PROJECTIONS OF WATER AVAILABILITY IN THE LOWER RIO GRANDE, GILA-SAN FRANCISCO AND MIMBRES DRAINAGE BASINS TO 2005

by

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ABSTRACT

The management of New Mexico water resources requires an understanding of the magnitude and source of future water scarcity conditions. Without detailed information regarding the specific nature of future water scarcity conditions, resource management activities may incorrectly assign priorities to particular scarcity-mitigating efforts. Current and projected water supply and demand conditions are analyzed for the Lower Rio Grande Surface Drainage Basin, the Gila River and San Francisco River Surface Drainage Basin and the Mimbres Closed Basin. This analysis relies on 1980 data and projects future water scarcity conditions over a 25-year period to 2005.

Water use data for 1980 provided by the State Engineer Office is combined with economic and demographic data (from several sources) to allow calculation of water use coefficients for differing water use sectors within the hydrologically defined portions of each county. Future water scarcity conditions are assessed at both the county and basin-wide level in relation to existing water supplies identified by the State Engineer Office.

The analysis identified increased water scarcity conditions in the projection for both the Lower Rio Grande Surface Drainage Basin and the Mimbres Closed Basin. The 25-year projection of water resource demands in the Gila-San Francisco Surface Drainage Basin shows a decline in scarcity conditions.

Key Words: water demand forecasting, water requirements, long-term planning, regional analysis, competing uses, water policy, management.

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CHAPTER I

OVERVIEW OF RESEARCH

Introduction

Access to sufficient water supplies for continued existence and prosperity is one of the most critical public issues facing New Mexico today. In the research described, we investigate the future water supply and demand conditions in the Lower Rio Grande Surface Drainage Basin, the Gila River and San Francisco River Surface Drainage Basin and the Mimbres Closed Basin. This research forecasts future water scarcity conditions[1] in these basins based on a 25-year projection of population and economic growth. The base year for this set of projections is 1980.

The report is structured in the following manner. Chapter II discusses water use and projections in the Lower Rio Grande Surface Drainage Basin. The specific profiles for Dona Ana and Sierra counties are contained in chapters III and IV. The Gila-San Francisco Surface Drainage Basin and the Mimbres Closed Basin are addressed in chapter V. The specific counties within these basins, Catron, Hidalgo, Grant and Luna, are discussed in more detail in chapters VI-IX. Chapter X provides a summary assessment for the Lower Rio Grande Surface Drainage Basin. The implication of the projections for the Gila-San Francisco Surface Drainage Basin and the Mimbres Closed Basin is contained in chapter XI.

Overview

The history of the pursuit of--and continued access to--adequate water supplies has provided for the unique set of rules, regulations and administrative agencies that govern use of New Mexico's water resources. The laws that govern the use of the water resources provide for a specific system of property rights to the water. Under this system of water rights, new uses of water are controlled and existing water uses are protected from impaired access to water supplies by other appropriations. This structure is most simply described as the prior appropriation doctrine of water law; although many federal, interstate, and local conditions may be superimposed on the basic state water law system. The superimposed conditions may cause unique circumstances of appropriation and water availability in particular hydrologic basins and localities.

Under New Mexico water law there is now a provision that allows municipalities to consider future water demands and to appropriate sufficient water to satisfy their anticipated future water demands over a 40-year time horizon.[2] Having accepted a need to consider future water demands, the question must be addressed as to the specific uses which will induce increased water demands. Consideration of the specific sources of increased demands also must be sensitive to the available water supplies satisfy these new demands and the extent to which conditions of a water scarcity may impose a constraint on development in particular regions of the state.

Inherent to any projection of future water demands are assumptions as to the relationship between the activities of the state's populous and observed levels of water use. The State Engineer Office (SEO) inventory of water use by category for 1975 and 1980 is used in profiling specific patterns of water use in counties and hydrologic basins throughout the state.[3] Under the prior appropriation system of water rights, there is substantial reason to assume that patterns of water use observed in any particular year are likely to be similar to the patterns of use in future years.[4] Although water right laws provide for an ability to reassign and transfer water right entitlements to different places and purposes of use, other conditions may limit the extent of transfers. In particular, the investments that have historically been made in the ways and means of use of water--and the "community" motivations that serve as a foundation for a stable economic base in most of the state--provide an ability to assert a similarity between current water use patterns and future use patterns.

Water right entitlements are subject to state water law and the condition imposed by interstate, federal and local administrative arrangements. Key stipulations associated with water rights entitlement include:[5]

1. Under state law one is entitled to surface water rights based on actual historic appropriation to use. The rights are based on either use prior to the assumption of jurisdiction by the state engineer if the usage occured after the state engineer acquired jurisidiction over surface waters. These rights, like all rights in New Mexico, are subject to the constitutional rule that beneficial use is the measure and limit of these rights and prior appropriation gives the better right. Thus, in water-short years some rights may be limited in physical supply of water because they carry a junior priority date.
2. A second major category of water rights under state law is rights in underground waters:
   a. Where groundwater is hydrologically connected to surface water in a stream system, the state engineer conjunctively manages the ground and surface water so as to allow the taking of groundwater while requiring that surface rights be retired over time to insure that senior river rights are protected.

b. Where groundwater is being recharged at a rate less than the rate of depletion (i.e., groundwater mining), the state engineer allows development of groundwater rights subject to a formula that anticipates a controlled depletion rate. The methods for limiting groundwater rights varies from basin to basin. In general, however, the system anticipates that the water table in each basin will be allowed to drop at no more than a specific rate for over a specific period of time. When the granting a new applications would result in an increase in the decline of the water table beyond that established by the state engineer, such new applications will be denied.

3. All new water rights applications, both surface and groundwater, are limited by the requirements that such applications be consistent with the public welfare and conservation of water and that they not impair existing rights.

4. Federal projects that store water often result in the creation of more usuable water. The rights in these projects are established under state law. They are, however, often subject to the federal statutory provisions that provided for the project funding. When such projects are paid out, federal conditions may be removed depending upon the relevant federal legislation. These projects still remain subject to state laws regulating these projects as well as the state water law described above.

The question must be addressed as to the extent that growth will be constrained by water availability and the existing structure of water rights. If water rights are assumed freely transferred subject to the economic pressures of supply and demand, then there is little reason to be concerned as to the satisfaction of future water needs. However, implicit to this assumption is the likely decline of agriculture, which has been a fundamental economic force in rural New Mexico. One possibility entails the "cannibalization" of the agricultural economy and water use patterns in favor of nonagricultural development. An alternative assumption is that increased water demand requirements will be satisfied by improvements in the efficiency of water use within the existing water use categories.

Both of these possibilities are considered in the projections contained herein, and in practice neither assumption is mutually exclusive. Most important to these projections, however, is the intention that critical water scarcity circumstances can be identified such that management practices might be implemented in a way so as to avoid any unnecessary constraints on development. It is to this end that the research contained in this report has been directed.

Methodology

The investigation of future water demands in the three separate basins described here is based on a 1980 profile of demographic, economic and water use conditions in each county that comprises a portion of the various basins. The first step in the process was to define county data according to the boundaries of the hydrologic units described. That is, all economic and demographic data is available on a county-boundary basis. There was need to allocate these data to the geographic areas inside and outside the hydrologic boundaries that define the basins. Maps 1 and 2 depict the boundaries of the considered basins and are presented with the basin profiles in chapters II and V.

Data on subareas of counties are available from the 1980 Census of Population.[6] It was required that the census division boundaries be matched as closely as possible to the boundaries of the hydrologic basins. In some cases these two sets of boundaries matched well; in others, the assignment of particular hydrologic regions of a county according to the census divisions was less accurate. The details of the specific matches are provided in the county profiles that follow. Once a basis for allocating county population and economic data to the basin areas was established, the analysis could proceeded to profile the specific activities of the hydrologic basins in the 1980 base year.

Annual employment data for each county is available from the Employment Security Department (ESD) of the state of New Mexico.[7] These data series allow for very specific identification of economic activities found within the county. The allocation of economic data provided by the 1980 census data to the basin subareas of a county was then utilized to assign the ESD employment data for the purposes of profiling each of the basins considered. Chapters III and IV detail this procedure for the counties within the Lower Rio Grande Surface Drainage Basin while chapters VI through IX detail the allocation for the Gila-San Francisco Drainage Basin and the Mimbres Closed Basin. Having profiled the county level patterns of population and economic activity on a hydrologic basin basis, the next step was to associate these economic and demographic profiles with specific patterns of water use.

The 1980 SEO inventory of water withdrawals and depletions by hydrologic basins (at a county level) allowed for much of this correspondence of water use to economic and demographic activities. With the exception of Grant County, agricultural activity accounts for the greatest consumptive use of water in each of the county areas in this research. The SEO data provides detailed information with respect to the specific patterns of irrigated agriculture, livestock, and stockpond uses of water. The SEO data also provides water usage data for other categories. These include mineral use, power use, recreation use, and reservoir evaporation. Specific economic activities could be assigned to each of these four use categories.

Four other water use categories are also defined in the 1980 SEO data, but were not so easily allocated to specific economic and population water use activities. Two of these categories--urban and rural water use--describe the combined water using activities of both residential and nonresidential users. It was assumed, based on a U.S. Geological Survey sponsored investigation of municipal water use, that 65 gallons per capita per day (GPCD) could be associated with residential water use.[8] The balance of the reported 1980 urban and rural water use was assigned to nonresidential uses, as were the remaining SEO categories of 1980 water use described as self-supplied commercial and industrial use. By this method, the 1980 water use data was assigned to the basin economic and demographic data in a manner that profiled the 1980 base year for each of the counties in this investigation.

There was also need to consider and summarize the important legal and institutional constraints that affected water use in the 1980 base year profiles. Although these institutional constraints are frequently difficult to summarize, an attempt to do so was undertaken in each of the county profiles. This then completed the 1980 water use profiles for each of the county-basin areas included in this investigation. The next step was the forecasting of future water demand requirements.

The forecasts of future water demand condition relied heavily on the projections of county population growth for the 25-year period provided by Lynn Wombold, Senior Demographer at the Bureau of Business and Economic Research (BBER), University of New Mexico.[9] Also of extreme importance to the forecast of future water demands were the county employment projections by Brian McDonald, Director of the BBER and the FOR-UNM State of New Mexico forecasting service. These employment projections are contained in the appendix of the Wombold report.[9] With both sets of projections, adjustments were required to reflect basin specific patterns of population and employment. These county-basin allocations were done using the information provided by the 1980 census data, although in some specific cases it was necessary to impose exogenous assumptions with respect to the specific patterns of growth found within the portion of the county included in a particular water basin. In many of the sectors, totally exogenous assumptions of future sector activities were required. This is particularly true of the agricultural and mining water use sectors. These specific exogenous assumptions are described in the county profiles when they are utilized in the projections.

The Wombold and McDonald projections and the "most likely" set of exogenous assumptions are combined in the county-basin water use forecast and described as the baseline scenario for the county. Projections were performed for residential water demands based on population projections and for non-residential demands based on the nonagricultural/nonmining employment projection.[10] Projections of water use in the minerals sector were based on the measure of economic activity provided by the nonagricultural/nonmining employment forecast when the sector was dominated by sand and gravel operations. However, when water use in the mining sector was dependent on production from the regions' copper mines, exogenous assumptions were made regarding the level of production in 2005. In the baseline scenario, agricultural water use was rounded to reflect approximately the same level of irrigated acreage as found in 1980. Projections of future water demands in the recreation category of use were tied to the projection of population for the county-basin region. Throughout the baseline projections, there was assumed to be no change in the efficiency of water use. These baseline projections are described in detail for each county and basin in the body of the report.

In several of the county-basin forecasts, alternative scenario projections of future water demands were provided. Each of these alternative forecasts were based on unique assumptions that are described in the county-basin profiles. Most of the alternatives considered are best characterized as optimistic scenarios of growth for each of the regions. Incorporated in the alternative projections are assumptions regarding the improved efficiency in water use in the particular categries. A 5 percent efficiency gain for residential water use implies that water use would decline by 5 percent in the period of the forcast if the population remained constant. The efficiency gain for agricultural use was assumed to be 5 percent for surface water and 10 percent for groundwater. In each sector this change in efficiency is different; the motivation can be generally described as a price elasticity response to increasing costs of water use.[11] It is difficult to a priori assume how patterns of water demand and supply will respond to conditions of scarcity. However, there is substantial evidence that increases in both implicit and explicit costs of appropriation will induce a response reflected in a sector's pattern of water use.[12] This relationship between expected demands and available supplies is explored when pertinent.

The best use of the alternative scenario projections of water demands is in comparison to the baseline scenario. This comparision can provide the reader with a means to assess the sensitivity of the specific forecast to the assumptions upon which those forecasts are based. The baseline case reflects the most likely pattern of growth. However, the alternative projections provide valuable information with respect to each of the county-basin forecasts.

Finally, water supplies available to satisfy these increased demands must be considered. In all cases it is assumed that surface water rights will continue to be available in the quantities described by 1980 appropriations. These appropriations are assumed to be described by the 1980 SEO water use inventory. Groundwater appropriations in 1980 are assumed to describe available water rights in those basins where there is a tributary relationship between surface and groundwater supplies (i.e., Lower Rio Grande and Gila-San Francisco basins). Where groundwater is being mined, assumptions must be made as to the future availability of water resources. A September 1983 memo from the SEO describes water availability in each of the basins considered.[13]

Summary

The objective of this study was to project the quantitative demand for water relative to the projected supply in portions of Southern New Mexico. The projection of future water demand relative to available supply is thought to be useful principally from a management perspective. It is hoped that the identification of critical water scarcity conditions prior to the actual occurrence of these critical scarcity circumstances will aid in the alleviation and mitigation of problems associated with these water availability conditions. Further, it is hoped that the analysis will provided some clarity to the specific nature of the problems which must be addressed. In particular it is hoped that the specific timing of responses to scarcity problems may be better considered, and that the programs implemented may be more precisely tailored to the specific scarcity conditions.

This report is intended to identify the most severe problems related to future water supply and demand conditions in the Lower Rio Grande Basin, the Gila-San Francisco Basin, and the Mimbres Closed Basin. It is possible that the analysis of these supply/demand conditions will also provide insight into the direction which economic development efforts should take with respect to water scarcity conditions. It is hoped, at a minimum, that the analysis allows those concerned with the management of water resources in the region a greater ability to focus on the specific water resource problems that are faced on a county-wide or possibly a larger area of concern.

CHAPTER I

ENDNOTES

1 Water scarcity is defined in this report to mean a situation in which the currently available (or forecasted) demand for water is said to exceed the currently available (or forecasted) supply of water. The existence of such a scarcity condition will lead to a higher value being placed on water which in turn will most likely result in an increase in the price of water, additional conservation efforts or possible undertakings to augment the water supply.

2 New Mexico Statues Annotated. 72-12-8F (Cumm. Supp. 1984); The state engineer is also allowed to consider future water needs of the state in decisions relating to new interstate appropriations of water under N.M. Stat. Ann. § 72-12B-1B and § 72-12B-1D (Cumm. Supp. 1984).

3 E.F. Sorensen, Water Use by Categories in New Mexico Counties and River Basins, and Irrigated Acreage in 1980, New Mexico State Engineer, Technical Report 44, Santa Fe, New Mexico, 1982; and Sorensen, Water Use by Categories in New Mexico Counties and River Basins, and Irrigated and Dry Cropland Acreage in 1975, New Mexico State Engineer, Technical Report 41, Santa Fe, New Mexico, 1977.

4 Under the prior appropriation doctrine water rights are granted in perpetuity (in most cases). This perpetual right requires continuous benefical use or may be lost under several abandonment and forfeiture provisions. It is the perpetual nature of the right, combined with durable fixed investments in diversion facilities, which provides stability to the property value associated with, and sometimes dependent on, the water right. The behavior of owners of water rights is likely to be such as to maintain or enhance the value of their water right entitlements. Thus, barring the transfer of water rights to new place and purpose of use, there can be anticipated to be continuation of existing water use activities until such time as those activities are clearly unprofitable in a long-term sense.

5 Special thanks to Charles T. Dumars, Professor of Law, University of New Mexico, who provided valuable assistance in the preparation of this section on water rights entitlements.

6 Bureau of the Census, 1980 Census of the Population, U.S. Department of Commerce, Washington,D.C., Data from Summary Tape Files 3 and 5.

7 New Mexico Employment Security Department, Covered and Non-Covered Employment in New Mexico, by County, State of New Mexico, monthly and annual data, Tables A and B, and detailed data found in the ES-202 file (subject to confidentiality restrictions).

8 J.J. Boland, W. Moy, J.L. Pacey and R.C. Steiner, Forecasting Municipal and Institutional Water Use: A Handbook of Methods, U.S. Army Corps of Engineers, Engineer Institute for Water Resources, Ft. Belvoir, VA, 1983, p. VII-17.

ENDNOTES
(continued)

9 Lynn Wombold, Projection of the Population of New Mexico by County, 1980-2005, Bureau of Business and Economic Research, University of New Mexico, June, 1985. Employment projections, done by Brian McDonald (Director, Bureau of Business and Economic Research), are contained in the appendix to these population projections. Hereinafter these population and employment projections will be refered to by the authors' last names (i.e., Wombold and McDonald).

10 Because mining and agricultural water use were projected independently, nonresidential water use projections were based on nonagricultural/nonmining employment. This required "backing-out" mining employment from nonagricultural employment data used and projected by McDonald.

11 Price elasticity is a common notion in economics, and describes the response of commodity demand to a change in price. That is, as a commodity or productive input becomes relatively more costly the consumer of this good will reduce his consumption by either forgoing use of the good or substituting for it. With respect to water, the response to increased water prices is either to improve the efficiency of use or curtail use (if economic profits are to remain constant). For the residential consumer, faced with a reduction in disposable income as a result of increased water prices, the price elasticity response is probably greater than for a nonresidential consumer utilizing the water resource in an economically productive use.

12 The price elasticity response of residential water users is well documented in a number of studies. Of greatest relevance to New Mexico is J. Zamora, A.V. Kneese and E. Erickson, "Pricing Urban Water: Theory and Practice in Three Southwestern Cities," The Southwestern Review of Management and Economics, 1(1), 1981, in which water demand in Santa Fe, Tucson and Denver were analyzed. Other important research with respect to residential water price elasticity include: C.W. Howe, "The Impact of Price on Residential Water Demand; Some New Insights," Water Resources Research, 18(4), 1982; L.E. Danielson, "An Analysis of Residential Demand for Water Using Micro Time-Series Data," Water Resources Research, 15(4), 1979; J.J. Opaluch, "Urban Residential Demand for Water in the United States: Further Discussion," Land Economics, 58(2), 1982; F.G. Babin, C.E. Willis and P.G. Allen, "Estimation of Substitution Possibilities Between Water and Other Productive Inputs," American Journal of Agricultural Economics, Febuary 1982; C.V. Jones and J.R. Morris, "Instrumental Price Estimates and Residential Water Demand," Water Resources Research, 20(2), 1984.

13 S.E. Reynolds, State Engineer, letter to Charles T. DuMars, chairman, Governor's Water Law Study Committee, September 1, 1983. A copy of this memorandum is provided in the appendix, and hereinafter this letter will be referred to as the SEO Memo.

CHAPTER II

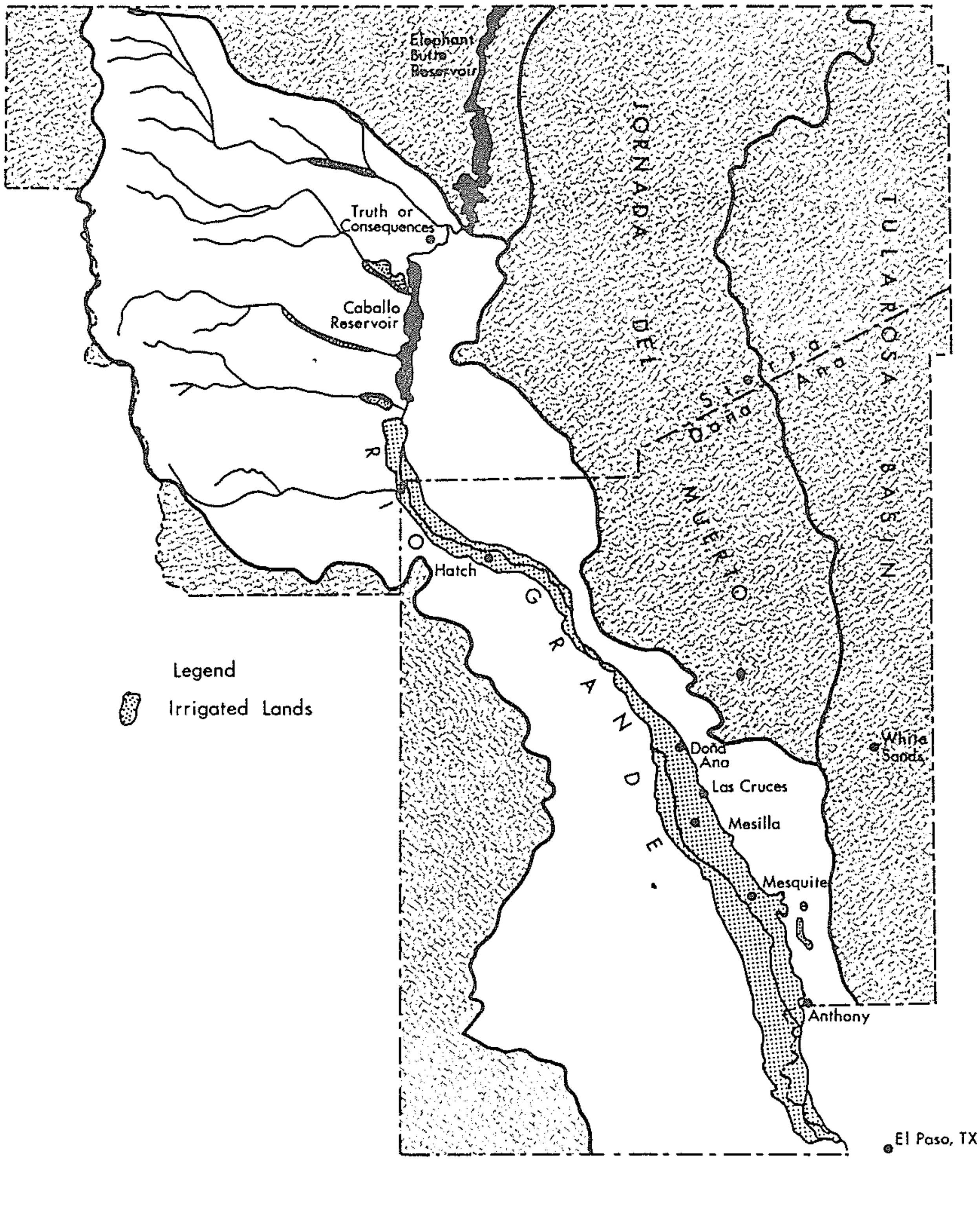
LOWER RIO GRANDE SURFACE DRAINAGE BASIN

Basin Description

The Rio Grande Basin in New Mexico extends from the Colorado border to Texas. In this study the Lower Rio Grande Basin is defined as the surface drainage area tributary to the Rio Grande mainstem below the Elephant Butte Dam face, and the closed water basins within this region that are hydrologically connected to the Rio Grande. In this report, we are only concerned with water use conditions in the Lower Rio Grande Surface Drainage Basin. This surface drainage basin is outlined in map 1.

The Lower Rio Grande Surface Drainage Basin includes parts of both Sierra and Dona Ana counties. Truth or Consequences is the northernmost city within this basin. The Rio Grande Valley south of Elephant Butte Reservoir consists of a series of valleys and flood plains bordered by sometimes steep escarpments. The Rincon Valley begins in southern Sierra County and extends southward to the San Diego Mountains. The community of Hatch is located in this valley. The other significant valley, the Mesilla Valley, extends from north of Las Cruces to the Texas border. Las Cruces, the largest urban community in the basin, is located in the Mesilla Valley. The irrigated lands along the Rio Grande (see map for location) are also the most important crop producing region in New Mexico. Land use in this basin is discussed more fully in the county profile chapters for Dona Ana and Sierra counties (chapter III and chapter IV).

The areas of Sierra and Dona Ana counties outside this surface drainage area lie almost entirely within neighboring closed basins. Outside the surface



MAP 1. Lower Rio Grande Surface Drainage Basin

drainage area the most significant human activity within these counties occurs at White Sands Missile Range Headquarters in eastern Dona Ana County.

Population

The total population of the Lower Rio Grande Surface Drainage Basin was estimated to be 99,401 in 1980. Table 2.1 provides a summary of the basin population.[1] The most populated community in the basin is Las Cruces with a 1980 population of 45,086. Truth or Consequences, in Sierra County, is the other major urban area with a 1980 population of 5,219. As table 2.1 indicates, a little over two-thirds of the basin's population lives in urbanized areas.

Table 2.1

Lower Rio Grande Surface Drainage Basin
1980 Population

	County Total	Basin Population	Basin Urban Population	Basin % Urban
Dona Ana	96,340	91,818	61,734	67.2
Sierra	8,454	7,583	5,219	68.8
Total	104,794	99,401	66,953	67.4

Economy

Total employment by sector in the basin is outlined in table 2.2. The county profile sections (chapters III and IV) describe the methodology for obtaining basin employment. Dona Ana County dominates this basin, accounting for almost 94 percent of the employment. The government sector dominates the basin's economy accounting for over one-third of all employment in 1980. Important government employers include New Mexico State University and the local public schools.

Table 2.2

Lower Rio Grande Surface Drainage Basin
1980 Employment Profile

Employment Sector	Dona Ana Basin	Sierra Basin	Total Basin
Agriculture	2,891.0	359.0	3,250.0
%Total	10.1	20.6	10.7
Manufacturing	2,643.0	25.0	2,668.0
%Total	9.3	1.3	8.8
Mining	NA	55.0	55.0
%Total		2.9	0.2
Construction	1,793.0	111.0	1,904.0
%Total	6.3	5.9	6.3
TCU	1,129.0	112.0	1,241.0
%Total	4.0	5.9	4.1
Trade	5,167.0	349.0	5,516.0
%Total	18.1	18.4	18.2
FIRE	1,140.0	67.0	1,207.0
%Total	4.0	3.5	4.0
Services	3,982.0	228.0	4,210.0
%Total	14.0	12.1	13.9
Government	9,753.0	556.0	10,309.0
%Total	34.2	29.4	33.9
Total Jobs	28,498.0	1,862.0	30,360.0

Source: See Dona Ana and Sierra County Profiles (Chapters III and IV) for a description of basin employment allocation.

Note: TCU refers to transportation, communications and utilities.
FIRE refers to finance, insurance and real estate.
NA indicates that due to disclosure laws, employment data is not available for this sector. If there is any employment in this sector, it is included in services.

Agriculture is important to this basin's economy. Although accounting for only 10.7 percent of employment, it is worth noting that employment in other sectors, i.e., food processing in manufacturing and agricultural services, is related to the agricultual economy. Principle crops in the basin include cotton and vegetables such as lettuce, onions, chile and tomatoes. In the Elephant Butte Irrigation District, a total of about 83,100 acres were in irrigated cropland in 1980.[2] There were a total of 94,480 acres irrigated in the entire Lower Rio Grande Basin in 1980. The value of irrigated crops in Sierra and Dona Ana counties combined totaled $92.5 million in 1982 or about 23 percent of the total state value of irrigated crops.[3]

The three population driven sectors, finance, insurance and real estate (FIRE), trade and services, account for over one-third of the basin's employment. The manufacturing sector, although not proportionally significant, has experienced substantial growth in the last ten years.

The dynamic area in this basin is the city of Las Cruces. This city has derived enormous economic benefit from federal expenditures related to White Sands Missile Range and from state expenditures related to New Mexico State University. The city has recently experienced substantial growth in trade and manufacturing employment.

