections

7.--Specific conductance of water

8.--Classification of irrigation water

9.--Water sales, Santa Fe, New Mexico

10.--Lowest runoff for period of record, Santa Fe River
and others as the study develops

11.--Predicted water-level declines in areas of development

Tables:

Table 1.--Records of wells

2.--Records of springs

3.--Chemical analysis of water from wells and springs

4.--Chemical analyses of surface water

5.--Common chemical constituents and properties of water
and summary of analyses

6.--Logs of selected wells

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