Water Use Profile

Table 2.3 profiles water usage in the Lower Rio Grande Surface Drainage Basin. This table is a summation of the county water use data presented in table 3.5 and table 4.2. A total of 546,672 acre-feet were withdrawn, and a corresponding 267,483 acre-feet were depleted in the Lower Basin during 1980. Nearly 83 percent of withdrawals, and approximately 78 percent of depletions, were provided by surface water supplies of the basin.

Table 2.3

Summary of Water Use in the
Lower Rio Grande Surface Drainage Basin
1980

USE	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Total Wd	Total Dp	Population	Total Acres	Irrigated Acres
Urban	0	0	15,587	7,793	15,587	7,793	56,305		
Rural	0	0	4,867	2,434	4,867	2,434	43,096		
Commercial	0	0	234	141	234	141			
Industrial	0	0	51	31	51	31			
Minerals	0	0	201	63	201	63			
Military	0	0	10	9	10	9			
Power	0	0	2,150	2,150	2,150	2,150			
Recreation	255	255	3,030	1,620	3,285	1,875			
Irrigated Agriculture	420,670	176,870	67,820	44,440	488,490	221,310		104,060	94,480
Livestock	474	474	1,073	953	1,547	1,427			
Stockpond Evaporation	1,120	1,120	0	0	1,120	1,120			
Fish and Wildlife	0	0	0	0	0	0			
Reservoir Evaporation	29,130	29,130	0	0	29,130	29,130			
Total Use	451,649	207,849	95,023	59,634	546,672	267,483			

Note: Dp (depletions) and Wd (withdrawals) in acre-ft.

As the data indicate, irrigated agriculture clearly dominates water use in the region with 83 percent of total depletions. If evaporation from Caballo Reservoir is not considered in the totals, the percentage use associated with irrigated agriculture rises to 93 percent. Urban use, associated with Las Cruces, Truth or Consequences and other communities, accounts for 3.4 percent of total depletions (reservoir evaporation excluded).

Water use in the Lower Rio Grande Surface Drainage Basin is controlled by a number of administrative and institutional arrangements. The most important of these is the Rio Grande Compact among Colorado, Texas, and New Mexico.[4] Under the Rio Grande Compact a system of required water deliveries from Colorado and New Mexico is provided to their immediately downstream neighbors. New Mexico's point of delivery to Texas is at Elephant Butte Dam. This compact obligation delivery point defines the Lower Basin in New Mexico.

The compact provides a variable delivery requirement based on the flow of the Rio Grande measured at Otowi Bridge (35 miles N.W. of Santa Fe). Water use below Elephant Butte is significantly impacted by the availability of water necessary to satisfy the specific delivery requirements under the compact provisions. The compact also explicitly provides for deliveries to Mexico under the Mexican Treaty of 1906.[5]

The Rio Grande Project is one of the first projects considered under the Reclamation Law of 1902.[6] A major feature of the project in New Mexico is the irrigation works and administrative structure maintained by the Elephant Butte Irrigation District (EBID). Under federal law, the EBID was authorized to be no larger than 90,640 acres. Elephant Butte and Caballo reservoirs and the accompanying irrigation water delivery system have been instrumental in promoting the agricultural economy of the Lower Rio Grande Basin.

The other major control on the water resources of the Lower Rio Grande Basin is provided under the administration of declared underground water basins by the SEO. Within the Lower Rio Grande Surface Drainage Basin there are three separate declared underground basins: the Hot Springs Artesian Basin in Sierra County (declared April 15, 1935), Las Animas Creek Basin in Sierra County (declared August 9, 1968), and the Lower Rio Grande Underground Water Basin in Dona Ana County (declared September 11, 1980). The SEO maps of the declared underground water basins are provided in appendix B. The declaration of a underground basin brings all new appropriations and transfers of existing water rights under the jurisdiction of the state engineer. New appropriations and transfers are subject to state engineer approval based on a host of impairment and water availability conditions.

A discussion of water availability in the Lower Rio Grande cannot ignore the applications for appropriation currently being pursued by El Paso, Texas. These applications are for supplies to be utilized over many years in the future, and are in quantity greater than any current use in the Lower Basin.[7] This potential use may significantly impact the availability of water for other purposes. The question that is addressed in our study is the magnitude of the new uses that are likely to occur in the Lower Basin in New Mexico as a result of growth within the state of New Mexico. The specific impacts of the new demands from outside the state (like El Paso) are not considered in our research.

CHAPTER II

ENDNOTES

1 See county descriptions (chapters III and IV) for a discussion of how basin population was determined. The Mimbres Closed Basin portion of Dona Ana County is included in the population data. Urban population is defined to comprise all persons living in urbanized areas and places of 2,500 or more outside urbanized areas. This data was obtained from the U.S. Bureau of Census, Number of Inhabitants, (1960, 1970 and 1980).

2 E.F Sorensen, 1982. Water Use by Categories in New Mexico and River Basins and Irrigated Acreage in 1980, New Mexico State Engineer, Technical Report 44, Sante Fe, New Mexico. Total cropland (irrigable acreage) for the EDID is reported to be 90,690 acres.

3 Tom Clevenger and Paula Carpenter, 1984. Irrigated Acerage in New Mexico and Estimated Crop Value by County, 1981, New Mexico State Agricultural Experiment Station, Research Report 521 (January) Las Cruces, New Mexico.

4 Rio Grande Compact (1938), New Mexico Statues Annotated § 75-34-3 (1953), Act of May 31,1939, ch.155, 53 Stat. 785 (hereinafter Rio Grande Compact).

5 Convention between the United States of America and Mexico, May 21, 1906, 34 Stat. 785, T.S. No. 455. Under the treaty the United States aggreed to furnish 60,000 acre-feet of water per annum to the Mexican Canal at Juarez, Mexico, and the Mexican Government waived all claims to water in the Rio Grande above Fort Quitman, Texas.

6 Reclamation Act, Act of June 17, 1902, ch. 1093, 32 Stat. 388. Under the Reclamation Act the Rio Grande Project was approved by the Secretary of the Interior on December 2, 1905. Construction of Elephant Butte Dam was authorized by Congress as a major feature of the Rio Grande Project on May 4, 1907, and storage of water was first begun in 1915. Irrigation in the area included within the Rio Grande Project probably dates to the fifteenth century. The service of all irrigated lands included within the Rio Grande Project was not completed until the mid-1940s.

7 On September 12, 1980, El Paso filed 226 applications to appropriate 246,000 acre-feet of ground water annually from the Lower Rio Grande Basin. On September 18, of the same year, the city filed an additional 60 applications to appropriate 50,000 acre-feet annually from the Hueco Basin. (Annual Report, 73rd Fiscal year, State Engineer of New Mexico, Santa Fe, November, 1985). The Hueco Groundwater Basin is located outside the Lower Rio Grande Basin as defined in this report.

CHAPTER III
DONA ANA COUNTY

Current Profile

Water Basin Description. All of Dona Ana County is included within the Rio Grande hydrologic basin; however, only the central stem of the county is part of the Rio Grande Surface Water Drainage Basin. The northeastern portion and the eastern edge of the county is part of the Jornada del Muerto Water Basin and the Tularosa Closed Water Basin. White Sands Monument, White Sands Missle Range headquarters and a Ft. Bliss target range are located in this area. The sparsely populated western edge of the county, (west of the Portillo and Sierra de las Uvas mountains) is part of the Mimbres Closed Basin.

In this report, we define water use conditions for the portion of the Lower Rio Grande Surface Drainage Basin to include the portion of the county within the Mimbres Closed Basin. It may be recalled that the economic and demographic data allocations to surface drainage basins were based on census division boundaries. No census boundary coincided closely with the Mimbres Basin portion of Dona Ana County. Consequently, the water use data for the Mimbres Basin portion of the county was added to water use in the Lower Rio Grande Surface Drainage Basin. The 1980 SEO water data shows this (Nutt-Hocket) area to contain 400 irrigable acres, with 360 acres irrigated in 1980. According to the SEO, no other water use occured in this portion of Dona Ana County in 1980.

Land Use.[1] The total land area in Dona Ana County is 2,434,560 acres. The single largest landholder in the county is the Bureau of Land Management (BLM) with 1,137,071 acres. The Department of Defense, controlling 543,721 acres, is the second largest landholder in the county. Virtually all this defense land is part of the White Sands Missile Range and is located outside the Lower Rio Grande Basin.

As table 3.1 indicates, the Lower Rio Grande Surface Drainage Basin portion of the county totals 1,105,920 acres or about 45 percent of the total county. The greatest share of this land is BLM or state owned grazing land. About 99 percent of the total county cropland of 93,520 acres is located within this basin. Urban and built-up land in the basin, primarily Las Cruces and vicinity, totals about 61,000 acres.

Table 3.1

Acreage by Water Basin
Dona Ana County

Basin	Acres
Mimbres Closed	391,680
Lower Rio Grande Surface Drainage	1,105,920
Jornada Closed	414,720
Tularosa Closed	522,240
Total County	2,434,560

Population.[2] According to the 1980 census data, 96,340 people live in Dona Ana County making Dona Ana the second most populated county in New Mexico. As table 3.2 indicates, an estimated 91,799 live in the Surface Drainage Basin. The surface drainage area population is concentrated in the city of Las Cruces with a 1980 population of 45,086. Of the 64,854 urban residents of Dona Ana County, 61,734 or over 95 percent live in this basin. The only area of the county, considered to be urbanized, but outside the drainage basin is the White Sands Missile Range Headquarters.[3] The only other populated area in the county, outside the surface drainage area, is the community of Chaparral, located in the Tularosa Basin in eastern Dona Ana County.

Dona Ana experienced a substantial increase in population in the decade of the 1970s as population increased at an average annual rate of 3.8 percent. The average annual rate of population growth for the three-year period 1981-1983 was also 3.8 percent. Total 1983 population for the county was estimated to be 107,700.

Table 3.2
Dona Ana County Population by Water Basin

Area	1980
Total County	96,340
Lower Rio Grande Surface Basin	91,799
Jornada Del Muerto Basin	11
Mimbres Basin	19
Tularosa Basin	4,511

Economy. An employment profile of Dona Ana County is contained in table 3.3. Employment by sector is presented for Dona Ana for the years 1970, 1980 and 1982. Note that total employment has increased in the county by 48 percent from 1970 to 1982. All sectors of the economy have experienced growth in this period.

A traditional mainstay of the Dona Ana economy has been agriculture. As table 3.4 illustrates, the cash receipts from all farm commodities (in real or nominal dollars) has increased since 1978. Based on cash receipts from all agricultural commodities, Dona Ana is the most important agricultural county in

Table 3.3

Dona Ana County Employment Profile

Employment Sector	Total County 1970	Total County 1980	Total County 1982	Basin County 1980
Agriculture	2,432.0	2,914.0	2,754.0	2,891.0
%Total	10.5	9.0	8.0	10.1
Manufacturing	1,198.0	2,675.0	3,000.0	2,643.0
%Total	5.2	8.2	8.8	9.3
Mining	NA	NA	NA	NA
%Total				
Construction	968.0	1,825.0	1,700.0	1,793.0
%Total	4.2	5.6	5.0	6.3
TCU	1,122.0	1,150.0	1,300.0	1,129.0
%Total	4.8	3.5	3.8	4.0
Trade	3,484.0	5,325.0	6,000.0	5,167.0
%Total	15.0	16.4	17.5	18.1
FIRE	641.0	1,175.0	1,200.0	1,140.0
%TOTAL	2.8	3.6	3.5	4.0
Services	2,620.0	4,025.0	4,200.0	3,982.0
%Total	11.3	12.4	12.3	14.0
Government	10,739.0	13,375.0	14,100.0	9,753.0
%Total	46.3	41.2	41.2	34.2
Total Jobs	23,204.0	32,464.0	34,254.0	28,498.0

Source: New Mexico Employment Security Division and U.S. Dept. of Commerce, Bureau of Economic Analysis (For Agricultural Employment). 1980 Census employment data (Bureau of Census) used to allocate county data to basin.

Note: TCU refers to transportation, communications and utilities.
FIRE refers to finance, insurance and real estate.
NA indicates that due to disclosure laws, employment data is not available for this sector. If there is any employment in this sector, it is included in services.

New Mexico. Dona Ana County's share of all the state's agricultural sales in 1983 was 17 percent. With regards to crop production only, Dona Ana's cash receipts accounted for almost 30 percent of the state total.[4]

Since 1960, the acreage devoted to agriculture (as measured by irrigated cropland) has increased slightly. In 1960, Dona Ana had 94,000 acres of irrigated cropland and this increased to 96,030 by 1983. It is important to note that irrigated cropland includes idle and fallow acreage. The total irrigated acreage data shows a sharp decline in recent years in acres to which water is applied for irrigation. There is significant deviation in data for acreage actually irrigated.[5] In 1980, the SEO calculated irrigated acreage water use based on a figure of 87,010 acres for the county. Of the county irrigated acreage, 86,660 acres were part of the Lower Rio Grande Basin portion of the county.[6]

Based on Bureau of Economic Analysis data, the agricultural sector has experienced the smallest increase of employment in the county compared to the other sectors (mining excluded). Employment had increased by only 13 percent since 1970 to a total of 2,754 in 1982.

With regards to employment, the government is dominant in Dona Ana County. In 1982, this sector accounted for 41.2 percent of total county employment. Important government employers in Dona Ana include White Sands Missle Range and New Mexico State University. Note that White Sands is not within the Rio Grande Surface Basin. However, activity at this range greatly impacts areas within the drainage basin. For example, the White Sands Public Affairs Office estimated that over $23 million in contracts went to the Las Cruces area in FY 1984. In addition, about 40 percent of the personnel working on the missile range live in the Las Cruces area.[7]

Table 3.4

Agricultural Data for Dona Ana County

Year	Total[1] Irrigated Cropland (acres)	Total Acres Irrigated	Cash Receipts All Farm Commodities ($000)	Real Value[2] Cash Receipts ($000,1967)
1960	94,000	NA	NA	NA
1970	97,300	NA	NA	NA
1978	95,890	85,100	99,199	48,015
1979	95,730	85,450	104,130	45,313
1980	95,730	86,020	115,322	47,128
1981	95,730	81,190	138,253	54,971
1982	95,730	77,710	148,874	59,813
1983	96,030	70,400	165,182	66,552

1 Sum of irrigated planted crop acreage, diverted acerage and idle and fallow land.

2 Cash Receipts deflated by the annual average Farms Products and Processed Foods Producer Price Index.

Source: New Mexico Agricultural Statistics, U.S. Dept.of Agriculture and N.M. Dept. of Agriculture and Lansford, et al.1984. Sources of Irrigation Water and Irrigated and Dry Cropland Acreages in New Mexico, By County, 1978-1983, Agricultural Experiment Station, New Mexico State University, Research Report 554 (October), p.18.

Manufacturing employment has shown the most significant increase in employment. In 1982 this sector accounted for 8.8 of total employment, up from 5.2 percent in 1970. The growth in manufacturing jobs in Dona Ana has far exceeded the nation as a whole. For example, in the peak-to-peak period from 1978 to 1982, U.S. employment in manufacturing actually declined by 4.53 percent. In Dona Ana County, the number of manufacturing jobs increased by over 38 percent in the same period.

Nondurable manufacturing, such as textile products and food processing, is much more important in Dona Ana compared to the state as a whole. Based on 1984 data, about 60 percent of all manufacturing employment in Dona Ana was in nondurable manufacturing. In New Mexico about 36 percent of manufacturing jobs fall into this category. The significance of this employment in Dona Ana County is related to the importance of the agricultural sector in the area.

With regards to the other sectors, trade is the most important. In recent years, this sector has experienced significant growth in Las Cruces with the opening of the Mesilla Valley Mall and other shopping centers.

The final column of table 3.3 lists the employment by sector of the portion of the county within the Surface Drainage Basin for 1980.[8] As expected, the most significant difference between employment in the basin and for the entire county is government employment. The basin employment data indicates that government jobs account for 34.1 percent of all employment. For the entire county, the government accounts for 41.2 percent of employment. This result is directly associated with the exclusion of White Sands from the basin data.

Water Use. Total water withdrawals in Dona Ana County amounted to 482,273 acre-feet in 1980. The associated depletions totaled 221,202. Table 3.5 shows the water use for the Lower Rio Grande Surface Drainage Basin portion of the county. Although agriculture is not the dominant sector in Dona Ana County with respect to employment, it is clearly the most important sector with respect to water use.

In 1980 irrigated agriculture accounted for 93 percent of the total water depletions in this portion of the county. Eighty-eight percent of the irrigated agricultural withdrawal was from surface water. Surface water accounted for 82 percent of depletions associated with irrigated agricultural use.

Table 3.5

Summary of Water Use in Dona Ana County
Lower Rio Grande Surface Drainage Basin
1980

USE	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Total Wd	Total Dp	Population	GPCD
Urban	0	0	14,179	7,089	14,179	7,089	51,086	
Anthony	0	0	220	110	220	110	3,000	65
Dona Ana	0	0	336	168	336	168	3,000	100
Las Cruces	0	0	12,070	6,035	12,070	6,035	45,086	239
NMSU	0	0	1,553	776	1,553	776		
Rural	0	0	4,721	2,361	4,721	2,361	40,732	
Berino	0	0	20	10	20	10	326	55
Butterfield Park	0	0	26	13	26	13	460	50
Hacienda Acres MHP	0	0	111	56	111	56	685	145
Hatch	0	0	108	54	108	54	1,028	94
Mesilla	0	0	180	90	180	90	1,264	127
Mesilla Park	0	0	117	58	117	58	765	135
Mesquite	0	0	68	34	68	34	1,020	60
Organ	0	0	110	55	110	55	820	120
Pecan Valley Estates	0	0	31	16	31	16	240	115
Rincon	0	0	25	12	25	12	280	80
San Andres Estates	0	0	68	34	68	34	465	130
University Estates	0	0	170	85	170	85	466	325
Other Rural	0	0	3,687	1,844	3,687	1,844	32,913	100
Commercial	0	0	234	141	234	141		
Industrial	0	0	51	31	51	31		
Minerals	0	0	181	59	181	59		
Military	0	0	10	9	10	9		
Power	0	0	2,150	2,150	2,150	2,150		
Recreation	255	255	3,030	1,620	3,285	1,875		
							Total Acres	Irrigated Acres
Irrigated Agriculture	395,860	166,640	56,970	37,610	452,830	204,250	95,380	86,660
E.B.I.D.	395,860	166,640	32,680	22,300	428,540	188,940	86,660	79,330
Scattered	0	0	23,350	14,710	23,350	14,710	8,320	6,970
Nutt-Hockett	0	0	940	600	940	600	400	360
Livestock	257	257	738	642	995	899		
Stockpond Evaporation	340	340	0	0	340	340		
Fish and Wildlife	0	0	0	0	0	0		
Reservoir Evaporation	0	0	0	0	0	0		
Total Use	396,712	167,492	82,264	51,712	478,976	219,204		

: Wd (withdrawals) and Dp (depletions) in acre-ft.
GPCD=gallons per capita per day
E.B.I.D. denotes Elephant Butte Irrigation District

Source: **E.F. Sorensen, <u>Water Use Categories in New Mexico Counties and River Basins and Irrigated Acreage</u> in 1980, 1982. Technical Report 44, New Mexico State Engineer Office, Santa Fe, New Mexico and New Mexico State Engineer Office Files.**

A discussion of water use in Dona Ana County must clearly acknowledge the role of Elephant Butte Irrigation District (EBID). Part of the Rio Grande Project, EBID is one of the first reclamation projects to be considered after passage of the Reclamation Act of 1902. Construction of the Rio Grande Project was authorized in 1905, and EBID was formed from water users associations as an irrigation district consisting of 90,640 acres.[9] More than 95 percent of the EBID acreage is in Dona Ana County. The role of EBID in determining the present and future patterns of water use in the lower basin probably cannot be overemphasized. During the last six years, irrigated acreage farmed in EBID has averaged more than 78,000 acres.[10] It is EBID's policy that no water will be allowed transfer to nonagricultural use.[11]

The second most important use of water in Dona Ana County is associated with urban uses. Depletions totaled 7,089 acre-feet in 1980. All of this water was from groundwater sources. Recreation use in the county, consisting primarily of water use by golf courses, must also be associated with urban activities. Total recreational use accounted for 1,875 acre-feet of depletions in 1980.

Other important users of water in Dona Ana County include White Sands Missile Range and the El Paso Electric Rio Grande oil-fired electric generating plant. The White Sands water use occurs outside the Lower Rio Grande Surface Drainage Basin. The El Paso Electric plant, located in southern Dona Ana County, withdrew (and depleted) 2150 acre-feet in 1980. All this water was supplied by groundwater sources. Depletions in the minerals category can be attributed to a sand and gravel plant and to a natural gas compressor station.

Projections

Population. Population estimates for New Mexico counties, provided by Wombold, project a 2005 population for Dona Ana County of 171,400. It is assumed that 95 percent of all population growth in the county will occur in the Lower Rio Grande Surface Drainage Basin portion of the county. This implies that the basin portion of the county will maintain 95 percent of the county's population. Based on these assumptions, county basin population will be 162,093 in the year 2005. This represents a population increase of 71,537 in the basin.

Economy. Dona Ana's economy has historically been dominated by agriculture, activity related to the White Sands Missile Range and state government employment. Activity associated with White Sands could potentially increase due to a significant increase in research funds being devoted to "Star Wars" weapons research. However, it is not likely that state government employment or agriculture will significantly expand in the future. Local government employment should increase in step with the population growth of Dona Ana County. Regardless of the growth prospects, these three areas will continue to dominate the county's economy in the 25-year time horizon.

Despite the dominance of these traditionally important activities, future employment growth is likely to come in other areas. In recent years, the rate of growth of the small manufacturing sector has exceeded that of all other sectors. This growth is likely to continue in the future. In addition to manufacturing, the retail trade and service sectors should also experience substantial growth in the near future.

From the 1984 nonagricultural base employment of 35,400, the McDonald projections have employment increasing by 4 percent in 1985 and 3 percent in

1986. In the longer term, employment growth is expected to slow. In the period 1987 to 1990, employment growth was projected to grow at a 2.34 percent annual rate. For the time period 1990-2005, employment is projected to grow at a slower rate of 1.58 percent per year.[12] Based on these growth assumptions, total nonagricultural employment is expected to be 52,618 in the year 2005. The level of employment projected in the year 2005 represents a 78 percent increase over the 1980 nonagricultural base employment of 29,550.

Water Use. Table 3.6 presents the baseline scenario water use projections for the Lower Rio Grande Surface Drainage Basin portion of Dona Ana County. These projections of water demand are very dependent on the population and employment projections of Wombold and McDonald (respectively). The relatively large recreation use category was also tied to the population projections due to the dominance of golf course irrigation in this use catagory. The power use category was also tied to the growth in population, although it is quite possible that the older vintage electrical generation facility may be abandoned by 2005. Water use projections in the mineral use catagory were tied to the measure of economic activity provided by the employment projections. This was done because of the dominance of sand and gravel operations in this water use sector. The baseline projections were additionally based on the assumption that irrigated agriculture would continue at the nearly 87,000 acre level described in the 1980 SEO data. The military, livestock and stock pond evaporation use were all exogenously assumed to remain the same in the forecast period. Finally, the baseline scenario assumed that there would be no change in water use efficiency.

The coefficients in table 3.6 (and in all the water projection tables) indicate a per-unit withdrawal or depletion of water. For example, the

Table 3.6

Baseline Projections
Dona Ana County

USE	1980 WATER USE: Surface Wd	Surface Dp	Ground Wd	Ground Dp	Total Wd	Total Dp	WATER USE COEFFICIENTS AND PROJECTION VARIABLES: 1980 Projection Variable	1980 Water Use Coefficients: Surface Wd	Surface Dp	Ground Wd	Ground Dp	% Change in Use Efficiency	2005 Forecast Variable	BASELINE WATER USE PROJECTIONS: 2005 Surface Wd	2005 Surface Dp	2005 Ground Wd	2005 Ground Dp	Net Change in Total Wd	Net Change in Total Dp
Residential	0	0	6,721	3,371	6,721	3,371	91,818	0.000000	0.000000	0.073197	0.036709	0.00 %	162,093	0	0	11,865	5,950	5,144	2,580
Non-Residential (Urban & Rural)	0	0	12,464	6,251	12,464	6,251	25,607	0.000000	0.000000	0.764438	0.383283	0.00 %	45,597	0	0	34,856	17,477	22,392	11,225
Urban, Rural, Comm.& Indust.	0	0	19,185	9,622	19,185	9,622										46,721	23,427	27,536	13,805
Minerals	0	0	181	59	181	59	25,607	0.000000	0.000000	0.007068	0.002304	0.00 %	45,597	0	0	322	105	141	46
Military	0	0	10	9	10	9	EX06						EX06	0	0	10	9	0	0
Power	0	0	2,150	2,150	2,150	2,150	91,818	0.000000	0.000000	0.023416	0.023416	0.00 %	162,093	0	0	3,796	3,796	1,646	1,646
Recreation	255	255	3,030	1,620	3,285	1,875	91,818	0.002777	0.002777	0.033000	0.017644	0.00 %	162,093	450	450	5,349	2,860	2,514	1,435
Irrigated Agriculture	395,860	166,640	56,970	37,610	452,830	204,250	86,660	4.567967	1.922917	0.657397	0.433995	0.00 %	87,000	397,413	167,294	57,194	37,758	1,777	801
Livestock	257	257	738	642	995	899	EX06						EX06	257	257	738	642	0	0
Stockpond Evaporation	340	340	0	0	340	340	EX06						EX06	340	340	0	0	0	0
Total Use	396,712	167,492	82,264	51,712	478,976	219,204								398,460	168,341	114,129	68,596	33,614	17,733

Note: Wd (withdrawals) and Dp (depletions) in acre-ft.

coefficient of groundwater withdrawal for residential use (0.073197) corresponds to the per acre-feet withdrawal associated with a single unit (person). Multiplying this coefficient times the 2005 forecasted population, one obtains the 2005 withdrawal associated with total residential use (11,865 acre-feet). The coefficients of recreation and power likewise are related to population. The coefficients linked with minerals use as well as nonresidential use represent a per-employee use value while the irrigated agriculture coefficient represents a per acre-feet use of water associated with one acre of irrigated land.

The projections in table 3.6 reveal that increased water demands will be primarily the result of increased residential and nonresidential water uses. The water resources necessary to satisfy these demands are likely to be from groundwater sources. The next largest increase in water demands is likely to be associated with increasing recreation demands, a demand condition consonant with the increasing urbanization of the Mesilla Valley region of Dona Ana County. However, the most noteworthy observation from the baseline projection of water demands in 2005 is the fact that the total increase in demands amounts to less than a 7.5 percent increase in total withdrawals and depletions over 1980 water uses.

As a way of testing the sensitivity of these projections, two alternative scenarios for Dona Ana County were also considered. The results of these alternative scenarios are presented in table 3.7. Both of these scenarios must be described as being "optimistic." In addition, both of these scenarios incorporate increased water use efficiency assumptions for several catagories of use. In scenario A it was assumed that population and employment would grow in the manner described by the baseline scenario. It was further assumed that

Table 3.7

Alternative Water Use Projections
Dona Ana County

PROJECTION VARIABLES COMMON TO SCENARIOS

USE	1980 Projection Variable	% Change in Use Efficiency Surface	% Change in Use Efficiency Ground
Residential	91,818	0%	5%
Non-Residential (Urban & Rural)	25,607	0%	0%
Urban, Rural, Comm.& Indust.			
Minerals	25,607	0%	0%
Military	EXOG		
Power	91,818	0%	0%
Recreation	91,818	5%	10%
Irrigated Agriculture	86,660	5%	10%
Livestock	EXOG		
Stockpond Evaporation	EXOG		
Total Use			

ALTERNATIVE SCENARIO A: AGRICULTURE GROWTH ONLY

USE	2005 Forecast Variable	2005 Surface Wd	2005 Surface Dp	2005 Ground Wd	2005 Ground Dp	Net Change Total Wd	Net Change Total Dp
Residential	162,093	0	0	11,271	5,653	4,551	2,282
Non-Residential (Urban & Rural)	45,597	0	0	34,856	17,477	22,392	11,225
Urban, Rural, Comm.& Indust.				46,128	23,129	26,943	13,507
Minerals	45,597	0	0	322	105	141	46
Military	EXOG	0	0	10	9	0	0
Power	162,093	0	0	3,796	3,796	1,646	1,646
Recreation	162,093	428	428	4,814	2,574	1,957	1,127
Irrigated Agriculture	96,000	416,599	175,370	56,799	37,497	20,568	8,617
Livestock	EXOG	257	257	738	642	0	0
Stockpond Evaporation	EXOG	340	340	0	0	0	0
Total Use		417,623	176,395	112,607	67,752	51,254	24,943

ALTERNATIVE SCENARIO B: AGRICULTURAL GROWTH WITH OPTIMISTIC POPULATION AND EMPLOYMENT GROWTH

USE	2005 Forecast Variable	2005 Surface Wd	2005 Surface Dp	2005 Ground Wd	2005 Ground Dp	Net Change Total Wd	Net Change Total Dp
Residential	244,772	0	0	17,021	8,536	10,300	5,165
Non-Residential (Urban & Rural)	68,264	0	0	52,184	26,164	39,719	19,913
Urban, Rural, Comm.& Indust.				69,204	34,700	50,019	25,078
Minerals	68,264	0	0	483	157	302	98
Military	EXOG	0	0	10	9	0	0
Power	244,772	0	0	5,732	5,732	3,582	3,582
Recreation	244,772	646	646	7,270	3,887	4,631	2,658
Irrigated Agriculture	96,000	418,336	176,102	56,095	37,053	22,541	9,504
Livestock	EXOG	257	257	738	642	0	0
Stockpond Evaporation	EXOG	340	340	0	0	0	0
Total Use		419,579	177,344	139,531	82,180	81,074	40,920

Note: Wd (withdrawals) and Dp (depletions) in acre-ft.

agricultural acreage would increase by more than 10 percent to 96,000 acres under irrigation. This is acknowledged to be a very optimistic interpretation of the future of agriculture in the Lower Basin, in that agricultural interests would be competing with other potential water users in water rights. This acreage figure does correspond to the total irrigation crops in Dona Ana County (table 3.4)

The significant result of this optimistic scenario A projection is that even with a more than 10 percent increase in irrigated acreage, increased water demands associated with agriculture are less than the increased demands of the residential and nonresidential uses anticipated in Dona Ana County (26,943 acre-feet withdrawal of residential minerals usage vs. 20,568 acre-feet for irrigated agriculture). Also notable is the limited effect that a 5 percent increase in the efficiency of use has on the future demands of the residential and nonresidential water use sectors.

If the previous alternative growth scenario is correctly described as optimisic, then the growth described in alternative scenario B must be considered as "positively glowing." Not only does scenario B adopt the strong agricultural growth assumption of the previous alternative, the second alternative scenario assumes an average 4 percent annual growth in both population and employment throughout the 25-year projection period. Growth at this rate for a continuous 25-year period must be considered very strong. The alternative scenario B results are also presented in table 3.7

The result is clear in that increased water demand pressures will be largely exerted on the groundwater resources of the region. The net change in total withdrawals of approximately 81,000 acre-feet, with a corresponding increase in depletions of nearly 41,000 acre-feet, demonstrate that even under strong growth assumptions there can be anticpated less than a 20 percent increase in water demands during the 25-year period from 1980 to 2005 in Dona Ana County. This 20 percent indrease in water demand does suggest some upper bound on the water demand growth in the Lower Rio Grande Surface Drainage Basin portion of Dona Ana County.

Summary

Most important to an understanding and interpretation of future water demand conditions in the Lower Rio Grande Surface Drainage Basin is the role that will be played by irrigated agriculture. If the expressed plan of the EBID for no diminution of surface water irrigation is realized (see footnote 11) and the state engineer successfully asserts that there is a full appropriation condition in the Lower Basin,[13] then the only water resources available for satisfaction of increased residential and nonresidential water demands must be the result of retirement of groundwater rights now in agricultural use. Nearly 60 percent of the groundwater used in agriculture in 1980 was in combination with, or supplemental to, surface water deliveries for irrigation. Many of the EBID irrigators augment their surface water deliveries with groundwater appropriations. This is particularly true of the higher-valued crop farming enterprises.

There is no reason to speculate as to the specific motivation of Mesilla Valley irrigators in 2005. It is sufficient to note that the future of irrigated agriculture in the region largely determines the specific conditions of water scarcity in the lower basin portion of Dona Ana County. If the simultaneous conditions of agricultural growth and rapid economic and demographic growth occur (e.g., alternative scenario B), then water scarcity conditions in Dona Ana County are likely to become of great concern over the 25-year forecast period. However, the relatively small increases in residential and nonresidential water demands are likely to be easily satisfied by retirement of agricultural groundwater rights if economic conditions in agricultural markets discourage the continuation of agriculture at levels observed in 1980.

CHAPTER III

ENDNOTES

1 Data in this section was obtained from Diemer and Morrison, New Mexico Land Use, By County 1977-1982, p.13; Hydrologic Unit Map-1974, State of New Mexico; and Important Farmlands, Dona Ana County, New Mexico. 1979, U.S. Conservation Service, Department of Agriculture.

2 The population data was from the U.S. Bureau of the Census, Department of Commerce. The county basin population was determined by matching census to hydrological boundaries. The surface drainage portion of the county includes all populated census divisions with the exception of ED's 991 and 992 in the Anthony Division, ED 975 and other unpopulated areas in the White Sands Division, ED 979 in the Dona Ana-Hill Division and ED 988 in the Fairacres Division.

3 Number of Inhabitants 1980, U.S. Bureau of Census.

4 1983 New Mexico Agricultural Statistics, U.S. Department of Agriculture and New Mexico Department of Agriculture.

5 Three differing sources of actual irrigated acreage include the Census of Agriculture, U.S. Department of Commerce, Bureau of the Census; the New Mexico State Engineer Office; and Lansford, et al. 1984, Sources of Irrigation Water and Irrigated and Dry Cropland Acreages in New Mexico, by County, 1978-83. New Mexico State University, Agricultural Experiment Station, Research Report 554 (October).

6 New Mexico State Engineer files. Only 350 irrigated acres in the county, located in the Tularosa Basin, were excluded from the analysis.

7 Fact Sheet FY 1984, Public Affairs Office, White Sands Missile Range, New Mexico.

8 Employment in this portion of the county was determined by using census data to create weights of employment by sector within and outside the basin. These weights were then applied to the New Mexico Employment Security Division employment data (establishment based) in order to obtain estimates of basin employment. One adjustment was necessary to adequately take into account White Sands Missile Range. Census data does not take into account employment at this facility since virtually all civilian employees live elsewhere. Thus we were required to make an additional adjustment to take into account this employment. Agricultural employment in the basin was determined by using agricultural acreage as the weighing factor.

9 The EBID consists of all 90,640 acres served and benefited under the Bureau of Reclamation's Rio Grande Project, and all operations and maintenance of the Project in New Mexico are preformed under EBID's direction. The Irrigation District was formed and incorporated under N.M. Stat. Ann § 75 (Cumm. Supp. 1978).

CHAPTER III

ENDNOTES
(continued)

10 Elephant Butte Irrigation District, Annual Report to Land Owners, October 31, 1983, Las Cruces, New Mexico, 1983.

11 Interview with William J. Saad, treasurer manager, Elephant Butte Irrigation District, Las Cruces, New Mexico, May 1, 1985.

12 The long-term rates of growth were obtained by examining the trends implied by a linear regression model of Dona Ana County employment. In a simple model, nonagricultural employment was regressed on manufacturing employment and combined state/federal employment. Annual observations from 1970-1984 were used to estimate the coefficents of the model. To project nonagricultural employment, estimates of manu-manufacturing and state/federal employment to the year 2005 were obtained from the Data Resources, Inc. U.S. Long-Term Outlook (Winter 1984-1985). These projections were modified based on our belief that Dona Ana County would outperform the U.S. economy. State/federal employment was expected to grow at 1.25 the U.S. rate while county manufacturing employment was projected to exceed the U.S. rate by three times. The rate of growth in nonagricultural employment implied by this procedure (2.34 percent, 1987-90; 1.58 percent, 1990-2005) were used in projecting nonagricultural employment.

13 "Inasmuch as the Rio Grande is fully appropriated, any withdrawal of groundwater from storage requires a concomitant offsetting of the effect on the streams by retirement of surface water rights." S.E. Reynolds, state engineer, letter to Mr. Charles T. DuMars, Chairman, Govenor's Water Law Study Committee, September 1, 1983, p. 5 (copy provided in Appendix A).

CHAPTER IV

SIERRA COUNTY

Current Profile

Water Basin Description. Virtually all of Sierra County lies in the Rio Grande hydrologic basin. The area of interest in this report, the Rio Grande Surface Drainage Basin, consists largely of the portion of the county in the immediate vicinity and west of the river. The geographically small, mountainous, unpopulated area in the northwestern corner of the county is outside the basin and within the Lower Colorado River Basin. The Rio Grande, including Elephant Butte and Caballo reservoirs, is located in the eastern part of the surface drainage basin. A small area in the southwest corner of the county drains westward and is part of the Mimbres Closed Basin. The eastern half of the county is virtually unpopulated. This area is part of the Jornada del Muerto and Tularosa Closed Basins. A large portion of this area is part of the White Sands Missile Range and is used by the defense department for missile testing. This report focuses on the water use conditions in the portion of the county within the Lower Rio Grande Surface Drainage Basin. The Lower Basin is defined by the Rio Grande Compact and is the area of the surface drainage basin tributary to the river below the dam face at Elephant Butte, which is the New Mexico point of delivery under the compact.

Land Use.[1] An estimated 1,082,880 acres, or 40 percent of the total area of the county, lie within the Lower Rio Grande Surface Drainage Basin portion of the county. The Rio Grande Valley south of Elephant Butte Dam is dominated by the city of Truth or Consequences, Caballo Reservoir and the irrigated agricultural lands south of the reservoir. The vast majority of the mountainous land to the west of the valley consists of arroyos and narrow stream valleys used primarily for grazing. This land is under private, state and federal ownership. The far western edge of the basin portion of the county is part of the Gila National Forest.

Population.[2] In 1970 the population of Sierra County totaled 7,189. By 1980 the number of Sierra County residents had increased to 8,454 (almost an 18 percent increase). The 1983 population was estimated to total 8,900. An important factor in this steady population growth has been the popularity of Sierra County as a retirement area. The large retirement community is centered in Truth or Consequences, the county seat, with a total 1982 population of 5,533.

The Lower Rio Grande Surface Drainage Basin includes the majority of residents within the county. In 1980 7,583 people lived in this basin or almost 90 percent of the county's population. The only populated areas in the county outside the basin are the small communities of Placitas and Monticello in the northwestern part of the county and the land area to the west and adjacent to Elephant Butte Reservior.

Economy. As table 4.1 indicates, the county's economy is dominated by four sectors; agriculture, trade, services and the government. Total employment increased by almost 21 percent from 1970 to 1980 with all sectors experiencing some employment growth. Total nonagricultural employment in 1980 was 1,713.

Government agencies are the largest employer in Sierra County. However, this sector has become decreasingly important over time. For example, in 1970, 36.9 percent of all employed persons were in government service. This proportion had declined to 23.4 percent by 1982. The primary reason for this decline

Table 4.1

Sierra County Employment Profile

Employment Sector	Total County 1970	Total County 1980	Total County 1982	Basin County 1980
Agriculture	392.0	415.0	397.0	359.0
%Total	22.3	19.5	19.6	19.3
Manufacturing	16.0	33.0	NA	25.0
%Total	0.9	1.5		1.3
Mining	33.0	55.0	NA	55.0
%Total	1.9	2.6		3.0
Construction	152.0	125.0	96.0	111.0
%Total	8.6	5.9	4.7	6.0
TCU	60.0	125.0	75.0	112.0
%Total	3.4	5.9	3.7	6.0
Trade	335.0	397.0	436.0	349.0
%Total	21.3	18.7	21.5	18.7
FIRE	44.0	76.0	74.0	67.0
%Total	2.5	3.6	3.7	3.6
Services	197.0	265.0	473.0	228.0
%Total	11.2	12.5	23.4	12.2
Government	490.0	637.0	473.0	556.0
%Total	27.9	29.9	23.4	29.9
Total Jobs	1,759.0	2,128.0	2,024.0	1,862.0

Source: New Mexico Employment Security Division and U.S. Dept. of Commerce, Bureau of Economic Analysis (For Agricultural Employment). Census employment data (U.S. Bureau of Census) used to allocate county data to basin.

Note: TCU refers to transportation, communications and utilities.
FIRE refers to finance, insurance and real estate.
NA indicates that due to disclosure laws, employment data is not available for this sector. If there is any employment in this sector, it is included in services.

was the relocation of Carrie Tingley Children's Hospital from Truth or Consequences to Albuquerque in 1981.

The trade and services sectors are also important due to the county's significant retirement community, the location of Truth or Consequences along Interstate 25 and the presence of Elephant Butte State Park near Truth or Consequences. In 1980 more than 30 percent of all jobs were in these two sectors. Eating and drinking establishments and health services make up the greatest share of this employment. Recreation-related employment also results from boating, fishing and other activities at Elephant Butte and Caballo reservoirs.

Agriculture accounted for 22.3 percent of all jobs in 1970. This percentage dropped to 19.5 in 1980. Most of the cash receipts from agriculture, almost two-thirds in 1983, are derived from livestock production.[3] Most of the prime farmland in the county is located in the Rio Grande Surface Drainage Basin below Caballo Reservoir. The county's most important product, chile, accounts for about 43 percent of county gross crop value.[4]

There is some mining activity in Sierra County. Current operating mines include the St. Cloud and U.S. Treasury mines located near the community of Winston in northwestern Sierra County. The principal products of these mines are copper and silver. Total county mining employment was 55 in 1980. This employment had increased to 103 by 1984.[5]

The last column of table 4.1 indicates the 1980 employment pattern within the Lower Rio Grande Surface Drainage portion of the county.[6] Total employment in the basin was estimated to be 1,862 in 1980 or about 87 percent of total county employment. Employment patterns in the basin follow the county totals quite closely.

Since 1980, Sierra County's economy has stagnated. In the first six months of 1984, total nonagricultural employment averaged 1,602. This compared to 1,627 jobs in 1982 and 1,713 in 1980. This employment data illustrates that Sierra County, like other less urbanized areas in New Mexico, has not successfully rebounded from the 1980-82 recession.

Water Use. In 1980 total water withdrawals in Sierra County were 208,077 acre-feet with total depletions equaling 188,245 acre-feet.[7] The high depletion/withdrawal ratio is due to the significance of reservoir evaporation from Elephant Butte and Caballo. Reservoir evaporation accounted for 89 percent of all water depletion in Sierra County.

Table 4.2 outlines water use in the Lower Rio Grande Surface Drainage Portion of Sierra County. Reservoir evaporation associated with Caballo Reservoir dominates water use. Excluding the water depletion associated with reservoir evaporation, total depletions in the county in 1980 amounted to 19,149 acre-feet. The most significant water user in the county is irrigated agriculture, accounting for about 89 percent of nonreservoir depletions. Other agricultural uses (livestock consumption and stockpond evaporation) accounted for 6.8 percent of water depletions. Only 3.7 percent of the nonreservoir related water use in the county is related to urban uses. The minimal depletions in the minerals category are associated with a sand and gravel operation.

Surface and groundwater are both important water sources in Sierra County. About 59 percent of all water depletions (excluding reservoir evaporation) are of surface water sources. In agriculture, about 60 percent of water depletions are associated with surface water use. Irrigated agriculture in EBID accounted for approximately half the agricultural acreage and water use during 1980. Agriculture within EBID is less dependent on groundwater than

Table 4.2

Summary of Water Use in Sierra County
Lower Rio Grande Surface Drainage Basin
1980

USE	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Total Wd	Total Dp	Population	GPCD
Urban	0	0	1,408	704	1,408	704	5,219	
Truth or Consequences	0	0	1,408	704	1,408	704	5,219	241
Rural	0	0	146	73	146	73	2,364	55
Commercial	0	0	0	0	0	0		
Industrial	0	0	0	0	0	0		
Minerals	0	0	20	4	20	4		
Military	0	0	0	0	0	0		
Power	0	0	0	0	0	0		
Recreation	0	0	0	0	0	0		
							Total Acres	Irrigated Acres
Irrigated Agriculture	24,810	10,230	10,850	6,830	35,660	17,060	8,680	7,820
E.B.I.D.	18,590	7,280	1,960	1,240	20,550	8,520	4,030	3,770
Hot Springs	0	0	3,040	1,910	3,040	1,910	990	930
Scattered	6,220	2,950	5,850	3,680	12,070	6,630	3,660	3,120
Livestock	217	217	335	311	552	528		
Stockpond Evaporation	780	780	0	0	780	780		
Fish and Wildlife	0	0	0	0	0	0		
Reservoir Evaporation	29,130	29,130	0	0	29,130	29,130		
Total Use	54,937	40,357	12,759	7,922	67,696	48,279		

Note: Wd (withdrawals) and Dp (depletions) in acre-ft.
GPCD=gallons per capita per day
E.B.I.D. denotes Elephant Butte Irrigation District

Source: E.F. Sorensen, Water Use by Categories in New Mexico Counties and River Basins, and Irrigated Acreage in 1980, 1982. Technical Report 44, New Mexico State Engineer Office, Santa Fe, New Mexico and New Mexico State Engineer Files.

irrigators throughout the remainder of the Lower Rio Grande drainage. EBID surface water withdrawals account for more than 70 percent of surface water deliveries in the county study area. Urban and rural users are entirely dependent on groundwater resources.

Potential new users of water in the county include a new housing development and resort proposed for the eastern shore of Elephant Butte Reservoir and a vineyard project to be operated by the Engle Water Users Association. Both these projects are physically outside the Lower Rio Grande Surface Drainage Basin, but may be forced to rely on the water supplies of the lower basin to satisfy their future demands.

Projections

Population. Estimates of population by projections county were made by Wombold. The projected 2005 population for Sierra County is 9,900. In Sierra County, it is assumed that approximately 90 percent of all population growth will occur in the Lower Rio Grande Surface Basin portion of the county. This maintains the 1980 population ratio of 90 percent of residents being within the Lower Rio Grande Surface Basin portion of the county. Based on these assumptions, population will increase by 1,277 in this portion of the basin to a total of 8,860 by the year 2005.

Economy. The 1984 estimate of nonagricultural employment for the county, 1,618, is based on data available for the first nine months of the year. Based on projections by McDonald, nonagricultural employment is expected to grow at a rate of 2.61 percent per year from 1985-1990. This is based on the growth rate experienced from the peak-to-peak period 1962-1981. From 1990-2005, this growth rate is expected to decline to 1.75 percent. This decline is consistent with the projected decline in national growth. Based on these assumptions, total nonagricultural employment in Sierra County is expected to be 2,450 in the year 2005. This employment represents a 43 percent increase over 1980 nonagricultural employment of 1,713. For the Lower Rio Grande Basin portion of the county, total nonagricultural employment is projected to be 2,150 in 2005.

Water Use. Table 4.3 presents the baseline projections of Sierra County water use in the Lower Rio Grande Basin portion of the county. These project-ions are based principally on the Wombold population projections and the McDonald employment projections. Additionally, the following assumptions were incorporated in these projections of water use in 2005. The projection variable for residential use is basin population. Water use in the minerals sector was largely related to sand and gravel production in 1980. Thus, for the purpose of projection, future mineral water use was tied to the general indicator of economic activity provided by the employment forecast (nonagri-cultural employment less mining employment). Irrigated agriculture, in the baseline scenario, was assumed to be constant. In addition, the livestock, stockpond evaporation and reservior evaporation use catagories were assumed to remain at their 1980 levels. Finally, the baseline scenario provided for no increases in the efficiency of water use. As indicated previously, the water use coefficents indicate a per-unit withdrawal or depletion of water.

The baseline projection of future water demands in Sierra County suggests that only moderate increases in water demands should be anticipated in associa-tion with the most likely population and employment growth scenarios. Total withdrawals are projected to increase 451 acre-feet in the 25-year projection period. The associated increase in depletions is 225 acre-feet. All of these increased water uses are projections to be supplied by groundwater resources. It is likely that these limited increases in groundwater use could be

Table 4.3

Baseline Water Use projections
Sierra County

USE	1980 WATER USE: Surface Wd	Surface Dp	Ground Wd	Ground Dp	Total Wd	Total Dp	WATER USE COEFFICIENTS AND PROJECTION VARIABLES: 1980 Projection Variable	1980 Water Use Coefficients: Surface Wd	Surface Dp	Ground Wd	Ground Dp	% Change in Use Efficiency	2005 Forecast Variable	BASELINE WATER USE PROJECTIONS: 2005 Surface Wd	2005 Surface Dp	2005 Ground Wd	2005 Ground Dp	Net Change in Total Wd	Net Change in Total Dp
Residential	0	0	555	278	555	278	7,583	0.000000	0.000000	0.073197	0.036709	0.00 %	8,860	0	0	649	325	93	47
Non-Residential (Urban & Rural)	0	0	999	499	999	499	1,448	0.000000	0.000000	0.689881	0.344362	0.00 %	2,086	0	0	1,439	718	440	220
Urban, Rural, Comm.& Indust.	0	0	1,554	777	1,554	777								0	0	2,088	1,044	534	267
Minerals	0	0	20	4	20	4	1,448	0.000000	0.000000	0.013812	0.002762	0.00 %	2,086	0	0	29	6	9	2
Irrigated Agriculture	24,810	10,230	10,850	6,830	35,660	17,060	7,820	3.172634	1.308184	1.387468	0.873402	0.00 %	7,800	24,747	10,204	10,822	6,813	(91)	(44)
Livestock	217	217	335	311	552	528	EXOG						EXOG	217	217	335	311	0	0
Stockpond Evaporation	780	780	0	0	780	780	EXOG						EXOG	780	780	0	0	0	0
Reservior Evaporation	29,130	29,130	0	0	29,130	29,130	EXOG						EXOG	29,130	29,130	0	0	0	0
Total Use	54,937	40,357	12,759	7,922	67,696	48,279								54,874	40,331	13,274	8,173	451	225

Note: Wd (withdrawals) and Dp (depletions) in acre-ft.

accomplished with limited impairment impacts. Thus, in the baseline scenario, water is not likely to serve as a constraint on development in the Sierra County portion of the Lower Rio Grande Basin.

An alternative scenario projection of future water demands in Sierra County is provided in table 4.4. The assumptions utilized in this scenario are the same as those included in the baseline scenario with a few exceptions. The Alternative Scenario assumes an increase in irrigated agriculture amounting to nearly 800 acres over 1980 irrigated acreage. Additionally, there is assumed to be a 5 percent reduction in water demands of residential users, a 5 percent improvement in surface water irrigation efficiency and a 10 percent improvement in groundwater irrigation efficiency. This must be described as an optimistic outlook for Sierra County. The scenario is based in part on the investments being made by Engle Water Users Association in new agricultural acreage. This acreage is now being served by water leased from the city of Albuquerque--a lease which will expire in 2006. The maximum water use provided by this contract is 16,000 acre-feet in 1997. Thus, if the investment made in establishing vineyards is to be preserved, there will need to be an acquisition of additional water rights well in excess of the optimistic alternative scenario presented here. Most important to the analysis of results from these alternative projections is the fact that withdrawal and depletion demand increases are nearly triple those found in the baseline scenario. Clearly, the increased water demands under the alternative scenario would provide significant increases in water scarcity conditions in the Sierra County portion of the Lower Rio Grande Basin.

Table 4.4

Alternative Water Use Projections
Sierra County

USE	PROJECTION VARIABLES				ALTERNATIVE WATER USE PROJECTIONS					
	1980 Projection Variable	% Change in Use Efficiency Surface	Ground	2005 Forecast Variable	2005 Surface Wd	2005 Surface Dp	2005 Ground Wd	2005 Ground Dp	Net Change in Total Wd	Net Change in Total Dp
Residential	7,583	0%	5%	8,860	0	0	616	309	61	31
Non-Residential (Urban & Rural)	1,448	0%	0%	2,086	0	0	1,439	718	440	220
Urban, Rural, Comm.& Indust.					0	0	2,055	1,027	501	250
Minerals	1,448	0%	0%	2,086	0	0	29	6	9	2
Irrigated Agriculture	7,820	5%	10%	8,600	25,920	10,688	10,739	6,760	999	388
Livestock	EXOG			EXOG	217	217	335	311	0	0
Stockpond Evaporation	EXOG			EXOG	780	780	0	0	0	0
Reservior Evaporation	EXOG			EXOG	29,130	29,130	0	0	0	0
Total Use					56,047	40,815	13,158	8,104	1,509	640

Note: Wd (withdrawals) and Dp (depletions) in acre-ft.

Summary

Water use in the Lower Rio Grande portion of Sierra County reflects two important economic circumstances. First, the great majority of water use is provided by reservoir evaporation. Much of the county's economy and growth potential is dependent upon the development of recreational activities associated with the Elephant Butte and Caballo reserviors. Second, irrigated agriculture is the leading economic use of water; it is this sector which is most likely to induce water scarcity conditions on the county in the future. However, predicting increases in agricultural water use is certainly not a common assertion. In Sierra County it might be defended on the basis of the investments made in vineyards which are currently dependent on surplus city of Albuquerque water supplies.

In assessing future scarcity conditions in the Sierra County portion of the Lower Basin, the growth in water demands associated with increases in population and employment appear not to be problematic. However, there must be significant concern with regard to the source of supply for the continued operations of the vineyards now being established based on leased water right entitlements. The scenarios considered here do not implement new agricultural acreage anywhere near the approximate 8,000 new irrigated acres described by the Draft Environmental Assessment prepared for the French Wine Growers Association (now Engle Water Users Association).[8] The restricted consideration of new agricultural acreage in the alternative water use projection reflects an assumption that only limited new appropriations of water are possible due to consideration of full appropriation conditions and probable impairment claims. The tripling of new water demands associated with an increase of 800 acres is sufficient evidence that new appropriations for agriculture are likely to impose extreme water supply scarcity conditions, and thus serves as the limiting caveat to the projections presented here.

CHAPTER IV

ENDNOTES

1 Information in this section was obtained from Diemer and Morrison, New Mexico Land Use, By County 1977-1982, p. 33; and Hydrologic Unit Map-1974, State of New Mexico.

2 The population data was obtained from the U.S. Bureau of Census, Department of Commerce. The county basin population was determined by matching census to hydrological boundaries. The Lower Rio Grande Surface Drainage Basin portion of the county was determined to contain all census divisions within the county except for ED's 626, 627 and 629.

3 United States Department of Agriculture and New Mexico Crop and Livestock Reporting Service, New Mexico Agricultural Statistics 1983, U.S. Department of Agriculture and New Mexico Department of Agriculture, New Mexico State University, Las Cruces, New Mexico 1984.

4 Clevenger, Irrigated Acerage in New Mexico and Estimated Gross Crop Value by County, 1981, p. 34.

5 Based on data provided by the New Mexico Employment Security Division for the first six months of 1984.

6 Employment in this area of the county was determined by using census data to create weights of employment within and outside the basin. These weights were applied to all sectors (except mining and agriculture) to determine basin employment by sector. For the mining sector, all the employment was assigned to the Lower Rio Grande Surface Basin due to the fact that the active mining operations are located within the basin. For agricultural employment, irrigated acreage was used as the weighing factor to allocate employment.

7 Sorensen, Water Use by Categories in New Mexico Counties and River Basins and Irrigated Acreage in 1980, tables 3 and 4.

8 Espey, Huston and Associates, Inc. Draft Environmental Assessment for French Wine Growers Association Irrigation Project, prepared for United States Department of the Interior, Southwest Regional Office, December 1982.

CHAPTER V

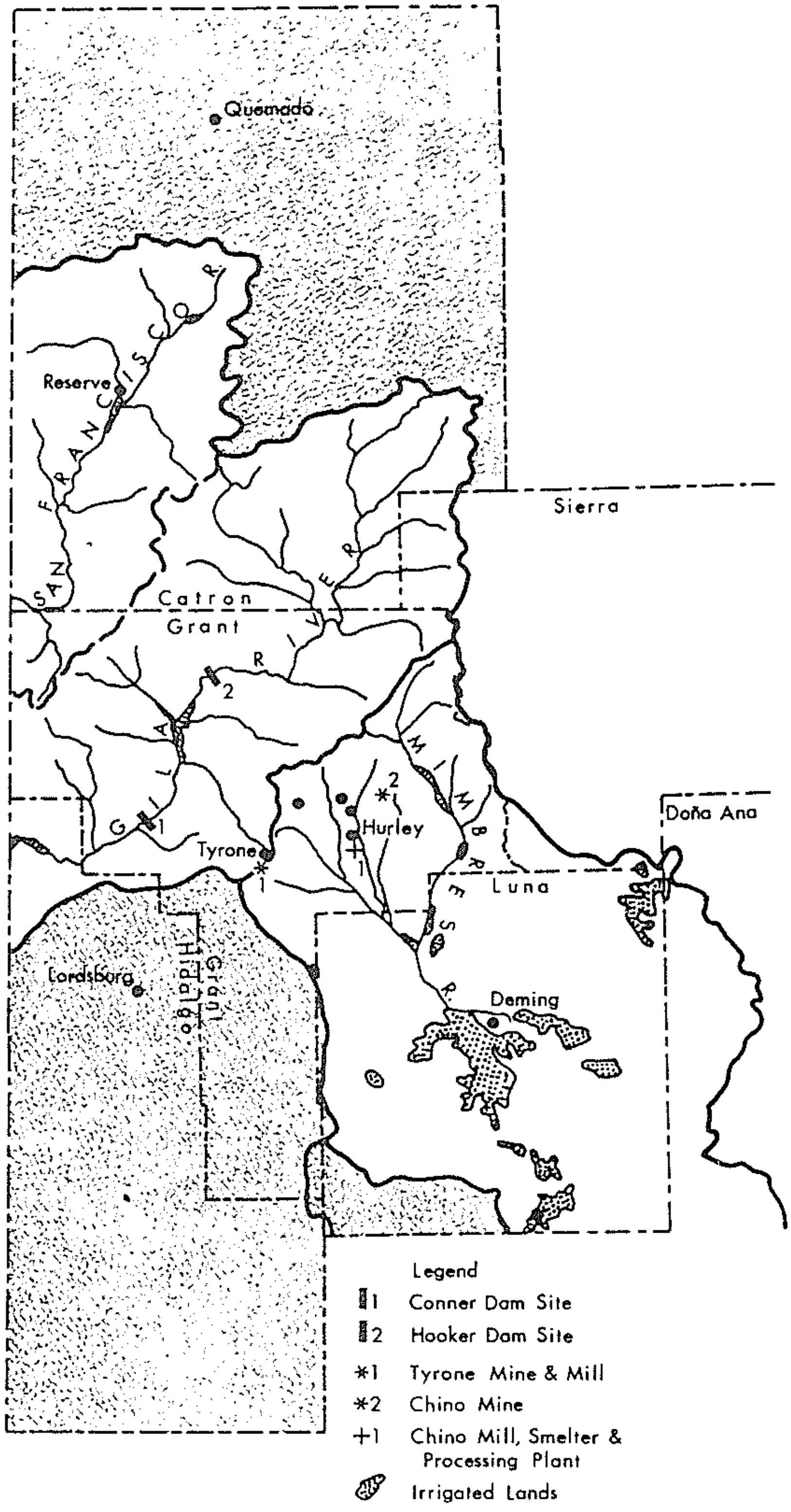
GILA SAN FRANCISCO SURFACE WATER DRAINAGE BASIN AND THE MIMBRES CLOSED BASIN

Basin Description

This section of the report investigates and projects water availability and use for the New Mexico portion of the Gila River and San Francisco River surface water drainage basins, and for the Mimbres Closed Basin. This area is shown in map 2.

The Gila-San Francisco Basin, which is within the Lower Colorado River Basin, is contained in the southern part of Catron county, the northern tip of Hidalgo County and the western portion of Grant County in southwest New Mexico. The Gila and San Francisco rivers and their tributaries in the combined basin area drain westward into Arizona. The topography of the basin is mostly mountainous and much of the land area is part of the Gila National Forest. The area has a small population base with mining activity and the cattle industry dominating the economy. As the map indicates, the economically important Phelps Dodge Tyrone mine and mill are located to the west of the continental divide just within the Gila-San Francisco Basin.

The Mimbres Basin is a part of Southwestern Closed Basin, a nontributary but hydrologically connected area within the Rio Grande River Basin (see River Basins in New Mexico Maps, appendix C). The Mimbres Basin encompasses southeastern Grant County, virtually all of Luna County and the western edge of Dona Ana. The principal drainage of the region is formed by the Mimbres River. Flows of the river are intermittent and rarely reach the vicinity of Deming in Luna County. The Wamel Basin, a small closed basin in southwestern Luna County, is also included as part of the discussion of the Mimbres Basin.



MAP 2. Gila, San Francisco & Mimbres Basins in New Mexico

In the northern part of the Mimbres Basin, the landscape is quite mountainous. Moving southward, the terrain is characterized by rolling hills. In the Luna County portion of the basin, the topography is semidesert interrupted by low mountain ranges. The communities of Silver City and Deming are located within the basin. Significant economic activities in the area include mining (Kennecott Corporation's Chino Mine, with related mill and smelter), trade and services (primarily Silver City and Deming), government and agriculture (principally in Luna County).

In this report we have combined the discussion of the Gila-San Francisco Basin and the Mimbres Closed Basin, because there is substantial interrelationship between the two basins both economically and in assessment of water use conditions. Although there is no natural hydrologic link between the basins, (i.e., the mountainous division, defined by the continential divide, serves as a geohydrologic barrier for the respective basin aquifers and is an indicator of surface drainage patterns), water may potentially be transported from the Gila-San Francisco Basin for use in the Mimbres Closed Basin.[1] Economic growth will largely occur within the Mimbres Basin area, but may be forced to rely on water supplies that originate in the Gila-San Francisco Basin. Indeed, the single largest water use question now of concern within the region relates to the development of additional water resources in the Gila-San Francisco Basin for anticipated use in both the basin in which it originates and within the Mimbres Basin. Thus, consideration of both basins simultaneously is required.

Population

Gila-San Francisco Basin. As table 5.1 indicates, the total population of the Gila-San Francisco Basin was estimated to be 4,532 in 1980.[2] The most populated community in this basin is Reserve in Catron County with a 1980 population of 439. However, it should be noted that the larger cities of Lordsburg (1980 population 3,195) and Silver City (1980 population 9,887) closely border this basin.

Table 5.1

Gila San Francisco Basin
1980 Population

County	County Population	Basin Population	Basin Urban Population
Catron	2,720	1,728	0
Grant	26,204	2,453	0
Hidalgo	6,049	351	0
Total	34,973	4,532	0

Mimbres Closed Basin. The total population of the Mimbres was estimated to be 39,204 in 1980. Table 5.2 indicates the distribution of this population between Grant and Luna counties and the proportion of urban population within the basin.[3] The largest cities in the basin are Deming (1980 population 9,887), Silver City (1980 population 9,964) and Bayard (1980 population 3,036).

Table 5.2

Mimbres Closed Basin
1980 Population

County	County Population	Basin Population	Basin Urban Population	Basin % Urban
Grant	26,204	23,619	12,923	54.7
Luna	15,585	15,585	9,964	63.9
Total	41,789	39,204	22,887	58.4

Economy[4]

Gila-San Francisco Basin. The economic base of the area is dominated by cattle ranching, government and mining employment. As table 5.3 indicates, these three sectors combined account for almost 78 percent of all employment in the Gila-San Francisco Basin. The largest source of employment in the basin is the Phelps-Dodge Tyrone copper pit and mill located in Grant County. Total employment at the site is about 700.

The second leading employment sector, the government, provides a little over one-fourth of the Gila-San Francisco Basin employment. Important employers include the U.S. Forest Service and local government.

The other significant employment sector in the Gila-San Francisco Basin is agriculture. This sector is dominated by the livestock production. Water was applied to 5,690 acres of agricultural land in 1980, although 7,440 acres were considered irrigable by the SEO. About two-thirds of this irrigated land was devoted to provide feed for livestock.[5]

The only notable manufacturing employment in the Gila-San Francisco Basin is in Reserve (Catron County). This employment, which averaged about 40 in the first six months of 1984, is in the lumber industry. The other sectors, such as trade or services, account for only a small amount of the employment in this region.

Mimbres Basin. As the employment data in table 5.3 indicates, the economy of the Mimbres Basin is more diversified than that of the Gila-San Francisco Basin. The single most important employer in the region is Kennecott's Chino Mines in Grant County. Based on 1982 output data, this mine is the seventh most productive copper mine in the U.S.[6] In addition to the mine, the company operates a copper mill and smelter in Hurley, Grant County. Mining

TABLE 5.3

Mimbres/Gila-San Francisco Basins
1980 Employment Profile

Employment Sector	Mimbres Basin	SF-Gila Basin	Mimbres-SF-Gila Basin
Agriculture	732.0	394.0	1,126.0
%Total	6.4	18.5	8.3
Manufacturing	608.0	116.0	724.0
%Total	5.3	5.4	5.3
Mining	2,002.0	707.0	2,709.0
%Total	17.4	33.2	19.9
Construction	549.0	67.0	616.0
%Total	4.8	3.1	4.5
TCU	509.0	30.0	539.0
%Total	4.4	1.4	4.0
TRADE	2,393.0	148.0	2,541.0
%Total	20.8	7.0	18.7
FIRE	400.0	22.0	422.0
%Total	3.5	1.0	3.1
Services	1,327.0	96.0	1,423.0
%Total	11.6	4.5	10.4
Government	2,960.0	553.0	3,513.0
%Total	25.8	25.9	25.8
Total Jobs	11,480.0	2,133.0	13,613.0

Source: See county profiles for Hidalgo, Luna Grant and Catron (Chapters VI-IX) for a description of how basin employment was determined.

Note: TCU refers to transportation, communications and utilities.
FIRE refers to finance, insurance and real estate.

employment accounts for 17.4 percent of the basin employment. Overall, the government sector provides the most employment. A significant share of these jobs are in local government.

Reflecting the more urbanized nature of the Mimbres Basin, employment in trade and services is significant in this basin. Together, these two sectors account for almost one-third of all jobs.

Agricultural activity is especially important in the Luna County portion of the basin. Note that Luna County ranks seventh among all New Mexico counties in cash receipts from all farm commodities.[7] However, employment in the agricultural sector provides for only 6.4 percent of all basin jobs.

Water Use Profile

Gila-San Francisco Basin. Table 5.4 summarizes water use information pertaining to the Gila-San Francisco Basin. This table combines the information contained in tables 6.3, 7.2, and 8.5. As table 5.4 indicates, about 54 percent of all depletions in the Gila-San Francisco Basin can be attributed to irrigated agriculture. The mining sector uses account for about 29 percent of total water use in the basin. Uses related to human consumption and nonmining economic activity account for an insignificant share of the basin's use.

Total water withdrawals in 1980 were reported by the SEO to be 44,088 acre-feet with corresponding depletions of 17,405 acre-feet. Nearly 86 percent of all withdrawals were from surface water sources, while only 74 percent of depletions were from surface sources. The significantly higher percent of withdrawals derived from surface sources reflects a somewhat unusal accounting procedure used in the 1980 SEO reporting of use. Due to restrictions on water use under the Arizona v. California[8] decree, all surface flows of the rivers are reported as withdrawn; however, only actual consumptive uses are reported

Table 5.4

Summary of Water Use in the
Gila-San Francisco Surface Drainage Basin
1980

USE	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Total Wd	Total Dp	Population	
Urban	0	0	0	0	0	0	0	
Rural	0	0	333	160	333	160	4,532	
Commercial	0	0	13	8	13	8		
Industrial	0	0	10	6	10	6		
Minerals	9,517	3,730	1,641	1,359	11,158	5,089		
Military	0	0	0	0	0	0		
Power	0	0	0	0	0	0		
Recreation	0	0	0	0	0	0		
							Total Acres	Irrigated Acres
Irrigated Agriculture	25,890	6,830	3,990	2,620	29,880	9,450	7,440	5,690
Livestock	348	348	356	354	704	702		
Stockpond Evaporation	1,031	1,031	0	0	1,031	1,031		
Fish and Wildlife	694	694	0	0	694	694		
Reservoir Evaporation	265	265	0	0	265	265		
Total Use	37,745	12,898	6,343	4,507	44,088	17,405		

Note: Wd (withdrawals) and Dp (depletions) in acre-ft.

as depletions in the 1980 data. The details of the Arizona v. California decree will be more thoroughly discussed as they apply to specific county water use patterns in the county profiles that follow.

It is appropriate, however, to discuss the major feature of the decree as it generally affects the water supply and demand conditions in the basin. Under the decree, New Mexico is limited to a consumptive use of 31,000 acre-feet, with all diversions in the basin required to be strictly metered. Under Public Law 90-537, with authorized the central Arizona project, there is provision that an additional 18,000 acre-feet may be made available for consumptive use in New Mexico by completion of a reservoir project on the Gila River. The project under consideration at this time is the Conner Dam and reservoir, a project that is proposed to provide for irrigation, municipal and industrial water supplies, as well as recreation benefits. The current proposal has many proponents and opponents, with much dispute regarding the balancing of benefits and costs inherent to the reservoir's development. The concerns over environmental damage may limit the feasibility of the project, and there is no clear consensus with respect to the specific need for the project's development.

In short, the Conner Dam project is currently the source of significant controversy and would dramatically change the availability of water resources within the basin. We do not speculate as to the outcome of this project and seek only to discuss water scarcity conditions both with and without the development of Conner Dam (or a suitable alternative). It should be noted that central to the discussion of Conner Dam is the issue of maximization of available water supplies in New Mexico. If it is the goal of the state's management of its resources to make the greatest quantity water available for beneficial use, then this goal may to a certain extent justify the project's development regardless of the specific benefit-cost assessment. However, a more general policy of maximizing the benefits from the use of all the state's resources may be counter to the specific feasibility of the Conner Dam project's development. These are issues that can only be resolved by continued public debate of the project.

Mimbres Closed Basin. Table 5.5 summarizes water use in the Mimbres Closed Water Basin. This table combines the water use information contained in table 8.4 and table 9.3. Total withdrawals in the Mimbres amount to 154,018 acre-feet. The depletions associated with these withdrawals total 95,966 acre-feet. Irrigated agriculture dominates water usage accounting for 84 percent of depletions. The second most important user of water is Chino Mines located in Hurley (Grant County). Mining activity in the basin consumed 9.3 percent of the total depletions in 1980. Human and economic use (the urban, rural and commercial categories combined) account for almost 3.8 percent of use.

The Mimbres Closed Basin was first declared on July 29, 1931, by the state engineer and has subsequently been extended to include its present boundaries by seven amendments to the original declaration. The declaration of the basin was in recognition that a condition existed where water depletions were in excess of annually renewed supplies, commonly referred to as a circumstance of groundwater mining. The declaration brings all new appropriations under the administrative control of the state engineer. In addition to the normal conditions on appropriations related to nonimpairment, the SEO has also imposed a special restriction in some areas of the Mimbres Closed Basin. In these areas new well appropriating groundwater must be from a depth of less than 230

Table 5.5

Summary of Water Use in the Mimbres Closed Basin
1980

USE	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Total Wd	Total Dp	Population	
Urban	0	0	5,551	2,775	5,551	2,775	22,887	
Rural	0	0	1,581	791	1,581	791	16,317	
Commercial	0	0	53	32	53	32		
Industrial	0	0	0	0	0	0		
Minerals	419	289	12,632	8,711	13,051	9,000		
Military	0	0	0	0	0	0		
Power	0	0	520	520	520	520		
Recreation	0	0	276	255	276	255		
							Total Acres	Irrigated Acres
Irrigated Agriculture	11,010	5,300	120,060	75,380	131,060	80,680	76,730	57,900
Livestock	366	366	381	378	747	744		
Stockpond Evaporation	524	524	0	0	524	524		
Fish and Wildlife	0	0	0	0	0	0		
Reservoir Evaporation	645	645	0	0	645	645		
Total Use	12,964	7,124	141,054	88,842	154,018	95,966		

Note: Wd (withdrawals) and Dp (depletions) in acre-ft.

feet (or above the first clay stratum below this level). The declaration of the basin has imposed significant constraints on water availability within the area.

There are significant concerns relating to both the quantity and quality of water resources in the Mimbres Closed Basin. The water quality issue is particularly acute in the Central and Bayard areas of the basin. The quantity of water available is at issue throughout the basin. The SEO has estimated that there are available supplies in storage of approximately 3.7 million acre-feet to a depth of 230 feet, and a total available supply of approximately 73.7 million acre-feet in saturated stratum to 1,000 foot depth are considered.[9]

Thus the question of available supplies relates to the depth at which groundwater is sought, as well as the extent to which asserted water rights are actually appropriated. The second question--the extent of existing water rights actually appropriated--relates primarily to the water right claims of Chino Mines (Kennecott). A spokesman for Chino Mines has asserted claims to water rights in excess of 40,000 acre-feet per annum.[10] However, current Chino Mines appropriations are approximately one-fourth of asserted rights. A majority of the unutilized rights are considered to be vested rights, and are currently being granted extensions of time for appropriation by the SEO. An additional share of the unappropriated water rights are considered subject to proof of beneficial use by the SEO. Thus, the water right claims of Chino Mines serve to limit all additional appropriations within the Mimbres Closed Basin due to their ability to assert impairment claims. The basin can be characterized as possessing significant additional water supplies, but an extremely constrained water availability subject to claims of impairment by existing holders of water right entitlements. Water in this generally arid portion of the state must be considered to be extremely scarce under the current administrative policies of the SEO.

CHAPTER V

ENDNOTES

1 Chino Mines (located in the Mimbres Closed Basin) has expressed an interest in water that might be made available by the construction of Conner Dam. According to Tom Shelly, Land and Resources Mimbres, Chino Mines, Hurley New Mexico (April 30, 1985 interview), pumping water from the Gila River to the Chino Mines site poses no special technical problems. In addition, the City of Silver City (also located in the Mimbres Basin) is on record as a strong support of the Gila River Dam project. A recently mentioned possible use of this "new" water is to recharge the Mimbres Basin aquifer. The goal of such a recharge is to provide Silver City with additional water. ("Proposal Uses Gila River to Recharge Acquifer," Albuquerque Journal, October 18, 1985, p.B-3.)

2 See individual county profiles for Catron, Hidalgo and Grant counties (chapters VI-VIII) for a description of how basin population was determined.

3 See individual county profiles for Grant and Luna counties (chapters VIII-IX) for a description of how basin population was determined.

4 A more detailed economic discussion is contained in the profiles of the counties within the Mimbres-Gila-San Francisco Basin (chapters VI-IX).

5 Based on an examination of cropping patterns in Clevenger and Carpenter, Irrigated Acreage in New Mexico and Estimated Crop Value by County, 1981.

6 J. Jolly and D. Edelstein, "Copper," Bureau of Mines Yearbook, U.S. Bureau of Mines, Department of the Interior, Washington, D.C., 1982, table 8.

7 United States Department of Agriculture and New Mexico Crop and Livestock Reporting Service, New Mexico Agricultural Statistics 1983, U.S. Department of Agriculture and New Mexico Department of Agriculture, New Mexico State University, Las Cruces, New Mexico, 1984.

8 Arizona v. California, et al., decree entered March 9, 1964, 376 U.S. 340 (1964).

9 S.E. Reynolds, State Engineer, letter to Charles T. DuMars, chairman, Governor's Water Law Study Committee, September 1, 1983, p. 4.

10 Interview with Tom Shelly, Land and Resources Manager, Chino Mines, Hurley, New Mexico, April 30, 1985.

CHAPTER VI

CATRON COUNTY

Current Profile

Water Basin Description. Catron County is centrally located on the state's western border with Arizona. This county lies in both the Rio Grande and Lower Colorado River basins, with the continential divide boundary closely corresponding to a northeast quadrant division of the county. The lower Colorado portion of the county is divided into three surface water drainage basins: the Little Colorado River, the San Francisco River and the Gila River. Most of the land area of the county, hydrologically connected to the Rio Grande Basin, is within closed basins (the North Plains or San Agustin Plains Closed basins). Only a small area in the northeast corner of Catron County drains into the Rio Grande Surface Water Basin. In this report, we are only concerned with the area of the county within the Gila River Surface Drainage Basin and the San Francisco River Surface Drainage Basin.

Land Use.[1] The total land area in Catron County is 4,414,720 acres. The land resources are predominately mountainous forest lands. About one-half, or 2.22 million acres, of the land is federally owned and part of the Gila or Apache National Forest. In the Gila-San Francisco Basin portion of the county an even higher proportion of the land is federally owned. Of the approximately 1,866,200 acres in the basin, all but 149,760 acres are within national forest boundaries. The remainder of the land outside the national forest is owned privately, by the Bureau of Land Management or the state of New Mexico. Many land use forms, such as urban buildup and irrigated agriculture are of minimal significance in Catron County.

Population.[2] In 1980 the population of Catron County totaled 2,720. The 1983 estimate puts the population count at 2,800. Catron County ranks thirty-first in population among New Mexico's 33 counties.

Total Gila-San Francisco Basin population was estimated to be 1,728 in 1980. This estimate was determined by matching census divisions to hydrological boundaries.

Economy. With regards to employment, Catron is dominated by two sectors; agriculture and government. As the employment profile of Catron County (table 6.1) indicates, 43.2 percent of all employment in 1982 was related to agriculture. The agricultural sector is dominated by livestock production. About 97 percent of all agricultural receipts in the county are related to livestock production.[3] Of the planted irrigated acres in 1981, about 92 percent of the acreage was allocated to food crops or pasture land for livestock.[4] The most important agricultural area in the county is the San Francisco River Valley stretching from Aragon to Glenwood. The cash receipts from livestock production have dropped substantially from the 1980 level. As table 6.2 indicates, the amount of irrigated cropland in Catron has also declined since 1960.

The government sector is becoming increasingly important in Catron County. It was the only sector to experience employment growth from 1970 to 1982. Federal government employment is especially important in Catron due to the presence of the Gila and Apache National Forests within the county.

There is some manufacturing employment in Catron. This employment is all related to logging activity and sawmills. This sector has experienced a sharp drop-off in employment in the last couple of years due to the slump in the lumber industry.

Table 6.1

Catron County Employment Profile

Employment Sector	Total County 1970	Total County 1980	Total County 1982	Gila-SF Basin County 1980
Agriculture	320.0	313.0	306.0	245.0
%Total	45.1	38.5	43.2	37.1
Manufacturing	NA	113.0	NA	95.0
%Total		13.9		14.4
Mining	NA	NA	NA	NA
%Total				
Construction	NA	NA	NA	NA
%Total				
TCU	10.0	NA	NA	NA
%Total	1.4			
Trade	34.0	33.0	31.0	17.0
%Total	4.8	4.1	4.4	2.6
FIRE	NA	NA	NA	NA
%Total				
Services	134.0	71.0	97.0	40.0
%Total	18.9	8.7	13.7	6.1
Government	212.0	283.0	274.0	263.0
%Total	30.0	34.8	38.7	39.8
Total Jobs	710.0	813.0	708.0	660.0

Source: New Mexico Employment Security Division and U.S. Dept. of Commerce, Bureau of Economic Analysis (For Agricultural Employment). 1980 Census data (U.S. Bureau of Census) used to allocate county data to basin.

Note: TCU refers to transportation, communications and utilities.
FIRE refers to finance, insurance and real estate.
NA indicates that due to disclosure laws, employment data is not available for this sector. If there is any employment in this sector, it is included in services.

As the last column of table 6.1 indicates, Gila-San Francisco Basin employment totaled 660 jobs or over 80 percent of the county total in 1980.[5] Like the county as a whole, the region is dominated by government and agricultural employment. The basin region includes the San Francisco River valley agricultural lands.

Table 6.2

Catron County Agricultural Data

Year	Irrigated Cropland (acres)	Cash Receipts:Livestock (000$)
1960	2,800	NA
1970	2,700	NA
1978	2,620	17,619
1979	2,620	19,645
1980	2,620	20,494
1981	2,620	9,545
1982	2,620	11,187
1983	2,620	11,494

Source: New Mexico Agricultural Statistics, U.S. Dept.of Agriculture and N.M. Dept. of Agriculture.

Water Use. Water withdrawals in Catron County totaled 15,866 acre-feet in 1980. Total depletions amounted to 4,736 acre-feet.[6] About 86 percent of all depletion was related to agricultural use. The second most important consumptive use of water was fish and wildlife habitat. In Catron, all this use was from lake or hatchery evaporation. Twelve percent of all water used in the county was related to this activity.

Table 6.3 summarizes water use in the Gila-San Francisco Basin portion of the county. Irrigated agriculture consumes more than 56 percent of water in this area. Other agricultural uses (livestock and stockpond evaporation)

Table 6.3

Summary of Water Use in Catron County
Gila-San Francisco Basin
1980

USE	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Total Wd	Total Dp	Population	GPCD
Urban	0	0	0	0	0	0	0	
Rural	0	0	117	52	117	52	1,728	
Reserve	0	0	59	26	59	26	439	120
Other Rural	0	0	58	26	58	26	1,289	40
Commercial	0	0	10	6	10	6		
Industrial	0	0	10	6	10	6		
Minerals	0	0	4	3	4	3		
Military	0	0	0	0	0	0		
Power	0	0	0	0	0	0		
Recreation	0	0	0	0	0	0		
							Total Acres	Irrigated Acres
Irrigated Agriculture	12,460	1,960	90	40	12,550	2,000	2,060	1,300
San Francisco River								
Luna	740	73	0	0	740	73	225	110
Apache Creek--Aragon	410	189	20	10	430	199	348	150
Reserve	2,100	314	20	10	2,120	324	507	260
Glenwood	9,210	1,384	50	20	9,260	1,404	980	780
Livestock	215	215	219	218	434	433		
Stockpond Evaporation	694	694	0	0	694	694		
Fish and Wildlife	263	263	0	0	263	263		
Reservoir Evaporation	25	25	0	0	25	25		
Total Use	13,657	3,157	450	325	14,107	3,482		

Note: Wd (withdrawals) and Dp (depletions) in acre-ft.
GPCD=gallons per capita per day

Source: E.F. Sorensen, <u>Water Use by Categories in New Mexico Counties and River Basins, and Irrigated Acreage</u> in 1980, 1982. Technical Report 44, New Mexico State Engineer Office, Santa Fe, New Mexico and New Mexico State Engineer Files.

account for another 33 percent of depletions. Water use by the population and associated economic activity is an insignificant share of the total (about 2 percent).

Projections

Population. The population projections prepared by Wombold show Catron County having 3,100 residents by the year 2005. The Gila-San Francisco portion of the county is projected to contain 1,970 people, or slightly over 63 percent of the county population in 2005.

Economy. In the period 1970 to 1981, nonagricultural employment grew at an annual rate of 1.3 percent. This trend is expected to continue for the period 1985 to 1990. Consistent with the expected slowdown in the national economy, McDonald assumes that employment growth will slow to 0.75 percent per annum for the period 1990 to 2005. Based on these assumptions, McDonald forecasts total nonagricultural employment in Catron County to be 540 by the year 2005, up from 500 in 1980. The Gila-San Francisco Basin share of this employment is projected to be 448 in the year 2005, a slight increase from the 415 nonagricultural employees in 1980.

Water Use Forecast and Summary. Table 6.4 presents the projections of water demands in the Gila-San Francisco Basin portion of Catron County for 2005. Consistent with the very limited growth potential for the area, the water demand forecast anticipates an increase of less than 20 acre-feet in total withdrawals and a corresponding increase in depletions of less than 10 acre-feet. It must be noted that all water use in the Gila-San Francisco Basin portion of Catron County is strictly limited by the Arizona v. California [7] decree. Even the minimal increase in withdrawals and depletions associated with the baseline projection would require acquisition of water rights from

Table 6.4

Baseline Water Use Projections
Catron County

USE	1980 WATER USE: Surface Wd	Surface Dp	Ground Wd	Ground Dp	Total Wd	Total Dp	WATER USE COEFFICIENTS AND PROJECTION VARIABLES: 1980 Projection Variable	1980 Water Use Coefficients: Surface Wd	Surface Dp	Ground Wd	Ground Dp	% Change in Use Efficiency	2005 Forecast Variable	BASELINE WATER USE PROJECTIONS: 2005 Surface Wd	2005 Surface Dp	2005 Ground Wd	2005 Ground Dp	Net Change in Total Wd	Net Change in Total Dp
Residential	0	0	126	59	126	59	1,728	0.000000	0.000000	0.073197	0.034194	0.00 %	1,970	0	0	144	67	18	8
Non-Residential (Urban & Rural)	0	0	11	5	11	5	415	0.000000	0.000000	0.026506	0.012048	0.00 %	448	0	0	12	5	1	0
Urban, Rural, Comm.& Indust.	0	0	137	64	137	64								0	0	156	73	19	9
Minerals	0	0	4	3	4	3	415	0.000000	0.000000	0.009639	0.007229	0.00 %	448	0	0	4	3	0	0
Irrigated Agriculture	12,460	1,960	90	40	12,550	2,000	1,300	9.584615	1.507692	0.069231	0.030769	0.00 %	1,300	12,460	1,960	90	40	0	0
Livestock	215	215	219	218	434	433	EXOG						EXOG	215	215	219	218	0	0
Stockpond Evaporation	694	694	0	0	694	694	EXOG						EXOG	694	694	0	0	0	0
Fish and Wildlife	263	263	0	0	263	263	EXOG						EXOG	263	263	0	0	0	0
Reservior Evaporation	25	25	0	0	25	25	EXOG						EXOG	25	25	0	0	0	0
Total Use	13,657	3,157	450	325	14,107	3,482								13,657	3,157	469	334	19	9

Note: Wd (withdrawals) and Dp (depletions) in acre-ft.

existing users. Thus, in some sense, this projection of future demands ignores the resource constraint. However, the projection is informative as an assessment of future water demand pressures within the region. The specific assessment of water scarcity in the basin portion of the county is dependent upon the availability of additonal water supplies by transfer from existing users in other counties served by the Gila-San Francisco River system.

CHAPTER VI

ENDNOTES

1 Information in this section was obtained from Diemer and Morrison, New Mexico Land Use, By County 1977-1982, p. 7; and the Hydrologic Unit Map-1974, State of New Mexico.

2 Population data was obtained from the U.S. bureau of Census, Department Commerce. The Gila-San Francisco surface drainage basin was determined to contain the Reserve Census Division (ED's 8-12) and ED's 6 and 7 within the Quemado Census Division.

3 United States Department of Agriculture and New Mexico Crop and Livestock Reporting Service, New Mexico Agricultural Statistics 1983, U.S. Department of Agriculture and New Mexico Department of Agriculture, New Mexico State Univesity, Las Cruces, New Mexico, 1984.

4 Clevenger, Irrigated Acreage in New Mexico and Estimated Gross Crop Value by County, 1981, p. 16.

5 Employment in the Gila-San Francisco Basin portion of the county was determined by using census data to create weights of employment within and outside the basin. These weights were applied to all sectors except agriculture to determine basin employment by sector. Irrigated acres were used to create weights of employment for the agricultural sector.

6 Sorensen, Water Use by Categories in New Mexico Counties and River Basins and Irrigated Acreage in 1980, tables 3 and 4.

7 Arizona v. California, et al; decree entered March 9, 1964, 376 U.S. 340 (1964).

CHAPTER VII

HIDALGO COUNTY

Current Profile

Water Basin Description. Bordering Arizona and Mexico, Hidalgo County is located in the southwestern corner of the state. The county lies in both the Rio Grande and the lower Colorado River hydrologic basins and is split into five separate hydrologic units by the SEO. The portion of the county that lies in the Rio Grande Basin is a closed basin (Playas Basin). The middle section of the county, the Animas Basin, is a closed basin within the Lower Colorado River Basin. A small corner of the southwestern part of the county, the Rio Yaqui, is also a closed basin and part of the Lower Colorado River Basin. The remaining two areas of the county, San Simeon Creek along the western edge and the Gila River in the northern part of the county, are surface water drainage areas. In this part of the study, we will only be concerned with the small portion of the county within the Gila River Surface Water Drainage Basin.

Land Use.[1] The total area of Hidalgo County is 2,206,080 acres. The Gila River Surface Drainage portion of the county encompasses about 138,240 acres or about 6 percent of the county land area. The land use in this portion of the county is characterized by irrigated farming within the Virden Valley (located about 30 miles northwest of Lordsburg) and grazing land outside the valley. The Bureau of Land Management is the dominant land owner outside the valley. Most of the land within the Virden Valley is privately held.

Population.[2] The population of Hidalgo County has increased since 1970. In 1970 the county's population was 4,734. By 1980 the population had increased to 6,049. The 1983 estimated population count was 6,400. Lordsburg is the most populated city in the county with a 1980 population of 3,195.

The population of the county within the Gila River Surface Drainage Basin was estimated to be 351 in 1980 or about 6 percent of the county total. This population is all located in rural areas with the greatest proportion centered in the Virden Valley.

Economy. The economy of Hidalgo County has been tied historically to service to travelers. Another mainstay of the economy is the agricultural sector--especially cattle ranching. In the late 1970s, manufacturing employment greatly increased with the location of a Phelps-Dodge copper smelter in Playas in the southern part of the county. The service center of the county, Lordsburg, and the Phelps-Dodge smelter are both located outside the Gila River Basin.

As table 7.1 indicates, overall employment increased by more than 35 percent from 1970 to 1980. Virtually all the increased employment was related to the opening of the Phelps-Dodge smelter. This plant employs about 500 people.[3] This employment is reflected in increased service employment since disclosure rules do not allow a single plant's employment to be listed separately.

With regards to agriculture, a little over 75 percent of the cash receipts from farm production are contributed by livestock production.[4] The important farmland in Hidalgo is located in the Animas Basin, Lordsburg Valley, Playas Valley and the Virden Valley. The most important crop in the county is cotton,

Table 7.1

Hidalgo County Employment Profile

Employment Sector	Total County 1970	Total County 1980	Total County 1982	Gila Basin County 1980
Agriculture	353.0	380.0	372.0	46.0
%Total	23.7	18.6	17.8	60.5
Manufacturing	NA	NA	NA	NA
%Total				
Mining	NA	NA	NA	NA
%Total				
Construction	NA	68.0	63.0	3.0
%Total		3.3	3.0	3.9
TCU	84.0	73.0	66.0	14.0
%Total	5.6	3.6	3.2	18.4
Trade	331.0	383.0	374.0	NA
%Total	22.3	18.7	17.8	
FIRE	32.0	43.0	32.0	NA
%Total	2.2	2.1	1.5	
Services	385.0	738.0	805.0	13.0
%Total	25.9	36.0	38.4	17.1
Government	302.0	363.0	383.0	NA
%Total	20.3	17.7	18.3	
Total Jobs	1,487.0	2,048.0	2,095.0	76.0

Source: New Mexico Employment Security Division and U.S. Dept. of Commerce, Bureau of Economic Analysis (For Agricultural Employment). Census data (U.S. Bureau of Census) used to allocate data to basin.

Note: TCU refers to transportation, communications and utilities.
FIRE refers to finance, insurance and real estate.
NA indicates that due to disclosure laws, employment data is not available for this sector. If there is any employment in this sector, it is included in services.

accounting for 35 percent of gross crop value.[5] The second largest contributor to county crop value is sorghum for grain. As table 7.1 indicates, employment in agricuture has remained relatively stable since 1970.

The other significant sectors of the county's economy, trade, services and government, have shown only minimal employment growth since 1970. Most of the trade and service employment is located in Lordsburg and is related to the community's location along Interstate 10 and on a Southern Pacific rail line. The leading government employers are elementary and secondary schools.

The economy of the Gila River Basin portion of the county is primarily agricultural. The population and economic activity centers on the farming community of Virden. As the last column of table 7.1 indicates, almost two-thirds of the employment in this area is directly related to agriculture.[6]

Water Use. Water withdrawals in Hidalgo County totaled 76,246 acre-feet in 1980. Depletions associated with these withdrawals amounted to 49,061 acre-feet.[7] Table 7.2 illustrates water use in the Gila River Surface Drainage Basin of the county. This area accounts for about 11 percent of Hidalgo County's total depletions or withdrawals. Water use in this region is dominated by agriculture. Irrigation in the Virden Valley used 5,350 acre-feet of water in 1980 or 97 percent of the region's depletion total. Approximately 60 percent of water use in the Virden Valley is obtained from surface water supplies of the Gila River.

Water use in the Virden Valley is controlled principally by two judicial decrees. The Globe Equity decree, entered in 1935 by the U.S. District Court for the state of Arizona, adjudicated the use of surface waters in the Virden Valley in New Mexico. Although the SEO has little to do with the administration of this decree, the Sunset Canal Company provides the Interstate Stream

Table 7.2

Summary of Water Use in Hidalgo County
Gila River Surface Drainage Basin
1980

USE	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Total Wd	Total Dp	Population	GPCD
Urban	0	0	0	0	0	0	0	
Rural	0	0	24	12	24	12	351	60
Commercial	0	0	0	0	0	0		
Industrial	0	0	0	0	0	0		
Minerals	0	0	0	0	0	0		
Military	0	0	0	0	0	0		
Power	0	0	0	0	0	0		
Recreation	0	0	0	0	0	0		
							Total Acres	Irrigated Acres
Irrigated Agriculture Virden Valley	6,290	2,970	3,600	2,380	9,890	5,350	3,240	2,920
Livestock	31	31	32	31	63	62		
Stockpond Evaporation	95	95	0	0	95	95		
Fish and Wildlife	0	0	0	0	0	0		
Reservoir Evaporation	0	0	0	0	0	0		
Total Use	6,416	3,096	3,656	2,423	10,072	5,519		

Note: Wd (withdrawals) and Dp (depletions) in acre-ft.
GPCD=gallons per capita per day

Source: E.F. Sorensen, Water Use by Categories in New Mexico Counties and River Basins, and Irrigated Acreage in 1980, 1982. Technical Report 44, New Mexico State Engineer Office, Santa Fe, New Mexico and New Mexico State Engineer Files.

Commission with information relating to the administration of the decree.

The Arizona v. California [8] decree also places strict control on the total quantity of water available for appropriation. As a result of these decrees, there is very little potential for any increase in water use without the augmentation of supplies provided by Conner Dam (or an alternative) or by transfer of a Gila River water right from some existing upstream user.

Projections

Population and Employment. The portion of Hidalgo County within the Gila-San Francisco Basin is highly agricultural with only a small population base. With regards to population and employment growth, it is assumed that this area will not experience any change in the next 25 years.

Water Use Forecast and Summary. Table 7.3 presents the water demand forecast for the Gila River Surface Drainage Basin portion of Hidalgo County. This forecast is based on the assumption that neither population nor employment in the basin portion of the county will increase. Irrigated agriculture acreage was increased by 80 acres to 3,000 acres for the projection. All other water using sectors in the region are assumed to be held constant at their 1980 levels of use. The 271 acre-feet increase in withdrawals and the 147 acre-feet increase in depletions results from the nominal increase in projected agricultural acreage. Clearly, these increased water demands would not be allowed without transfer of an existing water right entitlement from an upstream user. These increases in use serve principally to reflect the very limited potential for growth expected in this portion of Hidalgo County.

Table 7.3

Baseline Water Use Projections
Hidalgo County Gila River Surface Drainage Basin

USE	1980 WATER USE Surface Wd	Surface Dp	Ground Wd	Ground Dp	Total Wd	Total Dp	WATER USE COEFFICIENTS AND PROJECTION VARIABLES 1980 Projection Variable	1980 Water Use Coefficients Surface Wd	Surface Dp	Ground Wd	Ground Dp	% Change in Use Efficiency	2005 Forecast Variable	BASELINE WATER USE PROJECTIONS 2005 Surface Wd	2005 Surface Dp	2005 Ground Wd	2005 Ground Dp	Net Change in Total Wd	Net Change in Total Dp
Residential	0	0	18	9	18	9	351	0.000000	0.000000	0.050407	0.025203	0.00 %	351	0	0	18	9	0	0
Non-Residential (Urban & Rural)	0	0	6	3	6	3	30	0.000000	0.000000	0.210238	0.105125	0.00 %	30	0	0	6	3	0	0
Urban, Rural, Comm.& Indust.	0	0	24	12	24	12								0	0	24	12	0	0
Irrigated Agriculture	6,290	2,970	3,600	2,380	9,890	5,350	2,920	2.154110	1.017123	1.232877	0.815068	0.00 %	3,000	6,462	3,051	3,699	2,445	271	147
Livestock	31	31	32	31	63	62	EXOG						EXOG	31	31	32	31	0	0
Stockpond Evaporation	95	95	0	0	95	95	EXOG						EXOG	95	95	0	0	0	0
Total Use	6,416	3,096	3,656	2,423	10,072	5,519								6,588	3,177	3,755	2,488	271	147

Note: Wd (withdrawals) and Dp (depletions) in acre-ft.

CHAPTER VII

ENDNOTES

1 Information in this section was obtained from Diemer and Morrison, New Mexico Land Use, By County 1977-1982, p.18; the Hydrologic Unit Map-1974, State of New Mexico; and State of New Mexico, Land Status Map 1982.

2 The population data was obtained from the U.S. Bureau of Census, Department of Commerce. The population within the Gila Basin portion of the county was determined by matching census to hydrological boundaries. This basin was determined to include census ED's 275 and 281.

3 1983 New Mexico Manufacturing Directory, New Mexico Economic Development and Tourism Department.

4 United States Department of Agriculture and New Mexico Crop and Livestock Reporting Service, New Mexico Agricultural Statistics 1983, U.S. Department of Agriculture and New Mexico Department of Agriculture, New Mexico State University, Las Cruces, New Mexico, 1984.

5 Clevenger, Irrigated Acreage in New Mexico and Estimated Crop Value by County 1981, p.24.

6 Employment in the Gila-San Francisco Basin portion of the county was determined by using census data to create weights of employment within and outside the basin. These weights were applied to all sectors except agriculture to determine basin employment by sector. Irrigated acres were used to create weights of employment for the agricultural sector.

7 Sorensen, Water Use by Categories in New Mexico Counties and River Basins and Irrigated Acreage in 1980, Tables 3 and 4.

8 Arizona v. California, et al., decree entered March 9, 1964, 376 U.S. 340 (1964).

CHAPTER VIII

GRANT COUNTY

Current Profile

Water Basin Description. Grant County, bounded on the west by the Arizona border, is primarily mountainous in its northern half but gives way to desert plains in its southern reaches. The county is located in both the Rio Grande and the lower Colorado River hydrologic basins. The continental divide separates these two basins. The area within the Lower Colorado Basin is primarily within the Gila River or San Francisco River surface drainage basins. A smaller area, in the southern part of the county, is within the Animas Closed Basin. All the land area within the Rio Grande Basin, on the east side of the continental divide, is within closed basins (primarily the Mimbres Basin). In this report, we are concerned with the water use conditions in the Gila-San Francisco Surface Drainage Basin and the Mimbres Closed Basin portions of Grant County.

Land Use.[1]. The total land area in Grant County is 2,548,800 acres. Table 8.1 indicates the approximate distribution of the acreage among the water basins in the county.

Table 8.1

Grant County
Acreage by Water Basin

Basin	Acres
San Francisco Surface Drainage	103,680
Gila River Surface Drainage	1,198,080
Mimbres Closed	714,240
Other	524,800
Total County	2,540,800

In the Gila-San Francisco portion of the county, the greatest proportion of the land (approximately 816,400 acres) is within the Gila National Forest. Private land holdings are quite extensive in the county. Public rangeland managed by the BLM or the State of New Mexico are also significant. Approximately 7,730 acres of the county is urbanized or builtup. Virtually all this acreage is in the Mimbres Closed Basin around Silver City. The only significant cropland acreage in the county occurs in the Mimbres and Gila River valleys. County cropland land area (both cropped and idle) amounted to 8,540 acres in 1982.

Population.[2] In 1980, the total population of Grant County was 26,204. Of the 33 New Mexico counties, Grant County ranked fourteenth in population. Silver City is the most populated community in the county with a 1980 population of 9,887.

From 1970 to 1980, the total county population increased by 18.9 percent or an average annual growth rate of 1.89 percent. The county's population continued to increase in the early 1980s and was estimated to be 28,300 by 1982. With the steep decline in copper industry employment, total population declined in 1983 to about 28,000.

Table 8.2 shows the distribution of the county population by surface drainage basin. Over 90 percent of the population is within the Mimbres Closed Basin. Included in this basin are all the larger communities of the county including Silver City, Bayard, Hurley and Central.

Table 8.2

Grant County Population

Area	1980
Gila-San Francisco Basin	2,453
Mimbres Closed Basin	23,619
Animas and Playas Basins	132
Total County	26,204

Economy. Table 8.3 outlines employment by sector for all of Grant County and for the subregions of the county of interest in the water use forecast. The growth rate in employment has been historically tied to changes in mining employment. In 1970 mining employment directly accounted for more than one-third of all the jobs in the county. With the decline of the copper industry, mining accounted for only 16.5 percent of all the jobs by 1982. As a result of the depressed state of the copper industry, total nonagricultural employment declined to 7,802 in 1983 from the 1982 level of 8,089. The county's economy has improved somewhat in 1984.

The importance of the copper industry in Grant County extends beyond mining employment. For example, the leading manufacturing employer in the county is the Chino Mines smelter at Hurley. From 1970 to 1982 manufacturing employment declined in the county. Data available for the first six months of 1984 indicate that average employment in this sector has increased to 389.

Overall construction employment has increased substantially since 1970. However, the 1982 level was due in part to temporary highway construction work and mine modernization projects. The service and trade sectors have also experienced substantial employment growth since 1970 while TCU, FIRE and goverment employment has increased only moderately.

With the decline of the mining sector, government employment now makes up the largest portion of total county employment. Significant government employers include elementary and secondary schools, Western New Mexico University in Silver City, state and local hospitals and the U.S. Forest Service.

Agriculture in Grant County accounts for 4 percent of total employment. The three areas in the county with significant irrigated acreage are the Mimbres Valley, the Gila River Valley and the Lordsburg Valley (which lies

Table 8.3

Grant County Employment Profile

Employment Sector	Total County 1970	Total County 1980	Total County 1982	Mimbres Basin County 1980	Gila-SF Basin County 1980
Agriculture	409.0	350.0	341.0	140.0	103.0
%Total	5.6	3.9	4.0	1.9	7.4
Manufacturing	360.0	407.0	318.0	358.0	21.0
%Total	5.0	4.5	3.7	4.8	1.5
Mining	2,543.0	2,619.0	1,391.0	1,912.0	707.0
%Total	35.2	29.0	16.5	25.5	50.6
Construction	306.0	451.0	1,108.0	387.0	64.0
%Total	4.2	5.0	13.1	5.2	4.6
TCU	248.0	251.0	295.0	235.0	16.0
%Total	3.4	2.8	3.5	3.1	1.1
Trade	940.0	1,557.0	1,625.0	1,426.0	131.0
%Total	13.0	17.2	19.3	19.0	9.4
FIRE	147.0	225.0	223.0	203.0	22.0
%Total	2.0	2.5	2.6	2.7	1.6
Services	508.0	950.0	911.0	907.0	43.0
%Total	7.0	10.5	10.8	12.1	3.1
Government	1,768.0	2,230.0	2,217.0	1,940.0	290.0
%Total	24.5	24.7	26.3	25.8	20.8
Total Jobs	7,729.0	9,040.0	8,429.0	7,508.0	1,397.0

Source: New Mexico Employment Security Division and U.S. Dept. of Commerce, Bureau of Economic Analysis (For Agricultural Employment). Census employment data (U.S. Bureau of Census) used to allocate county employment data to basin.

Note: TCU refers to transportation, communications and utilities. FIRE refers to finance, insurance and real estate.

outside the study area considered in this forecast). The majority of agricultural activity in the county is devoted to livestock production. Livestock products account for over 95 percent of all cash receipts from farm commodities.[3]

The final column of table 8.3 lists the employment by sector of the portion of the county within the Gila-San Francisco and Mimbres basins.[4] More than 83 percent of the employment is located within the Mimbres Closed Basin portion of Grant County. This is to be expected because all the large communities in the county are located in the Mimbres Basin. The leading employment source outside the Mimbres Basin is the copper mine at Tyrone operated by Phelps-Dodge. Due to its location and primary sources of water supply being found west of the continental divide, mining employment at the Tyrone Mine accounted for more than 50 percent of the Gila-San Francisco Basin employment. As the profile indicates, employment in sectors associated with a more urbanized population (i.e. FIRE, Services and TCU) accounts for only a small portion of the employment within the Gila-San Francisco Basin portion of the county. Two of the principle agricultural areas, the Mimbres River and Gila River valleys, provide only limited employment in Grant County.

Water Use. In 1980 water withdrawals in Grant County totaled 48,143 acre-feet, with total water depletions of 26,907 acre-feet.[5] Unlike other counties in southern New Mexico, agriculture is not the most significant user of water. Mineral use, primarily associated with the Chino Mines and Phelps-Dodge mining operations, accounted for over 50 percent of total county water depletions in 1980. Tables 8.4 and 8.5 outline water use for the Mimbres and Gila-San Francisco Basin portions of Grant County.

Table 8.4

Summary of Water Use in Grant County
Mimbres Closed Basin
1980

USE	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Total Wd	Total Dp	Population	GPCD
Urban	0	0	2,457	1,228	2,457	1,228	12,923	
Bayard	0	0	300	150	300	150	3,036	88
Silver City	0	0	2,157	1,078	2,157	1,078	9,887	195
Rural	0	0	1,069	535	1,069	535	10,696	
Central	0	0	240	120	240	120	1,968	109
Hurley	0	0	271	136	271	136	1,616	150
Other Rural	0	0	558	279	558	279	7,112	70
Commercial	0	0	0	0	0	0		
Industrial	0	0	0	0	0	0		
Minerals	419	289	12,205	8,421	12,624	8,710		
Military	0	0	0	0	0	0		
Power	0	0	520	520	520	520		
Recreation	0	0	0	0	0	0		
							Total Acres	Irrigated Acres
Irrigated Agriculture Mimbres Valley	2,610	1,330	2,940	1,690	5,550	3,020	2,790	2,000
Livestock	141	141	144	144	285	285		
Stockpond Evaporation	334	334	0	0	334	334		
Fish and Wildlife	0	0	0	0	0	0		
Reservoir Evaporation	630	630	0	0	630	630		
Total Use	4,134	2,724	19,335	12,538	23,469	15,262		

Note: Wd (withdrawals) and Dp (depletions) in acre-ft.
GPCD=gallons per capita per day

Source: E.F. Sorensen, Water Use by Categories in New Mexico Counties and River Basins, and Irrigated Acreage in 1980, 1982. Technical Report 44, New Mexico State Engineer Office, Santa Fe, New Mexico and New Mexico State Engineer Files.

Table 8.5

Summary of Water Use in Grant County
Gila-San Francisco Basin
1980

USE	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Total Wd	Total Dp	Population	GPCD
Urban	0	0	0	0	0	0	0	
Rural	0	0	192	96	192	96	2,453	70
Commercial	0	0	3	2	3	2		
Industrial	0	0	0	0	0	0		
Minerals	9,517	3,730	1,637	1,356	11,154	5,086		
Military	0	0	0	0	0	0		
Power	0	0	0	0	0	0		
Recreation	0	0	0	0	0	0		
							Total Acres	Irrigated Acres
Irrigated Agriculture Gila River Valley	7,140	1,990	300	200	7,440	2,190	2,140	1,470
Livestock	102	102	105	105	207	207		
Stockpond Evaporation	242	242	0	0	242	242		
Fish and Wildlife	431	431	0	0	431	431		
Reservoir Evaporation	240	240	0	0	240	240		
Total Use	17,672	6,735	2,237	1,759	19,909	8,494		

Note: Wd (withdrawals) and Dp (depletions) in acre-ft.
GPCD=gallons per capita per day

Source: E.F. Sorensen, Water Use by Categories in New Mexico Counties and River Basins, and Irrigated Acreage in 1980, 1982. Technical Report 44, New Mexico State Engineer Office, Santa Fe, New Mexico and New Mexico State Engineer Files.

Mimbres Closed Basin

In the Grant County portion of the Mimbres Basin, mineral use, primarily associated with Chino Mines, accounts for almost 57 percent of total water depletions. The agricultural sector is second, using 20 percent of the basin's water. Urban and rural uses accounted for slightly more than 11.5 percent of the Mimbres Basin Grant County water use in 1980. Due to the intermittent flow of the Mimbres River, groundwater provides the greatest share of the water used in the region.

The Mimbres Basin portion of Grant County has been suffering from conditions of water scarcity for many years. There is an extensive history of water right adjudications. In addition, there is a substantial belief that both water quality and quantities available serve as a constraint on development in the area. Although the Mimbres Basin contains groundwater resources for many years of continued appropriation, impairment claims are likely to prohibit any new appropriations.[6] Indeed, not all adjudicated water rights are currently being utilized. Chino Mines owns rights to an additional 7,000 acre-feet of water which are currently being granted extension of time by the SEO for proof of beneficial use.[7]

Gila-San Francisco Basin

Water utilized in the Gila-San Francisco portion of Grant County is obtained primarily from surface flows. The mining sector (primarily the Phelps-Dodge Tyrone Mine) dominates water use in this portion of the county. Mining accounts for almost 60 percent of total depletions. Although Phelps-Dodge possesses some 700 acre-feet of water rights in the Mimbres Basin, all of the water used by the Tyrone Mine in 1980 was obtained from sources within the Gila Surface Drainage Basin. Irrigated agriculture, located along the Gila

River, depletes a little over 25 percent of the county basin total. Human consumption in this region accounts for an insignificant share of total use.

Water rights and water supplies in the Gila-San Francisco portion of Grant County are subject to extensive restriction and regulation as a result of several judicial decrees. Most important of these decrees is the Arizona v. California, et al. entered in 1964, which set New Mexico's right to water in the basin.[8] This decree also requires the state to maintain records and report annually all surface and groundwater uses in the Gila-San Francisco Drainage Basin. As of the start of 1984, there were 64 well meters and 38 surface water measuring devices operating for the purposes of report water use. It is important to realize in utilizing the SEO data presented in table 8.5 that all surface water flows are assigned to irrigated agriculture withdrawals as an accounting technique under this decree. Clearly the approximate 10 percent depletion of total withdrawals found in irrigated agriculture in this portion of Grant County is a fiction resultant from the judicial regulation of the river.

Projections

Population. The projected population for Grant County in 2005 is 37,400. It is assumed that the population of the Gila-San Francisco portion of the county will increase from 2,453 (in 1980) to 2,816 in 2005, a nearly 15 percent total population increase in the 25-year projection period. Population in the Mimbres Basin portion of the county is projected to be 34,584 in the year 2005. This provides for a population increase in the Mimbres Basin portion of Grant County of approximately 46 percent during the 25-year forecast period.

Economy. The growth in population and employment in the near term in Grant County is inextricably tied to the copper industry. The outlook for New Mexico production of copper depends on factors influencing the international markets, the national economy, recoverable ore stocks, as well as other influences such as technological innovation and government regulation. The outlook for the New Mexico (and U.S.) copper industry is not good for the next few years or in the long-term. The title of a recent feature article in Business Week, "The Death of Mining," highlights the status of the metal mining industry in the U.S.[9] From 1981 to 1984, total U.S. mine production of copper declined from 1,538 metric tons to 1,050 metric tons.[10]

Various factors contribute to the gloomy outlook. Clearly, increased production by a country like Chile contributes to weak copper prices. Chile's high production level does not seem to be a temporary phenomena as Chile is blessed with high grade ore, low labor costs and the need to generate a large amount of foreign exchange. Additionally, Chile has undertaken an extensive program to raise output of copper by an additional 25 percent by 1986.[11] Another Latin American country, Peru, is also expected to substantially increase production of copper in the future. This increased production is expected to keep prices of copper at depressed levels.

A second factor is that there does not seem to be any prospect for legislative protection for the U.S. copper industry. In September 1984, President Reagan rejected an International Trade Commission recommendation for higher tariffs or quotas on copper imports on the grounds such protection would cost jobs in copper using industries and restrain the export earnings of indebted copper producing countries.

A third issue that has affected the price of copper has been the strong value of the dollar. Ken Bennett, a spokesman for Phelps Dodge, (Tyrone, New Mexico) estimated that "the strong dollar has depressed the U.S. dollar price of copper by 13 percent below what it would be otherwise if the dollar had kept parity with european currencies."[12] Indications are that the dollar will weaken but the prospects for this are uncertain.

A fourth factor is that copper is being replaced by plastics and optic fibers in various production lines. Although continued low prices for copper may slow down this substitution, there appears to be little prospect for a substantial increase in copper demand.

Table 8.6

Copper Industry Data

Year	Mine Production of Copper (000 metric tons) U.S.	New Mexico	New Mexico Mining Employment	Price Domestic Cathode Copper (cents/lb.)
1960	980	61	1964	32.1
1970	1560	151	2543	58.2
1978	1358	128	2156	65.5
1979	1444	164	2569	92.2
1980	1181	149	2619	101.3
1981	1538	154	2849	84.2
1982	1140	74	1391	72.8
1983	1038	w	w	76.5
1984	1050	w	w	66.0

w Data Withheld.
Source:New Mexico Employment Security Division and U.S. Bureau of Mines.

In 1982-84 the New Mexico copper mining industry could be described as being depressed. The U.S. and New Mexico economic recovery bypassed the copper industry. As table 8.6 describes on previous page, production, employment and prices have fallen off substantially from previous years.

Recent investment in the New Mexico copper industry could potentially make New Mexico copper more competitive with other U.S. and international producers. These investments include a new solvent extraction facility at the Tyrone branch of Phelps Dodge, and a new milling plant and smelter at the Chino Mines plant of Kennecott (which will double smelting capacity). Phelps-Dodge recently announced plans to double the capacity of its solvent extraction facility at a total cost of $9-10 million.[13] However, the precarious financial condition of the state's copper producing companies ($50 million loss in first nine months of 1984 for Phelps Dodge and $483 million loss for Kennecott since 1981) add doubt to the long-term viability of this industry in New Mexico.[14]

Another important consideration with regards to the New Mexico copper industry is the amount of ore reserves present at the mines. With regards to Chino Mines Santa Rita mine, ore reserves do not appear to be a constraining factor in the 25-year time horizon.[15] However, at the Phelps Dodge Tyrone mine, the copper reserves are not as substantial. According to the 1984 Phelps Dodge Annual Report, 14,273 thousand tons of copper ore were mined in 1984. Total ore reserves were estimated to be 188,200 thousand tons. If the 1984 rate continues, the reserves at the Tyrone mine will be exhausted in about 13 years. After that time, the Tyrone mine will be likely reduced to a leaching and solvent extraction operation.[16]

The county, especially around the Silver City area, is attempting to diversify its economy. Specific proposals include a horse racing facility and a new industrial park.[17] Efforts are also underway to further promote the area as a retirement community and recreation area for tourism.

Even with the effort to diversify the Grant County economy, employment growth will continue to be highly dependent on the copper industry. As indicated, the outlook for this industry is not optimistic. The historical trend growth in nonagricultural employment has ranged from 2.3 to 3 percent. For projection purposes, this growth rate is much too high. From the 1985 base year employment, estimated to be 8,600, employment is expected to grow at a rate of 1.2 percent per year (about one-half the historical average). This trend is assumed to continue until 1997. In 1998 it is assumed that a 500 employee reduction at the Phelps-Dodge Tyrone mine will occur due to a partial shutdown in mining operations. After that, employment growth will return to the 1.2 percent growth trend. Based on these assumptions, total nonagricultural employment in the county is estimated to be 10,437 in the year 2005.

Copper production in Grant County is projected to slowly increase until the year 1997. With a reduction in production from Phelps-Dodge assumed to occur in 1998, overall production will decline to 108 thousand metric tons in 2005. This projected production level represents a 28 percent decline from 1980 county production.[18]

The employment projections were allocated to the Gila-San Francisco and Mimbres Basin portions of the county. Total nonagricultural employment in the Gila-San Francisco area is projected to be 989 in the year 2005. In the Mimbres portion of the county, employment is projected to total 9,448. From the 1980 base year, total nonagricultural employment will have declined by 305 in the Gila-San Francisco while increasing in the Mimbres by 2,080. However, nonagricultural/nonmining employment is anticpated to increase in both basins. Nonagricultural/nonmining employment increases from 5,456 in 1980 to 7,936 by 2005 in the Mimbres Basin, while during the same period in the Gila-San Francisco portion of Grant County employment is forecast to increase from 587 to 721.

Water Use. Water use projections for Grant County are divided into two sets of tables, each set describing the future water demand conditions in the two separate basins considered here. These forecasts of water demands are very dependent on the population and employment projections. Each set of water use forecasts also incorporate different assumptions regarding the specific pattern of growth for the basin. In both basins, the baseline scenario provides projections of future water demands without any change in the efficiency of water use by the various categories of use. With both sets of baseline projections, there is also a set of alternative scenario projections. The alternative scenarios consider more optimistic growth and water use scenarios than contemplated in the baseline cases. These two sets of projections are presented separately according to the basins in which future water demands are forecast.

Mimbres Closed Basin

Baseline scenario water use projections for the Mimbres Basin portion of Grant County are presented in table 8.7. This scenario might be described as a "status quo" projection. That is, aside from increases in basin population and nonagricultural/nonmining employment, all other categories of water use are assumed to remain constant at their 1980 levels of water use. The increases in water demand associated with increases in population and employment in the basin amount to withdrawal and depletion increases of less than 8 and 6 percent, respectively, over 1980 uses. However, the increase in total withdrawals of slightly more than 1,600 acre-feet, and depletion increases of approximately 800 acre-feet per annum by 2005, are likely to significantly exacerbate the already acute scarcity conditions in the basin. Of course, the baseline scenario projections do not contemplate any change in the exercise of claimed

Table 8.7

Baseline Water Use Projections
Grant County Mimbres Basin

1980 WATER USE

USE	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Total Wd	Total Dp
Residential	0	0	1,729	867	1,729	867
Non-Residential (Urban & Rural)	0	0	1,797	896	1,797	896
Urban, Rural, Comm.& Indust.	0	0	3,526	1,763	3,526	1,763
Minerals	419	289	12,205	8,421	12,624	8,710
Power	0	0	520	520	520	520
Irrigated Agriculture	2,610	1,330	2,940	1,690	5,550	3,020
Livestock	141	141	144	144	285	285
Stockpond Evaporation	334	334	0	0	334	334
Reservior Evaporation	630	630	0	0	630	630
Total Use	4,134	2,724	19,335	12,538	23,469	15,262

WATER USE COEFFICIENTS AND PROJECTION VARIABLES

USE	1980 Projection Variable	1980 Water Use Coefficients Surface Wd	Surface Dp	Ground Wd	Ground Dp	% Change in Use Efficiency	2005 Forecast Variable
Residential	23,619	0.000000	0.000000	0.073197	0.036709	0.00 %	34,584
Non-Residential (Urban & Rural)	5,456	0.000000	0.000000	0.329392	0.164217	0.00 %	7,936
Urban, Rural, Comm.& Indust.							
Minerals	prod						prod
Power	EXOG						EXOG
Irrigated Agriculture	2,000	1.305000	0.665000	1.470000	0.845000	0.00 %	2,000
Livestock	EXOG						EXOG
Stockpond Evaporation	EXOG						EXOG
Reservior Evaporation	EXOG						EXOG
Total Use							

BASELINE WATER USE PROJECTIONS

USE	2005 Surface Wd	2005 Surface Dp	2005 Ground Wd	2005 Ground Dp	Net Change Total Wd	Net Change Total Dp
Residential	0	0	2,531	1,270	803	403
Non-Residential (Urban & Rural)	0	0	2,614	1,303	817	407
Urban, Rural, Comm.& Indust.	0	0	5,145	2,573	1,619	810
Minerals	419	289	12,205	8,421	0	0
Power	0	0	520	520	0	0
Irrigated Agriculture	2,610	1,330	2,940	1,690	0	0
Livestock	141	141	144	144	0	0
Stockpond Evaporation	334	334	0	0	0	0
Reservior Evaporation	630	630	0	0	0	0
Total Use	4,134	2,724	20,954	13,348	1,619	810

Note: Dp (depletions) and Wd (withdrawals) in acre-ft.

water rights by Chino Mines. The source of water necessary to supply the increased demands under even this minimal increase seen in the baseline forecast must be addressed. It seems clear that the SEO will allow no new appropriations in the Mimbres Basin portion of the county; any increased use must rely on the transfer of existing water rights. It would appear that the most likely source of these water rights would be the unused Chino Mine rights. However, there is significant question as to the availability of these water rights to residential and nonresidential users due to the unwillingness of Kennecott to sell its water rights.[19]

Two alternative scenarios of growth in the Mimbres Basin portion of Grant County were also considered. Under both of the scenarios modeled there was assumed to be increased efficiency of water use in the residential and irrigated agriculture use categories. Residential users were assumed to increase their efficiency of use by a total of 5 percent during the 25-year projection period. Surface water use by irrigated agriculture was assumed to become 5 percent more efficienct while groundwater use was modeled to become 10 percent per acre more efficient. Water use in the power, livestock, stockpond evaporation and reservior evaporation categories of use was held constant at the 1980 and baseline levels of demand. The results of both of these alternative scenarios are presented in the water use forecasts summarized in table 8.8.

In alternative scenario A, it was assumed that the current conditions in the copper mining economy would be substantially improved and Chino Mines would increase production so as to utilize the full extent of their claimed water right entitlements. Associated with this increased mine production would be a slight increase in population growth over the baseline case, with population in

Table 8.8

Alternative Water Use Projections
Grant County Mimbres Basin

PROJECTION VARIABLES COMMON TO SCENARIOS

USE	1980 Projection Variable	% Change in Use Efficiency Surface	% Change in Use Efficiency Ground
Residential	23,619	0%	5%
Non-Residential (Urban & Rural)	5,456	0%	0%
Urban, Rural, Comm.& Indust.			
Minerals	PROD		
Power	EXOG		
Irrigated Agriculture	2,000	5%	10%
Livestock	EXOG		
Stockpond Evaporation	EXOG		
Reservoir Evaporation	EXOG		
Total Use			

ALTERNATIVE SCENARIO A
MINERAL AND AGRICULTURAL WATER USE GROWTH

USE	2005 Forecast Variable	2005 Surface Wd	2005 Surface Dp	2005 Ground Wd	2005 Ground Dp	Net Change Total Wd	Net Change Total Dp
Residential	36,000	0	0	2,503	1,255	774	388
Non-Residential (Urban & Rural)	8,100	0	0	2,668	1,330	871	434
Urban, Rural, Comm.& Indust.		0	0	5,171	2,586	1,645	823
Minerals	PROD	2,500	1,725	17,000	11,730	6,876	4,745
Power	EXOG	0	0	520	520	0	0
Irrigated Agriculture	2,500	3,099	1,579	3,308	1,901	857	461
Livestock	EXOG	141	141	144	144	0	0
Stockpond Evaporation	EXOG	334	334	0	0	0	0
Reservoir Evaporation	EXOG	630	630	0	0	0	0
Total Use		6,704	4,409	26,143	16,881	9,378	6,028

ALTERNATIVE SCENARIO B
BASELINE AGRICULTURE/MINERAL GROWTH
WITH LARGE SCALE RECREATION DEVELOPMENT

USE	2005 Forecast Variable	2005 Surface Wd	2005 Surface Dp	2005 Ground Wd	2005 Ground Dp	Net Change Total Wd	Net Change Total Dp
Residential	40,000	0	0	2,781	1,395	1,053	528
Non-Residential (Urban & Rural)	10,000	0	0	3,294	1,642	1,497	746
Urban, Rural, Comm.& Indust.		0	0	6,075	3,037	2,549	1,274
Minerals	PROD	419	290	12,205	8,420	0	0
Power	EXOG	0	0	520	520	0	0
Irrigated Agriculture	2,000	2,480	1,264	2,646	1,521	(425)	(236)
Livestock	EXOG	141	141	144	144	0	0
Stockpond Evaporation	EXOG	334	334	0	0	0	0
Reservoir Evaporation	EXOG	630	630	0	0	0	0
Total Use		4,004	2,659	21,590	13,642	2,125	1,039

Note: Wd (withdrawals) and Dp (depletions) the basin increasing to 36,000. However, it was assumed that this increase in mining activity would have only a nominal impact on the growth in nonagricultural/nonmining employment (which serves as the basis for the nonresidential water demand forecast). Nonagricultral/nonmining employment was assumed to increase to 8,100 in 2005. The impact of these assumptions in the alternative scenario A projections of water demands are significant. There is seen to be a more than 9,000 acre-feet increase in withdrawals and corresponding 6,000 acre-feet increase in depletions. The majority of the change from the baseline forecast is due to the full exercise of Chino Mine's claimed water rights. The most significant interpretation of this alternative scenario is that the increased residential and nonresidential demands must find new sources of water to satisfy their demand requirements. In short, water becomes critically scarce and there are likely to be substantial impairment claims and litigation associated with attempts to satisfy these increased demands.

The second alternative scenario considered provides for much less conflict as a result of less critical water scarcity conditions. Alternative scenario B is based on the assumption that Chino Mines will continue to operate at its 1980 level of production and water use. In addition, Grant County will be successful in attracting large scale increases in recreation and tourism activity. The increased nonmining economic activity is given expression as a 2005 population of 40,000 Mimbres Basin residents and nonagricultural/nonmining employment of 10,000. Both these variables represent substantial increases over the baseline scenario. Alternative scenario B also assumes no increase in agricultural acreage over that found in 1980.

The results of this second alternative projection are much more similar to those found in the baseline forecast. Total withdrawals are projected to increase by more than 2,100 acre-feet, with total depletions forecast to increase slightly more than 1,000 acre-feet. These are increases that are important in a water scarce area such as the Mimbres Basin in Grant County. However, these increased demands can be easily accommodated if the excess Chino Mine water right claims are transferred to the municipal uses. If these additional water rights are not made available or are used as the basis for impairment claims if new municipal appropriations are sought, then the water scarcity conditions of the region are likely to become critical. It is difficult to speculate as to the response of Chino Mines to regional water scarcity conditions. This response is likely to depend on changes in the economics of copper mining in the 25-year projection period.

Gila-San Francisco Surface Drainage Basin

Future water demand conditions in the Gila-San Francisco Basin portion of Grant County are almost totally dependent on the outlook for copper mining. It has been clearly established that Phelps-Dodge faces a resource constraint that will substantially reduce its mining activities during the 25-year projection period. For the purposes of this forecast it was assumed that the leaching operation will be ongoing throughout the projection period. However, all primary mining and milling activities will cease prior to 2005. Conversation with Phelps-Dodge's Chief Engineer have suggested that this leaching operation will likely require approximately 3,000 acre-feet per annum (withdrawals).[20] It was further assumed that the firm would utilize its groundwater rights first and pump water from the Gila River only as necessary to satisfy its total withdrawal demands.

Residential and nonresidential water demands were forecast based on the population and employment projections provided for Grant County by Wombold and

McDonald. All other water use categories were projected to remain at their 1980 use levels. The baseline forecast of water demands for the Gila-San Francisco Basin portion of Grant County is presented in table 8.9.

The general conclusion with respect to water scarcity is that by 2005 there will be "less scarcity" as compared to 1980 water use conditions. The baseline scenario shows total withdrawals to decline by more than 7,700 acre-feet and corresponding declines in depletions of 3,026. Essentially all of these changes in demands are from surface water sources of supply. Indeed, it would appear that there is room to consider new water using developments in the region, or interbasin transfer of these water rights to mitigate shortages elsewhere. This conclusion is, of course, in essense the antithesis of current water availability conditions in the Gila-San Francisico Basin. Current restrictions on use in the basin include a strict limit on all water depletions. This circumstance will likely not be the case under the water demand conditions modeled in this baseline scenario.

As an alternative to the baseline scenario there was considered the potential effects of successful development of tourism and recreation activities in the basin. Table 8.10 presents the results of the alternative scenario considered for the Gila-San Francisco Basin portion of Grant County. This alternative scenario assumes stronger population and employment growth as compared to the baseline scenario, with population in the basin forecast to increase to 3,500 and employment growth to 900 by the end of the projection period. In addition there is assumed to be a 5 percent improvement in the efficiency of use by the residential sector, a 5 percent efficiency improvement in surface water irrigation and a 10 percent increase in the efficiency of groundwater use by irrrigated agriculture.

Table 8.9

Baseline Water Use Projections
Grant County Gila-San Francisco Basin

USE	1980 WATER USE: Surface Wd	Surface Dp	Ground Wd	Ground Dp	Total Wd	Total Dp	WATER USE COEFFICIENTS AND PROJECTION VARIABLES: 1980 Projection Variable	1980 Water Use Coefficients: Surface Wd	Surface Dp	Ground Wd	Ground Dp	% Change in Use Efficiency	2005 Forecast Variable	BASELINE WATER USE PROJECTIONS: 2005 Surface Wd	2005 Surface Dp	2005 Ground Wd	2005 Ground Dp	Net Change Total Wd	Net Change Total Dp
Residential	0	0	0	0	0	0	2,453	0.000000	0.000000	0.073197	0.036709	0.00 %	2,816	0	0	206	103	206	103
Non-Residential (Urban & Rural)	0	0	195	98	195	98	587	0.000000	0.000000	0.332198	0.166951	0.00 %	721	0	0	240	120	45	22
Urban, Rural, Comm.& Indust.	0	0	195	98	195	98								0	0	446	224	251	126
Minerals	9,517	3,730	1,637	1,356	11,154	5,086	EX06						EX06	1,363	534	1,637	1,356	(8,154)	(3,196)
Irrigated Agriculture	7,140	1,990	300	200	7,440	2,190	1,470	4.857143	1.353741	0.204082	0.136054	0.00 %	1,500	7,286	2,031	306	204	152	45
Livestock	102	102	105	105	207	207	EX06						EX06	102	102	105	105	0	0
Stockpond Evaporation	242	242	0	0	242	242	EX06						EX06	242	242	0	0	0	0
Fish and Wildlife	431	431	0	0	431	431	EX06						EX06	431	431	0	0	0	0
Reservoir Evaporation	240	240	0	0	240	240	EX06						EX06	240	240	0	0	0	0
Total Use	17,672	6,735	2,237	1,759	19,909	8,494								9,664	3,580	2,494	1,889	(7,752)	(3,026)

Note: Wd (withdrawals) and Dp (depletions)

Table 8.10

Alternative Water Use Projections
Grant County Gila-San Francisco Basin

USE	1980 Projection Variable (PROJECTION VARIABLES)	% Change in Use Efficiency: Surface	% Change in Use Efficiency: Ground	2005 Forecast Variable	2005 Surface Wd (ALTERNATIVE WATER USE PROJECTIONS)	2005 Surface Dp	2005 Ground Wd	2005 Ground Dp	Net Change Total Wd	Net Change Total Dp
Residential	2,453	0%	5%	3,500	0	0	243	122	243	122
Non-Residential (Urban & Rural)	587	0%	0%	900	0	0	299	150	104	52
Urban, Rural, Comm.& Indust.					0	0	542	272	347	174
Minerals	EXOG			EXOG	1,363	534	1,637	1,356	(8,154)	(3,196)
Irrigated Agriculture	1,470	5%	10%	1,500	6,921	1,929	276	184	(243)	(77)
Livestock	EXOG			EXOG	102	102	105	105	0	0
Stockpond Evaporation	EXOG			EXOG	242	242	0	0	0	0
Fish and Wildlife	EXOG			EXOG	431	431	0	0	0	0
Reservoir Evaporation	EXOG			EXOG	240	240	0	0	0	0
Total Use					9,299	3,478	2,560	1,917	(8,050)	(3,099)

Note: Wd (withdrawals) and Dp (depletions) in acre-ft.

The improvements in the efficiency of use more than offset the increased use associated with successful recreation and tourism development as modeled. The reduction in water demands associated with the alternative scenario are even greater than in the baseline case. Total withdrawals in the Gila-San Francisco portion of Grant County are reduced by more than 8,000 acre-feet from their 1980 levels; depletions are forecast to decline by nearly 3,100 acre-feet. Even with these stronger assumptions regarding growth there seems to be no legitimate concern relating to the avaiability of water supplies relative to future demands in 2005 for the Gila-San Francisco portion of Grant County.

Summary

Much concern has recently been expressed in relation to the scarcity of water resources in Grant County.[21] In terms of current demands and supply restrictions, this concern is well founded. It is also the case that future water demand conditions in the Mimbres Basin portion of the county are also likely to place significant pressure on the naturally occurring available supplies of the basin. However, it is also clear that other resource constraints may help to mitigate water scarcity conditions in the county as a whole.

The physical constraint of recoverable copper ore faced by Phelps-Dodge is the mitigating factor in the water scarcity circumstances faced by Grant County over the next 25 years. Even without the benefit of numerical analysis, there can be little question that water scarcity conditions will continue to increase if current levels of water use by Phelps-Dodge persist until 2005. However, there is no reason to suspect that Phelps-Dodge would publish an estimate of recoverable reserves less than their best estimate of these reserves. Thus, it seems clear that the Phelps-Dodge operation must be significantly curtailed by 2005.

The only question of significant concern relative to the mitigation of water scarcity conditions in Grant County as a whole relates to the ability to accomplish a transfer of Gila-San Francisco Basin water resources to uses within the Mimbres Basin. Recall that this transfer would be from the Lower Colorado River Basin to the Rio Grande Basin across the continental divide. There would appear to be no strict obstacle to this transfer. However, there can be anticipated some greater difficulties (than might otherwise be expected) as a result of the interbasin nature of the transfer.

It is apparent that the county and communities must posture themselves in a manner that addresses the critical scarcity of water resources in the near-term. At the same time, it is important to avoid the stigma of long-term water scarcity if their attempts for increasing nonmineral economic development is to succeed. Water, in both quantity and quality sufficient for increased economic and population related demands, has in recent years been of critical concern to the development of Grant County. This issue will be resolved only as a result of the boom-bust cycle inherent to development of all nonrenewable mineral resources. The recent debate over the Conner Dam project has focused much attention on the current scarcity of water resources in the county. However, there appears to be no long-term need for these additional water resources unless mining activities continue or expand, or unless some nonmineral economic development occurs which is sufficient to significantly increase population, employment and (water using) recreational visitors in the region.

CHAPTER VIII

ENDNOTES

1 Data in this section was obtained from Diemer and Morrison, New Mexico Land Use, By County 1977-1982, p.15; and Hydrologic Unit Map-1974, State of New Mexico; and State of New Mexico Land Status Map 1982.

2 Population data was obtained from the U.S. Bureau of Census, Department of Commerce. The population in the basin was determined by matching census to hydrological boundaries. The Gila-SF Surface Drainage Basin portion of the county includes the Pino Altos (ED's 800-802) and the Tyrone (ED's 803-807) census divisions. The Mimbres Closed Basin includes all other census divisions with the exception of ED's 825,826 and 827. ED 825 is considered part of the Animas Closed Basin while ED's 826 and 827 are within the Playas Closed Basin.

3 United States Department of Agriculture and New Mexico Crop and Livestock Reporting Service, New Mexico Agricultural Statistics 1983, U.S. Department of Agriculture and New Mexico Department of Agriculture, New Mexico State University, Las Cruces, New Mexico, 1984.

4 Employment in all sectors (except mining and agriculture) was determined by using census data to create weights of employment within the basins. These weights were then applied to N.M. Employment Security Division data in order to obtain the estimates of county employment by basin. For agriculture, irrigated acreage within the respective basins was used to determine the weights. The location of mining operations within the respective hydrological basins was known. Employment allocation in the mining sector was made using this information.

5 Sorensen, Water Use by Categories in New Mexico Counties and River Basins and Irrigated Acreage in 1980, tables 3 and 4.

6 Not all of Chino Mines' water rights are currently being utilized, although there is substantial awareness of the need to prevent impairment of these rights by new appropriations which would draw on the same groundwater resources. To the extent that impairment would occur and could be proven, Chino Mines will challenge all applications for new appropriations or changes in place and purpose of existing appropriations (Tom Shelly, Chino Mines, Land and Resource Manager, April 30, 1985). See also SEO memo from D.E. Gray to S.E. Reynolds, "Recomended Criteria for Administering the Mimbres Basin," March 16, 1976. A good description of the specific problems faced by appropriators in the Grant County portion of the Mimbres Basin is provided in F.D. Trauger, D.N. Jenkins and R.L. Link, Water-Resources Appraisal for East-Central Grant County, New Mexico, Geohydrology Associates, Inc. for The Southwest New Mexico Council of Governments and The Four Corners Regional Commission, 1980.

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(continued)

7 It is difficult to specifically quantify the water right entitlements now utilized, vested and claimed by Chino Mines. The following information was provided by Tom Shelly, Land and Resources Manager, Chino Mines, June 19, 1985. Stark Ranch rights; five-year average of 2,420 acre-feet per annum, not to exceed 2,581 acre-feet in any one year. Adjudicated groundwater rights; 17,632 acre-feet per annum (not to exceed 88,160 acre-feet five year cummulative total), industrial rights with 10,927 acre-feet having been proven beneficially used. Adjudicated groundwater right; 28,978 acre-feet for industrial use. Surface water right; 11,583 acre-feet per annum on Whitewater and Santa Rita creeks, corresponding storage rights on these creeks. Surface right to floodwaters; 715.5 acre-feet. If all these water rights were available for appropriation in a single year total maximum use would be 61,328.5 acre-feet; however, the surface water supplies are unreliable, some 7,580 acre-feet are still subject to proof of beneficial use, and less than 15,000 acre-feet are actually being put to beneficial use under current mine, mill and smelter operations. The balance of unused rights are considered "vested rights" and subject to appropriation as need arises.

8 _Arizona v. California, et al._, decree entered March 9, 1964, 376 U.S. 340 (1964).

9 Patrick Houston, et al.,"The Death of Mining," _Business Week_, December 17, 1984, pp.64-70.

10 _Mineral Commodities Summaries 1985_, U.S. Bureau of Mines, Department of Interior.

11 "A Boom That Is Not Animal,Vegetable or Mineral," _The Economist_, August 11, 1984, p.62.

12 Harold Cousland, "N.M. Copper Industry Hopes to Tap Into Better Times," _Albuquerque Journal_, September 23, 1984, p.G-2.

13 "Phelps Dodge to Expand Tyrone Plant," _Albuquerque Journal_, March 13, 1985.

14 Houston, "The Death of Mining," p.65.

15 Interview with Tom Shelly, Land and Resource Manager, Chino Mines, April 30, 1985, Hurley, New Mexico.

16 Interview with J.T. Tysseling, Chief Engineer, Tyrone Mine, Phelps-Dodge Corporation, Tyrone, New Mexico, April 30, 1985.

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ENDNOTES
(continued)

17 See Silver City Daily Press, April 29, 1985, p.l.

18 To determine copper production in Grant County, the following information and assumptions were utilized: 1) Demand for copper is expected to increase at an annual rate of 1.8 percent from 1984 to 2005. This outlook is based on a forecast by the U.S. Bureau of Mines (Mineral Commodities Summary, January,1985). 2) U.S. mine production (as a percentage of total U.S. consumption or demand) will remain at the 1984 level of 0.50 from 1985 to 2005. 3) The New Mexico share of U.S. mine production will decline to 7 percent in the year 2005. This percentage is in line with the New Mexico share of production before Phelps-Dodge Tyrone Mine began operation in 1967.
Based on these assumptions, the total U.S. mine production will in crease from the 1984 level of 1,050 thousand metric tons to 1,537 thousand metric tons in 2005. This is approximately the same level of production as in 1981. Based on these assumptions, New Mexico's share of U.S. production will be 108 thousand metric tons.

19 Interview with Tom Shelly, Land and Resources Manager, Chino Mines, April 30, 1985, Hurley, New Mexico.

20 Interview with J.T. Tysseling, Chief Engineer, Tyron Mine, Phelps-Dodge Corporation, Tyrone, New Mexico, April 30, 1985.

21 See, for example, J.W. Hernandez, W.G. Hines and F.D. Trauger, Evaluation of a Municipal Water Supply for the Silver City Area Using Ground Water Recharge of Water From Corner (sic) Reservoir on the Gila River, prepared for Town of Silver City and New Mexico Interstate Stream Commission, August 1984.

CHAPTER IX

LUNA COUNTY

Current Profile

Water Basin Description. Located on the southern border of the state, all of Luna County is in hydrologically closed water basins. Most of the county lies within the Mimbres Closed Basin. The southwestern corner of the county is part of the Wamel Basin. Both these closed basins are hydrologically connected to the Rio Grande Basin; however, neither basin is tributary to the surface flows of the Rio Grande. Only a small land area (28 square miles) along the western edge of the county is within the Lower Colorado River Basin. This area is part of the Animas Closed Basin.

Land Use. Land Use in Luna County is dominated by ranching and grazing activities. As table 9.1 indicates, public rangeland in 1982 accounted for 1,271,441 acres or 67 percent of the county land area. The greatest proportion of the remaining land is held privately for grazing purposes. Total agricultural cropland amounts to 71,140 acres or 3.7 percent of the total county area. Only 4,500 acres of the county--in and around Deming--are considered urbanized or builtup.

Population.[1] Luna County ranks twentieth among New Mexico county's in population. From 1970 to 1980, the county's population increased by a total of 33.1 percent, an increase well above the state average. Most of this population increase occurred in the first half of the decade. During the latter part of the decade, net out-migration slowed growth significantly. The population totaled 15,585 in 1980. The 1983 estimated populated was 16,500. Deming is the most populous city in the county with a 1980 population of 9,964. All the

Table 9.1

Luna County Land Use
(Acres)

Land Use	1977	1980	1982
Cropland			
Cropped	58,370	46,840	48,870
Idle	14,810	18,040	21,270
National Forests	0	0	0
Public Rangeland			
BLM	731,589	746,547	746,747
State	524,701	524,701	524,701
National Forest			
Commercial Forest	0	0	0
Parks			
State	304	304	304
Fish and Game	0	0	0
Federal	0	0	0
Defense	2,081	2,081	2,081
Urban & Builtup	4,500	4,500	4,500
Airports	2,870	2,870	2,870
Highways/Roads	10,519	10,531	10,547
Energy Transmission Corridors	3,139	3,175	3,232
Railroads	616	616	616
Assessed Valuation of Real Estate ($000)	54,807	63,128	94,156
% Residential			39
% Non-Residential			61
% Oil/Gas			0

Total Land Area 1,892,480 acres
Total Water Area 0 acres

Source: Joel Diemer and Joy Morrison, New Mexico Land Use by County, 1977-1982. Research Report 532, Agricultural Experiment Station, New Mexico State University, Las Cruces, March 1984.

county population is considered to be in the Mimbres Closed Basin for the purposes of this analysis.

Economy. With regards to employment, Luna County is dominated by agriculture, government and the trade and service sectors. Among New Mexico counties in 1983, Luna ranked seventh in total cash receipts obtained from all farm commodities.[2] The mainstays of the agricultural sector are cattle, cotton, chile and sorghum production. About 29 percent of all irrigated acres are devoted to cotton production. In terms of gross crop value, cotton accounted for $7.8 million in 1981 or about 37 percent of the county value of crop production.[3] As table 9.2 indicates, agricultural employment has held steady since 1970 but has declined as a percentage of total employment.

As a percentage of all employment, the government sector is the most important in Luna County. In 1970 the government sector provided for 23.5 percent of all employment in the county. This percentage increased to 27 percent in 1982. The aggregate government sector in the county is led by employment in local government.

The service and trade sectors are the other significant employment sectors in Luna County. Their importance is a reflection of Deming's location along Interstate 10 and the significance of the retired population residing in the county. The other five sectors, mining, construction, TCU, FIRE and manufacturing, account for about one-fourth of the total employment in Luna County. Manufacturing employment, which is centered in Deming, has remained quite stable since 1970. A large portion of this employment is related to chile processing. This highly seasonal employment, occuring from August to October, increases county manufacturing employment by almost 200 percent above the average level of the other months.

Table 9.2

Luna County Employment Profile

Employment Sector	1970	1980	1982
		YEAR	
Agriculture	555.0	592.0	567.0
%Total	17.0	14.9	14.8
Manufacturing	252.0	250.0	263.0
%Total	7.7	6.3	6.8
Mining	36.0	90.0	68.0
%Total	1.1	2.3	1.8
Construction	127.0	162.0	157.0
%Total	3.9	4.1	4.1
TCU	301.0	274.0	221.0
%Total	9.2	6.9	5.8
Trade	766.0	967.0	899.0
%Total	23.4	24.3	23.4
FIRE	119.0	197.0	194.0
%Total	3.6	5.0	5.0
Services	346.0	420.0	436.0
%Total	10.6	10.6	11.4
Government	768.0	1,020.0	1,035.0
%Total	23.5	25.7	27.0
Total Jobs	3,270.0	3,972.0	3,840.0

Source: New Mexico Employment Security Division and U.S. Dept. of Commerce, Bureau of Economic Analysis (For Agricultural Employment)

Note: TCU refers to transportation, communications and utilities.
FIRE refers to finance, insurance and real estate.

Water Use. The SEO reported that 130,549 acre-feet of water was withdrawn in Luna County in 1980 with 80,704 acre-feet of depletions associated with these withdrawals. A water use profile for the county is contained in table 9.3. Water use in Luna County is dominated by agriculture. About 97 percent of all withdrawals (and depletions) are due to irrigation or other agricultural uses. The urban population accounts for less than 2 percent of consumptive uses in 1980. Minerals use, associated with tin, manganese and zinc mining, totaled 290 acre-feet in 1980. Golf course depletions (in the recreation use category) totaled 255 acre-feet.

Surface water use is extremely limited in the Luna County portion of the Mimbres Closed Basin. Surface water provided for less than 7 percent of total withdrawals, and less than 5.5 percent of total depletions in 1980. Irrigated agriculture makes the only substantial use of the surface waters available in Luna County. However, the intermittent flows of the Mimbres River provide significant limits on the reliance which may be placed on surface water supplies for irrigation. For urban water use, all the water is obtained from groundwater sources.

Projections

Population. Population forecasts for Luna County were prepared by Wombold for these water use projections. Total population is projected to be 21,200 in 2005. From the 1980 base year, this 25-year growth projection represents an increase of 5,600 residents in Luna County.

Economy. A review of historical trends and economic data shows that Luna's economy is primarily based on the government and trade sectors. Manufacturing employment accounts for only a small share of the total jobs in the county. Growth in Luna County measured through employment or real per capita

Table 9.3

Summary of Water Use in Luna County
Mimbres Closed Basin
1980

USE	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Total Wd	Total Dp	Population	GPCD
Urban	0	0	3,094	1,547	3,094	1,547	9,964	
Deming			3,094	1,547	3,094	1,547	9,964	277
Rural	0	0	512	256	512	256	5,621	
Columbus			133	66	133	66	414	287
Other Rural			379	190	379	190	5,207	65
Commercial	0	0	53	32	53	32		
Industrial	0	0	0	0	0	0		
Minerals	0	0	427	290	427	290		
Military	0	0	0	0	0	0		
Power	0	0	0	0	0	0		
Recreation	0	0	276	255	276	255		
							Total Acres	Irrigated Acres
Irrigated Agriculture	8,400	3,970	117,120	73,690	125,520	77,660	73,940	55,900
Nutt-Hockett Area	0	0	20,440	12,860	20,440	12,860	10,900	7,800
Mimbres Valley	8,400	3,970	96,680	60,830	105,080	64,800	63,040	48,100
Livestock	225	225	237	234	462	459		
Stockpond Evaporation	190	190	0	0	190	190		
Fish and Wildlife	0	0	0	0	0	0		
Reservoir Evaporation	15	15	0	0	15	15		
Total Use	8,830	4,400	121,719	76,304	130,549	80,704		

Note: Wd (withdrawals) and Dp (depletions) in acre-ft.
GPCD=gallons per capita per day

Source: E.F. Sorensen, Water Use by Categories in New Mexico Counties and River Basins, and Irrigated Acreage in 1980, 1982. Technical Report 44, New Mexico State Engineer Office, Santa Fe, New Mexico and New Mexico State Engineer Files.

income has not been dramatic. Between 1970 and 1984 total nonagricultural jobs increased slightly less than 1.7 percent on an average annual basis. Real per capita income gained only about 1.2 percent per annum in this period. Since 1980, on an average annual basis, the county experienced zero employment growth and almost no gain in real per capita income.

Although Luna County has shown almost no growth since 1980, characteristics of the area suggest a potential for steady, but slow, growth in the future. Four factors support this conclusion: (1) the prospect for continued growth in trade and services employment related to Deming's location along Interstate 10, (2) some renewed activity in copper mining in Grant County (at least through the mid-1990s), (3) continued retiree migration into the county, and (4) the designation of an international free-trade zone which may stimulate some development of manufacturing enterprises in the county. These potential growth factors were considered in the McDonald projections of the growth rate of employment in the county. The rate of growth in employment in Luna was uniformly increased and assumed to be 1.5 percent by 1990. This growth rate was held constant until 2005. Based on these assumptions, total nonagricultural employment was expected to increase to 4,420 by 2005.

Water Use. Table 9.4 presents the baseline water use projections for Luna County. These forecasts of future water demands are dependent on the population and employment projections provided by Wombold and McDonald, respectively. Several additional assumptions are also important in establishing the baseline scenario. Most important of these assumptions is that irrigated agriculture will increase by more than 7 percent to 60,000 irrigated acres by 2005. This assumption of agricultural growth is supported by the recent establishment of several vineyards in Luna County which have added nearly 1,000

Table 9.4

Baseline Water Use Projections
Luna County

USE	1980 WATER USE: Surface Wd	Surface Dp	Ground Wd	Ground Dp	Total Wd	Total Dp	WATER USE COEFFICIENTS AND PROJECTION VARIABLES: 1980 Projection Variable	1980 Water Use Coefficients: Surface Wd	Surface Dp	Ground Wd	Ground Dp	% Change in Use Efficiency	2005 Forecast Variable	BASELINE WATER USE PROJECTIONS: 2005 Surface Wd	2005 Surface Dp	2005 Ground Wd	2005 Ground Dp	Net Change Total Wd	Net Change Total Dp
Residential	0	0	1,141	572	1,141	572	15,585	0.000000	0.000000	0.073197	0.036709	0.00 %	21,200	0	0	1,552	778	411	206
Non-Residential (Urban & Rural)	0	0	2,518	1,263	2,518	1,263	3,290	0.000000	0.000000	0.765418	0.383857	0.00 %	4,302	0	0	3,293	1,651	775	388
Urban, Rural, Comm.& Indust.	0	0	3,659	1,835	3,659	1,835								0	0	4,845	2,430	1,186	595
Minerals	0	0	427	290	427	290	EXOG					0.00 %	EXOG	0	0	427	290	0	0
Recreation	0	0	276	255	276	255	15,585	0.000000	0.000000	0.017709	0.016362	0.00 %	21,200	0	0	375	347	99	92
Irrigated Agriculture	8,400	3,970	117,120	73,690	125,520	77,660	55,900	0.150268	0.071020	2.095170	1.318247	0.00 %	60,000	9,016	4,261	125,710	79,095	9,206	5,696
Livestock	225	225	237	234	462	459	EXOG						EXOG	225	225	237	234	0	0
Stockpond Evaporation	190	190	0	0	190	190	EXOG						EXOG	190	190	0	0	0	0
Reservoir Evaporation	15	15	0	0	15	15	EXOG						EXOG	15	15	0	0	0	0
Total Use	8,830	4,400	121,719	76,304	130,549	80,704								9,446	4,691	131,594	82,395	10,491	6,382

Note: Wd (withdrawals) and Dp (depletions) in acre-ft.

acres to irrigated agriculture since 1980. However, recent trends in total irrigated acreage for Luna County suggests this increase in acreage to be a very optimistic assumption. Acreage irrigated in Luna County has declined from 55,860 acres in 1979 to only 33,000 acres in 1983.[4] Most of this decline is at this time temporary, as indicated by the lands status as idle and fallow. However, without substantial improvement in the farm economy there can be significant doubt as to whether these lands will ever return to production.

In addition to the population, employment and agriculture assumptions, the baseline projections of water use in the recreation category were tied to the measure of economic growth provided by the employment forecast. It may be recalled that the recreation use is principally golf course irrigation. The baseline scenario also assumed that water use in minerals, livestock, stockpond evaporation, and reservior evaporation will remain at the levels reported by the SEO in 1980. The final assumption which must be mentioned is that the baseline projections contemplate no change in the efficiency of use by any of the use categories.

As would be expected in a county with little reliable surface water supply, the majority of increased water demands affect the groundwater resources of Luna County. Residential and nonresidential demands increase by nearly 1,200 acre-feet for withdrawals and almost 600 acre-feet for depletions. The great majority of the increased demands presented in the baseline forecast are in the agricultural sector. The caveats to this increased agricultural demand forecast are clear. Thus, one is drawn to the conclusion that much of the water resource scarcity in Luna County will be determined exogenously by the conditions of agricultural markets during the 25-year projection period.

In an attempt to more precisely characterize future water demand conditions in Luna County an alternative forecast scenario also was prepared. This alternative projection incorporated very pessimistic assumptions with respect to agriculture and much more optimistic assumptions regarding population and employment growth when compared to the baseline scenario. It was assumed in the alternative scenario that irrigated acreage would decline to 40,000 acres, with population increasing to 25,000 and employment increasing to 5,500 by 2005. The results of this alternative scenario forecast are presented in table 9.5.

It is apparent that a decrease in agriculture of the magnitude described by this alternative scenario will substantially impact the net change in water demands for the county. Even though residential and nonresidential demands nearly double under the optimistic population and employment forecasts, the decline in water demands associated with the reduced irrigated acreage provides for a substantial net decrease in total water demands. Under the alternative scenario considered, total withdrawals are reduced by nearly 42,000 acre-feet. Corresponding declines in depletion demands amount to more than 26,000 acre-feet. There can be little question that the specific change in Luna County water demands is highly dependent on the future of irrigated agriculture in the county.

Summary

Agriculture dominates 1980 water use in Luna County and will largely determine the specific future water demand conditions in this portion of the Mimbres Closed Basin. The SEO has estimated that approximately 3.7 million acre-feet of groundwater remains available in storage in the Mimbres Basin at currently feasible pumping depths for irrigated agriculture.[5] However, to a depth of a

Table 9.5

Alternative Water Use Projections
Luna County

USE	1980 Projection Variable	% Change in Use Efficiency Surface	% Change in Use Efficiency Ground	2005 Forecast Variable	2005 Surface Wd	2005 Surface Dp	2005 Ground Wd	2005 Ground Dp	Net Change Total Wd	Net Change Total Dp
	PROJECTION VARIABLES				ALTERNATIVE WATER USE PROJECTIONS					
Residential	15,585	0%	5%	25,000	0	0	1,738	872	598	300
Non-Residential (Urban & Rural)	3,290	0%	0%	5,500	0	0	4,210	2,111	1,692	848
Urban, Rural, Comm.& Indust.					0	0	5,948	2,983	2,289	1,148
Minerals	EXOG	0%	0%	EXOG	0	0	427	290	0	0
Recreation	15,585	5%	10%	25,000	0	0	398	368	122	113
Irrigated Agriculture	55,900	5%	10%	40,000	5,710	2,699	75,426	47,457	(44,384)	(27,504)
Livestock	EXOG			EXOG	225	225	237	234	0	0
Stockpond Evaporation	EXOG			EXOG	190	190	0	0	0	0
Reservoir Evaporation	EXOG			EXOG	15	15	0	0	0	0
Total Use					6,140	3,129	82,437	51,332	(41,972)	(26,243)

Note: Dp (depletions) and Wd (withdrawals) in acre-ft.

1,000 feet, there is estimated to be approximately 70 million acrefeet of recoverable groundwater in the Mimbres Closed Basin. The lesser estimate of available supplies would provide for more than 40 years of water based on use levels projected for 2005. A substantial reduction in irrigated acreage would have the effect of making more water available to nonagricultural uses and forestalling any critical water scarcity conditions well beyond the period considered in this forecast.

It must be noted that the hot, dry climatic conditions of the Mimbres Basin in Luna County are among the most severe in New Mexico. Due to the length of the growing season in the county there is substantial potential for agriculture; however, the constraint on agricultural development may be simply stated as the cost of pumping groundwater. If net returns to specific crops are sufficiently high during the 25-year projection period there is substantial potential for water scarcity conditions to prevail in Luna County. If, alternatively, net returns to irrigated agriculture are not sufficient to justify pumping costs, then water demand conditions in the county will not likely constrain economic growth in any fashion.

CHAPTER IX

ENDNOTES

1 Population data was obtained from the U.S. Bureau of Census, Department of Commerce.

2 United States Department of Agriculture and New Mexico Crop and Livestock Reporting Service, New Mexico Agricultural Statistics 1983, U.S. Department of Agriculture and New Mexico Department of Agriculture, New Mexico State University, Las Cruces, New Mexico, 1984.

3 Clevenger, Irrigated Acreage in New Mexico and Estimated Gross Crop Value by County, 1981, p. 26.

4 R.R. Lansford, et al., Sources of Irrigation Water and Irrigated and Dry Cropland Acreages in New Mexico, By County, 1978-1983, Agricultral Experiment Station, Research Report 554, New Mexico State University, 1984.

5 S.E. Reynolds, State Engineer, letter to Charles T. DuMars, Chairman, Governor's Water Law Study Committee, September 1, 1983, p. 4.

CHAPTER X

LOWER RIO GRANDE PROJECTION SUMMARY

Water Use Projection Summary

The projections of water use in the Lower Rio Grande Surface Drainage Basin for the 25-year forecast period are presented in table 10.1. The data are summarized from the county-basin baseline scenario projections for Sierra and Dona Ana counties (tables 3.6 and 4.3). Recall that the baseline scenario is based primarily on the population and employment projections provided by Wombold and McDonald, respectively. The efficiency of water use in the various sectors is assumed constant in this scenario, and agricultural water use is projected to remain essentially constant at its 1980 level.

The projection shows that there is likely to be an increase in water demands over the 25-year period requiring approximately 34,000 acre-feet in withdrawals and nearly 18,000 acre-feet in depletions. This represents a 6.2 percent increase in total witdrawals and a 6.7 percent increase in total depletion demands. More than 95 percent of the increased demands are demands related to groundwater resources. Approximately 80 percent of the demand increases are associated with residential and nonresidential municipally supplied water uses.

Most surprising of the forecast results is the levels of increase associated with recreation uses of water. The recreation use category in the lower basin largely consists of golf course irrigation, and the projections were tied to increases in the population in the basin. Another area where there can be anticipated to be very strong increases in water demands is associated with the nonresidential water use sector. This category of use consists of many diverse urban and rural activities, ranging from the specific needs of industry to the general needs of parks and fire protection.

Table 10.1

Lower Rio Grande Surface Drainage Basin
Projection Summary

USE	1980 WATER USE				BASELINE WATER USE PROJECTIONS					
	Surface Wd	Surface Dp	Ground Wd	Ground Dp	2005 Surface Wd	2005 Surface Dp	2005 Ground Wd	2005 Ground Dp	Net Change Total Wd	Net Change Total Dp
Residential	0	0	7,276	3,649	0	0	12,513	6,276	5,237	2,627
Non-Residential (Urban & Rural)	0	0	13,463	6,750	0	0	36,295	18,195	22,832	11,445
Urban, Rural, Comm.& Indust.	0	0	20,739	10,399	0	0	48,808	24,470	28,069	14,071
Minerals	0	0	201	63	0	0	351	111	150	48
Military	0	0	10	9	0	0	10	9	0	0
Power	0	0	2,150	2,150	0	0	3,796	3,796	1,646	1,646
Recreation	255	255	3,030	1,620	450	450	5,349	2,860	2,514	1,435
Irrigated Agriculture	420,670	176,870	67,820	44,440	422,160	177,498	68,016	44,570	1,685	758
Livestock	474	474	1,073	953	474	474	1,073	953	0	0
Stockpond Evaporation	1,120	1,120	0	0	1,120	1,120	0	0	0	0
Reservior Evaporation	29,130	29,130	0	0	29,130	29,130	0	0	0	0
Total Use	451,649	207,849	95,023	59,634	453,334	208,672	127,403	76,769	34,065	17,958

Note: Wd (withdrawals) and Dp (depletions) in acre-ft.

There is no attempt made here to summarize the alternative scenarios considered in the Lower Basin county profile projections. It should be recalled, though, that even the most optimistic of the alternatives considered provided water use projections that were less than twice the levels of increase found in the baseline scenario. It must also be recognized that the specific quantitative values of increased demands are not as important as the general magnitude of the results. That is, there can be anticipated to be less than a 10 percent increase in the total water use demands in the Lower Rio Grande Basin over the 25-year projection period. These increases in demand will largely draw on the groundwater resources of the basin.

Future Water Scarcity Conditions

The 1983 SEO memo, which details water available for appropriation, describes the Rio Grande stream related basin below Elephant Butte as fully appropriated.[1] This condition then requires that any new groundwater appropriations would require the retirement of existing surface water rights to offset the effects of the groundwater appropriation on the stream. This memo also estimates that there is sufficient water in groundwater storage to allow cummulative depletions of 4.8 million acre-feet over the next 100 years.

The El Paso litigation clearly demonstrates that there is substantial dispute as to the validity of the SEO assertion of fully appropriated supplies. However, until litigants prove otherwise, the only plausible assumption is that the retirement of surface water rights would be a condition of new groundwater appropriations. Under these circumstances there is likely to be significant water resource scarcity in the Lower Rio Grande Basin associated with the pressures of increased water demands during the 25-year projection period.

With the imposed constraint of water availability two responses must be anticipated. First, the scarcity of water resources will cause an increase in the efficiency of use, thereby, partially mitigating the increased demand pressures. Second, there can be little question that existing water rights--probably from the agricultural sector--will be transfered to these new residential and nonresidential demand sectors. The extent to which transfers are required will be based on an economic calculus of alternative costs. The alternative costs are simply the costs incumbent to a surface to groundwater transfer versus the costs inherent to changes in the efficiency of use. This evaluation of alternative costs will be dependent on the specific conditions and circumstances posed by each change in use considered.

This forecast of increased water resource scarcity in the Lower Rio Grande Basin must be put into perspective. Most important is the perspective that the magnitude of increases are not so substantial as to suggest critical water scarcity condtions. The specific increases in demands are not nominal; however, careful management and planning will allow for all the growth considered without significant constraint on development activities. Another important perspective is that the current marginal economic viability of much agricultural activity would suggest that these transfers could be accomplished without substantial disruption of the lower basin economy. Finally, it must be considered that some additional water will possibly be found available as a result of the El Paso litigation, and that these additonal water supplies may be available to satisfy the increased water demands expected to be found in the lower basin by 2005. In short, water scarcity is anticipated in the Lower Rio Grande Surface Drainage Basin; however, the severity of the scarcity is not likely to be great.

CHAPTER X

ENDNOTES

1 S.E. Reynolds, State Engineer, letter to Charles T. DuMars, Chairman, Govenor's Water Law Study Committee, September 1, 1983, (appendix A).

CHAPTER XI

GILA-SAN FRANCISCO AND MIMBRES BASINS PROJECTION SUMMARY

Water Use Projection Summary

Water use projections for the county-basin areas of the Gila River and San Francisco River surface water drainage basins and the Mimbres Closed Basin are provided in chapters 6 through 9. It should be recalled that the Gila-San Francisico Basin and the Mimbres Closed Basin are hydrologically distinct and separate. However, there is need to consider the future water demand conditions of these two basins together because of interbasin transfers of water supplies and the interrelationship of the economic and demographic projections for the two basins. The summaries of the basin water demand projections are kept separate in the descriptions which follow, but the assessment of future water scarcity conditions in the two basins will be combined below.

Gila-San Francisco Basin Water Use Projections. The baseline scenario 25-year water demand projections for the Gila River and San Francisco River surface water drainage basins are summarized from the county-basin profiles and are presented in table 11.1. This summary table is based on the aggregation of tables 6.4, 7.3, and 8.9. Recall that these projections are very dependent on the population and employment forecasts provided by Wombold and McDonald, respectively. However, the most important assumption contained in these projections is that the Phelp-Dodge Tyrone Mine will exhaust its recoverable ore reserves prior to 2005, and will be reduced to leaching and solvent extraction operation by that time. All other categories of use are assumed to remain at essentially their 1980 levels of water use.

Table 11.1

Gila-San Francisco Surface Drainage Basin
Projection Summary

USE	1980 WATER USE Surface Wd	Surface Dp	Ground Wd	Ground Dp	BASELINE WATER USE PROJECTIONS 2005 Surface Wd	2005 Surface Dp	2005 Ground Wd	2005 Ground Dp	Net Change Total Wd	Net Change Total Dp
Residential	0	0	144	68	0	0	368	180	224	112
Non-Residential (Urban & Rural)	0	0	212	106	0	0	258	129	46	23
Urban, Rural, Comm.& Indust.	0	0	356	174	0	0	626	309	270	135
Minerals	9,517	3,730	1,641	1,359	1,363	534	1,641	1,359	(8,154)	(3,196)
Irrigated Agriculture	25,890	6,920	3,990	2,620	26,208	7,042	4,095	2,689	423	191
Livestock	348	348	356	354	348	348	356	354	0	0
Stockpond Evaporation	1,031	1,031	0	0	1,031	1,031	0	0	0	0
Fish and Wildlife	694	694	0	0	694	694	0	0	0	0
Reservior Evaporation	265	265	0	0	265	265	0	0	0	0
Total Use	37,745	12,988	6,343	4,507	29,909	9,914	6,718	4,711	(7,461)	(2,870)

Note: Wd (withdrawals) and Dp (depletions) in acre-ft.

Water demands in the portions of Grant, Catron, and Hidalgo counties which comprise the surface drainage area, are forecast to decline substantially in the 25-year projection period. Total withdrawals are expected to decrease by nearly 7,500 acre-feet, with a corresponding decline in depletions of almost 2,900 acre-feet. In a region that is currently subject to conditions of extreme water resource scarcity, this forecast of reduced water demands is indeed controversial. However, the constraint of finite resource stocks and conditions in domestic copper markets provide substantial credibility to the projected decline in water demands at the Tyrone mine. Most of the current use for this mine is provided by surface water supplies of the Gila River, and demands on the surface supplies are forecast to decline by more than 20 percent by 2005.

Mimbres Closed Basin. Water use projections for the Mimbres Closed Basin are presented in table 11.2. This table is based on the county-basin projections for the portions of Grant and Luna counties which are a part of the Mimbres Closed Basin (tables 8.7 and 9.4). The summary of future water demands projected from the 25-year forecast period shows an approximate 12,000 acre-foot increase in withdrawals and a corresponding increase in depletions of nearly 7,200 acre-feet. Several important points must be made with respect to these projections.

First, there are forecast very substantial increases in the residential and nonresidential use categories. During the 25-year forecast period there is expected to be a nearly 40 percent increase in water use by these aggregate categories of use. However, even with these very substantial increases, water use associated with these categories shows a net growth in withdrawals of approximately 2,800 acre-feet and increases in depletions of about 1,400

Table 11.2

Mimbres Closed Water Basin
Projection Summary

USE	1980 WATER USE Surface Wd	Surface Dp	Ground Wd	Ground Dp	BASELINE WATER USE PROJECTIONS 2005 Surface Wd	2005 Surface Dp	2005 Ground Wd	2005 Ground Dp	Net Change Total Wd	Net Change Total Dp
Residential	0	0	2,870	1,439	0	0	4,083	2,048	1,214	609
Non-Residential (Urban & Rural)	0	0	4,315	2,159	0	0	5,907	2,955	1,591	796
Urban, Rural, Comm.& Indust.	0	0	7,185	3,598	0	0	9,990	5,002	2,805	1,404
Minerals	419	289	12,632	8,711	419	289	12,632	8,711	0	0
Power	0	0	520	520	0	0	520	520	0	0
Recreation	0	0	276	255	0	0	375	347	99	92
Irrigated Agriculture	11,010	5,300	120,060	75,380	11,626	5,591	128,650	80,785	9,206	5,696
Livestock	366	366	381	378	366	366	381	378	0	0
Stockpond Evaporation	524	524	0	0	524	524	0	0	0	0
Reservior Evaporation	645	645	0	0	645	645	0	0	0	0
Total Use	12,964	7,124	141,054	88,842	13,580	7,415	152,549	95,743	12,111	7,192

Note: Dp (depletions) and Wd (Withdrawals) in acre-ft.

acre-feet. The second area of increase in demands is associated with the irrigated agriculture sector. Recall that it was assumed agricultural acreage in Luna County would increase by less than 10 percent, but remain substantially below the total acreage levels to which water rights are currently appurtenant. This baseline scenario assumption may be overly optimistic. However, recently there has been some significant investment in vineyard acreage and changes in cropping patterns that would suggest some increased agricultural activity over that seen in the 1980 data. Finally, it should be noted that the baseline scenario assumes no increase in the efficiency of water use during the projection period. Any postulated increase in agricultural use efficiency would serve to mitgate the increases in agricultural water demands in this forecast.

Also important to the baseline scenario projections for the Mimbres Closed Basin is the assumed level of production from the Chino mines copper operations. In the baseline case there was postulated no change in the level of water use by the minerals category. Recall, however, that Chino mines possess water right claims far in excess of their current uses. Full exercise of these rights would substantially change the water demands for the Mimbres Closed Basin. The assumption of no change from 1980 use is based on information provided by Chino mines with respect to their likely future operations. Any change in this pattern of mineral water use would require substantial change in the domestic copper market conditions.

Future Water Scarcity Conditions

In both the Gila-San Francisco Surface Drainage Basin and the Mimbres Closed Basin absolute constraints are now being placed on new appropriations of water. In the Gila-San Francisco Basin these constraints are imposed as a result of the Arizona v. California and Globe Equity decrees. In the Mimbres Closed Basin the restrictions on use are those imposed by the SEO under its administration of the declared underground water basin.

The 1983 SEO Memo (appendix A) states that there are no groundwater supplies available in the Gila-San Francisco Basin; however, in the Mimbres Closed Basin the memo reports that a total stock of 3.7 million acre-feet is available in storage at a depth of less than 230 feet, with a total of 73.7 million acre-feet available in storage to a depth of 1,000 feet. Note that the SEO memo asserts only municipal and industrial users are thought able to afford appropriations of groundwater below the depth of 230 feet.

Two conditions are clear with respect to scarcity circumstances in the Gila-San Francisico and Mimbres basins. First, water is currently very scarce in both basins. Silver City recently paid almost $2,000 per acre-foot for 633 acre-feet of water rights transferred from mining use.[1] There are almost no dependable surface water flows in the Mimbres River or its tributaries, and rights have been granted to the flood flows of the river. Currently in the Gila-San Francisco Basin, water rights are sold in fractions of an acre-foot to allow for outside taps (and other uses) due to the absolute constraint on allowed water use. It can safely be asserted that there are no unappropriated water supplies in either basin.

However, the second important condition of water scarcity in these two basins relates to the potential development and availability of water supplies in the future. If the Conner Dam project is approved, an additional 18,000 acre-feet of water will be made available for consumptive use in the Gila-San Francisico Basin. Current discussion would call for approximately 8,000 acre-feet of these new supplies to be transfered to the Mimbres Basin for use by Silver City. With this augmentation of supplies, combined with the likely declines in appropriations at the Tyrone mine, there can be little concern about scarcity of water resources in the two basins near the end of the 25-year projection period.

Unfortunately, this improved water availbility is not descriptive of circumstance in the near future. The Phelps-Dodge mining operation is likely to continue for at least another ten years; and, even if funds were approved for the construction of Conner Dam today it would be nearly ten years before water would be available from the project. Thus the projection of no water scarcity in these two basins in 2005 is misleading in that critical water scarcity conditions exist today and will continue to exist until at least 1995.

CHAPTER XI

ENDNOTES

1 "Pact Eases Silver City Water Woes," Albuquerque Journal October 19, 1985, p. B-3.

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APPENDIX A

NEW MEXICO STATE ENGINEER MEMO TO GOVERNOR'S WATER LAW STUDY COMMITTEE

STATE OF NEW MEXICO

STATE ENGINEER OFFICE

SANTA FE

S. E. REYNOLDS
STATE ENGINEER

BATAAN MEMORIAL BUILDING
STATE CAPITOL
SANTA FE, NEW MEXICO 87503

September 1, 1983

Mr. Charles T. DuMars, Chairman
Water Study Committee
The University of New Mexico
School of Law
1117 Stanford, N.E.
Albuquerque, New Mexico 87131

Dear Mr. DuMars:

Your letter of July 19, 1983 advises that the Water Law Study Committee has begun to review and analyze possible impacts of recent court decisions concerning water and interstate commerce and requests responses to three questions. For convenience the questions are repeated below followed by my response.

1. How much unappropriated ground water is there in New Mexico and what is its approximate location and quality?

A summary of the ground water in storage may be helpful before discussing the unappropriated water. Estimates of the amount of recoverable fresh and saline water in storage have been made and are tabulated in Table 1, by surface drainage basin.

TABLE 1

River Basin (See attached map of river basins)	Approximate amount of recoverable ground water in storage million acre-feet		
	Fresh 1/	Slightly Saline 2/	Total
Arkansas-White-Red	75	160	235
Texas-Gulf	30	55	85
Pecos	25	345	370
Rio Grande	2,515	580	3,095
San Juan Structural Basin 3/	420	760	1,180
TOTAL	3,065	1,900	4,965

1/ 0 to 1,000 mg/1 total dissolved solids
2/ 1,000 to 3,000 mg/1 total dissolved solids
3/ includes San Juan and Little Colorado

The amount of unappropriated water potentially available for appropriation, under current administrative criteria, for each underground water basin wherein a mining situation exists is listed below in Table 2. Except where noted, the water is fresh. The actual amount of water available is further limited to the extent that future appropriations can only be permitted if they are of magnitudes and at locations such that impairment to existing water rights will not occur.

TABLE 2

WATER AVAILABLE FOR NEW APPROPRIATIONS IN DECLARED UNDERGROUND WATER BASINS WHEREIN A MINING SITUATION EXISTS
(See attached map of declared underground water basins)

Rio Grande Region

Basins	Water Available in storage, acre-feet	Comments
Estancia Underground Water Basin	3.39 million	1.35 million of the 3.39 million is poor quality ranging from 1,000 to 4,000 mg/l.

High Plains Region

Basins	Water Available in storage, acre-feet
Jal Underground Water Basin	40,760
Lea County Underground Water Basin	770,080
Portales Underground Water Basin	0
Tucumcari Underground Water Basin	400,000
Tularosa Underground Water Basin	10.7 million
Hueco Underground Water Basin	6.2 million

Southwestern Region

Basins	Water Available in storage, acre-feet
Animas Underground Water Basin	0 1/
Lordsburg Valley Underground Water Basin	600,000 1/
Mimbres Underground Water Basin	3.7 million 1/
Nutt-Hockett Underground Water Basin	129,600
Playas Valley Underground Water Basin	0

1/ The amounts are based on economic pumping lifts. These basins have water in storage that is below the current economic pumping depth for irrigated agriculture of around 230 feet. Assuming a storage coefficient of 0.1, the water in storage from a depth of 230 feet to 1000 feet is as follows:

Mimbres Basin	70.0 million ac.-ft.
Animas Basin	7.9 million ac.-ft.
Lordsburg Basin	4.9 million ac.-ft.

This water could be available for municipal and industrial purposes after the pumping depth is no longer economic for irrigation purposes.

Stream Related Underground Water Basins

In basins wherein ground water is interrelated to surface waters of interstate streams, unappropriated water will only be available from storage for an interim period before effects of the ground water withdrawal are fully transmitted to the river. The quantity of fresh water available from storage during the interim period depends on numerous factors, a discussion of which follows for each region.

Gila-San Francisco Region

Under the terms of the U.S. Supreme Court Decree in *Arizona* v. *California*, the following amounts of ground water are available:

Basins	Water Available in storage, acre-feet	Comments
Gila-San Francisco Underground Water Basin	0	
Virden Valley Underground Water Basin	0	
San Simon Underground Water Basin	350 acre-feet per year	Water is available for non-irrigation purposes only, totalling 350 acre-feet per year

Rio Grande Region

Inasmuch as the Rio Grande is fully appropriated, any withdrawal of ground water from storage requires a concomitant offsetting of the effect on the streams by the retirement of surface water rights. To determine the amount of unappropriated ground water, it is assumed that the 1980 surface water depletions are representative of the amount of surface water available for retirement. It is also assumed that wells would be located 6 miles from the river and that there are no return flows.

The results of the calculations are as follows:

Area & Model Parameters	1980 Surface Depletion Acre-feet	Accumulated Ground Water Depletion Year		Million Ac. Ft.
Above Otowi				
T = 1500 ft.²/day	44,200	100 yr.	-	5.5
S = 0.1		300 yr.	-	11.2
Boundary @ 5 miles		500 yr.	-	13.8
Otowi to Elephant Butte	126,630	100 yr.	-	2.7
T = 13368 ft.²/day		300 yr.	-	2.7
S = 0.1		500 yr.	-	2.7
Boundary @ 3 miles				
Below Elephant Butte	173,920	100 yr.	-	4.8
T = 17380 ft.²/day		300 yr.	-	5.0 1/
S = 0.1		500 yr.	-	5.0
Boundary @ 8 miles				

1/ Value based on water table coefficients. If artesian, the value would be about 0.005.

It should be noted that the annual amount of unappropriated groundwater is equal to the 1980 surface depletion. If there are return flows associated with the appropriation, the annual amount of unappropriated water is increased by the annual return flow reaching the river.

San Juan Region

New appropriations have been allowed if the water-level decline does not exceed 400 feet at existing water rights having a priority date earlier than September 13, 1976. Past work in the San Juan Basin has indicated that about 4,000 acre-feet is produced for a one foot reduction in artesian head. With a head lowering of 400 feet under artesian conditions (Storativity = 4 x 10-4), 1.6 million acre-feet can be depleted by rights established before and after September 13, 1976. If 5% of the aquifer is under water-table conditions (Storativity = 0.1), then the amount is 21.5 million acre-feet.

Pecos River Region

As in the Rio Grande, the Pecos River is fully appropriated. To determine the amount of unappropriated ground water it is assumed that the 1980 surface water depletions are representative of the amount of surface water available for retirement. It is assumed that the wells would be located about 6 miles from the river, and that there is no return flow.

Model Parameters	1980 Surface Depletion Acre-feet	Accumulated Ground Water Depletion	
		Year	Million Ac. Ft.
T = 2,500 ft²/day S = 0.05 Boundary @ 10 miles	83,300	100 yr.	3.4
		300 yr.	7.1
		500 yr.	8.0

2. Are there deep ground water stocks, not subject to your jurisdiction (e.g., N.M. Stat. Ann. § 72-12-25) which nevertheless might be taken and used by some party? If so, can you identify the approximate nature, extent, quality, and location of these stocks?

I am not aware of any substantial ground water stocks not subject to the State Engineer's jurisdiction that would be attractive to those seeking water for beneficial use.

3. Is there any remaining surface water which is unappropriated? If so, will you identify the approximate location, extent, and quality of this water?

Some unappropriated water exists in the Arkansas River and Little Colorado systems, as noted below:

Arkansas-White-Red Basin

Canadian River, Quay County	20,000	acre-feet per annum
Dry Cimarron River, Union County	18,800	acre-feet per annum
sub-total	38,800	acre-feet

Little Colorado River Drainage

Black Creek, McKinley County	5,000	acre-feet per annum
Puerco River, McKinley County	5,400	acre-feet per annum
Zuni River, McKinley County	11,100	acre-feet per annum
Carrizo Wash, McKinley County	2,600	acre-feet per annum
sub-total	24,100	acre-feet

Only very small amounts of unappropriated waters of the Canadian River system are likely to be developed because of the storage limitation of the Canadian River Compact. Because most of the unappropriated water in the Little Colorado is ephemeral, storage would be required to make use of the water. As the evaporative losses are high, development of this water would be very costly.

There are modest amounts of surface water that have been appropriated but not yet contracted for consumptive use, as follows:

a. Approximately 27,000 acre-feet of diversion annually for 25 years and 16,000 acre-feet of diversion annually for 50 years available for contract with the Interstate Stream Commission from the Ute Reservoir on the Canadian River, Quay County, near Logan, New Mexico.

b. Approximately 49,000 acre-feet annually to year 2005 of depletion available under contract with the Secretary of the Interior from the Navajo Reservoir supply located on the San Juan River in San Juan County.

c. The authorized Animas-La Plata Project, when completed, will make available an additional 34,000 acre-feet of depletion annually under contract with the Secretary of the Interior in the Animas and La Plata River basin in San Juan County.

d. Public Law 90-537 authorized Hooker Dam and Reservoir, or suitable alternative, and an additional annual average of 18,000 acre-feet of consumptive use from the Gila River Basin. The consumptive use will be available under contract with the Secretary of the Interior to New Mexico upon completion of the Hooker Dam and Reservoir or suitable alternative in Grant County. The amount of consumptive use authorized includes reservoir evaporation, which could amount to 4000 to 7000 acre-feet per year depending upon the resevoir site selected. If the groundwater-source option is selected there would be no reservoir evaporation.

All of the above surface water sources are suitable for domestic, municipal and industrial and irrigation purposes, but would require treatment including filtration if used for domestic purposes. Surface waters of tributaries of the Canadian River, Dry Cimarron River, Black Creek, Puerco River, Zuni River and Carrizo Wash contain large amounts of sediment because most of the available flow results from thunderstorm activity which produces rapid rises in these streams. There is a small amount of base flow in the Zuni River which is relatively clear of sediment.

With respect to all of the foregoing discussion, I must emphasize that the numbers given above are gross estimates. Further, every application to appropriate water is subject to protest and hearing and presentation of evidence that could modify the estimates given.

Please let me know if further discussion of this matter would be helpful.

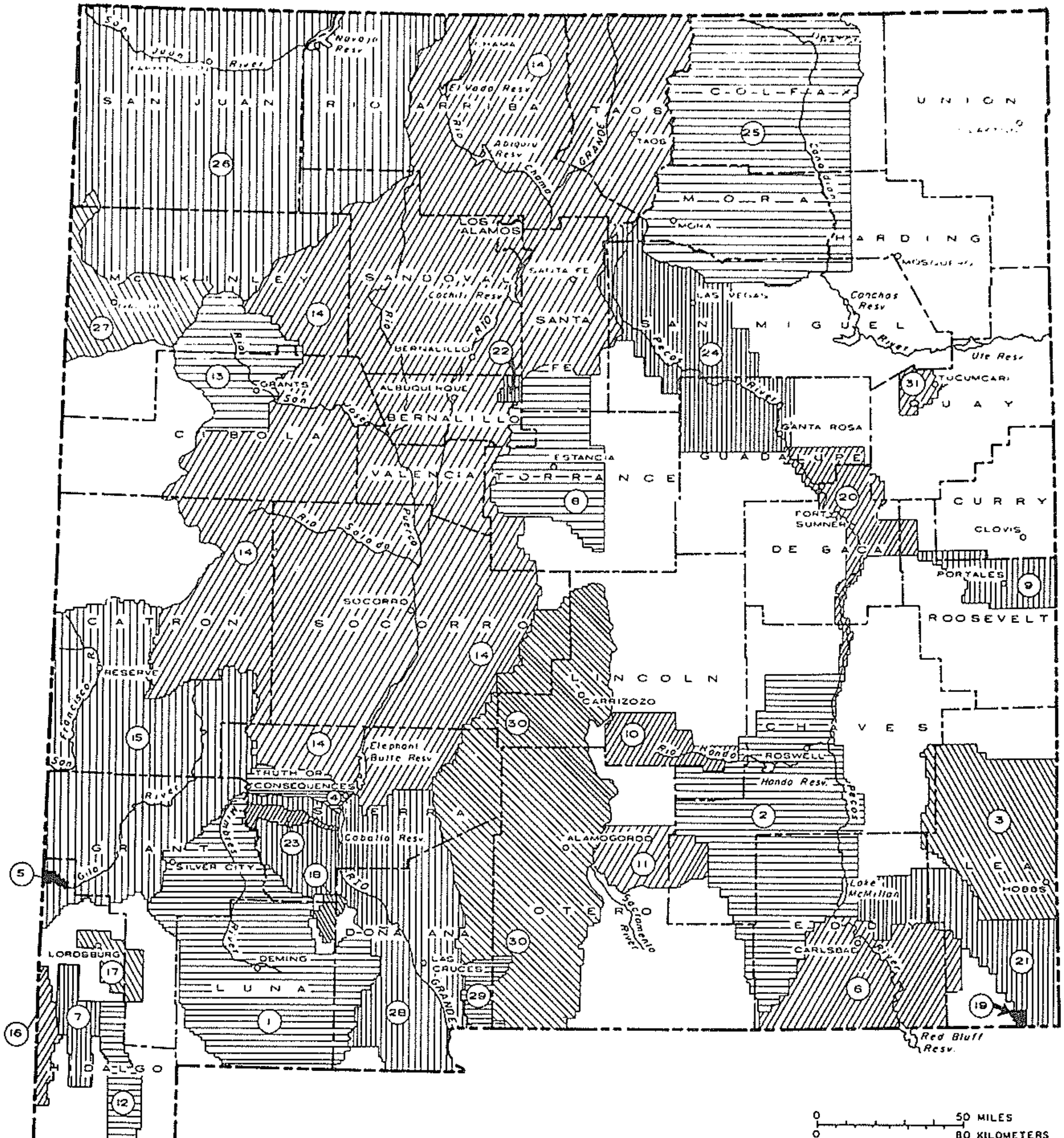
Sincerely,

S. E. Reynolds
State Engineer

Attachments
SER:rav
cc: Members of the Water Law Study Committee

APPENDIX B

NEW MEXICO STATE ENGINEER UNDERGROUND WATER BASIN MAPS



DECLARED UNDERGROUND WATER-BASINS IN NEW MEXICO

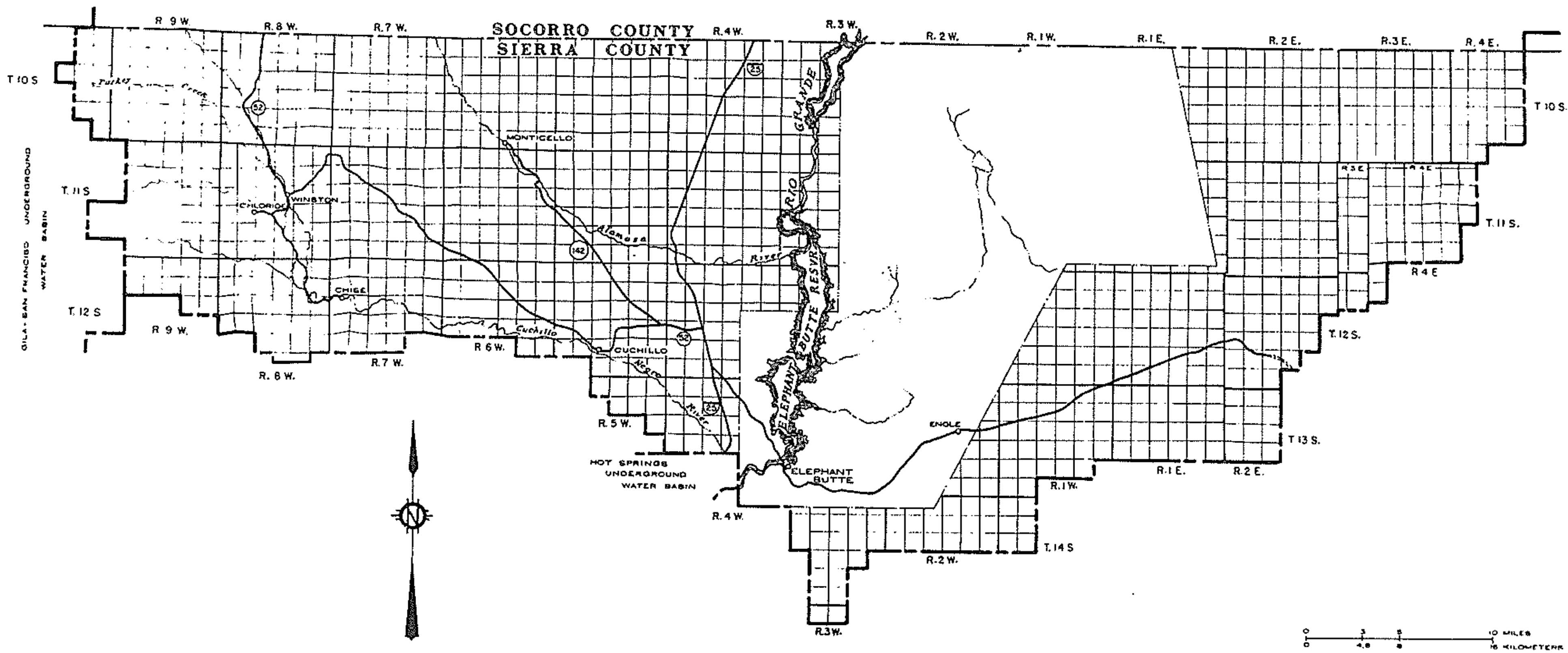
BASIN	AREA IN SQUARE MI	BASIN	AREA IN SQUARE MI.
1. MIMBRES VALLEY	4,279	16. SAN SIMON	263
2. ROSWELL	4,281	17. LORDSBURG VALLEY	329
3. LEA COUNTY	2,180	18. NUTT-HOCKETT	133
4. HOT SPRINGS	284	19. JAL	15
5. VIRDEN VALLEY	19	20. FORT SUMNER	1,059
6. CARLSBAD	1,965	21. CAPITAN	1,550
7. ANIMAS	426	22. SANDIA	73
8. ESTANCIA	1,724	23. LAS ANIMAS CREEK	131
9. PORTALES	628	24. UPPER PECOS	2,708
10. HONDO	611	25. CANADIAN RIVER	5,825
11. PENASCO	723	26. SAN JUAN	9,727
12. PLAYAS VALLEY	515	27. GALLUP	1,439
13. BLUEWATER	1,318	28. LOWER RIO GRANDE	3858
14. RIO GRANDE	26,209	29. HUECO	255
15. GILA-SAN FRANCISCO	5,659	30. TULAROSA	6,070
		31. TUCUMCARI	177
			84,433

RIO GRANDE UNDERGROUND WATER BASIN

WITHIN SIERRA COUNTY

N. MEX. STATE ENGINEER

DECEMBER 23, 1980



CHANGE 3
DECEMBER 22, 1980

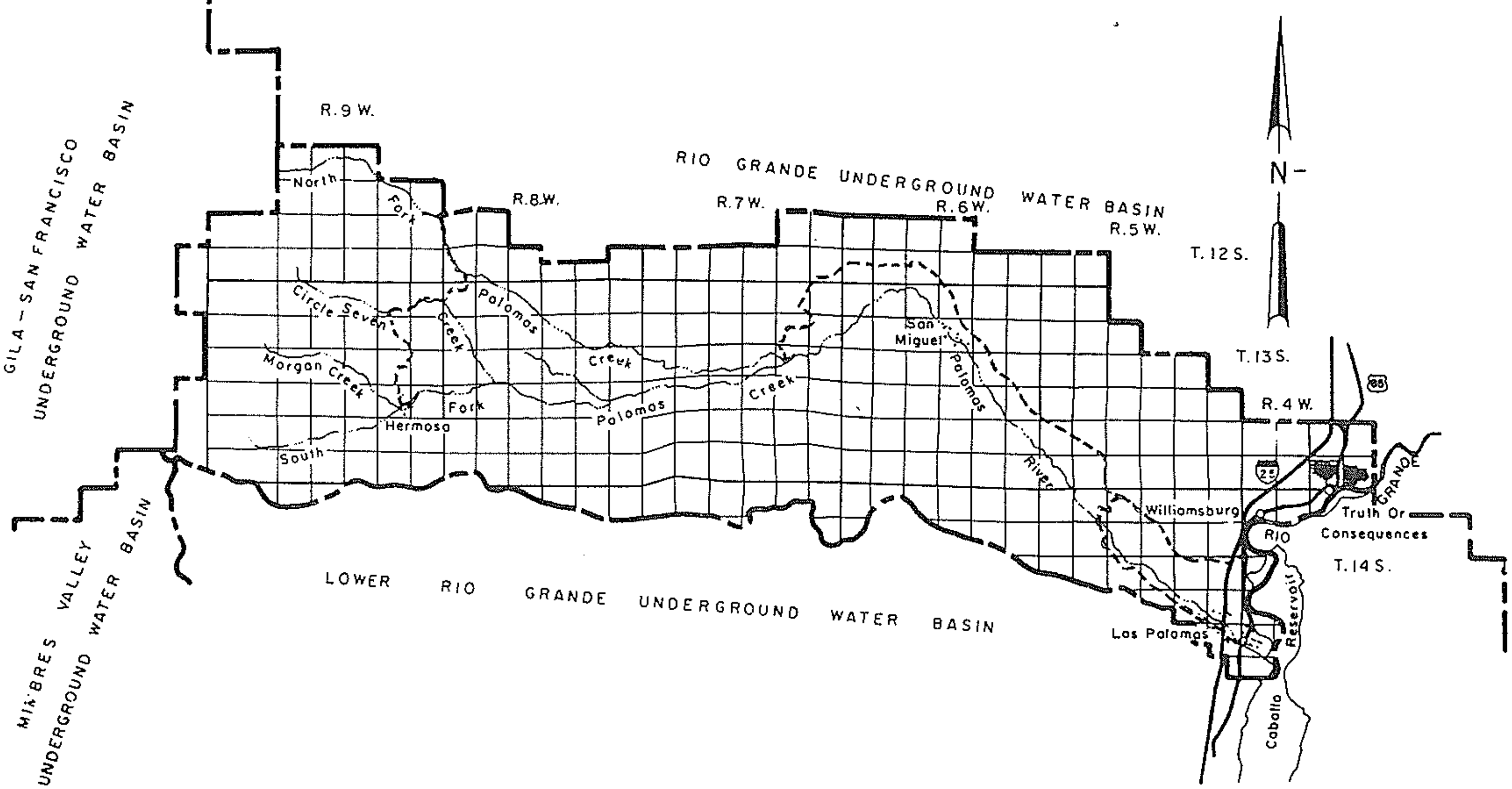
State Engineer of the State of New Mexico
Rule No. 2, Amendment No. 17

HOT SPRINGS UNDERGROUND WATER BASIN

WITHIN SIERRA COUNTY

STATE ENGINEER OFFICE

SEPTEMBER 17, 1982



Change I
September 17, 1982

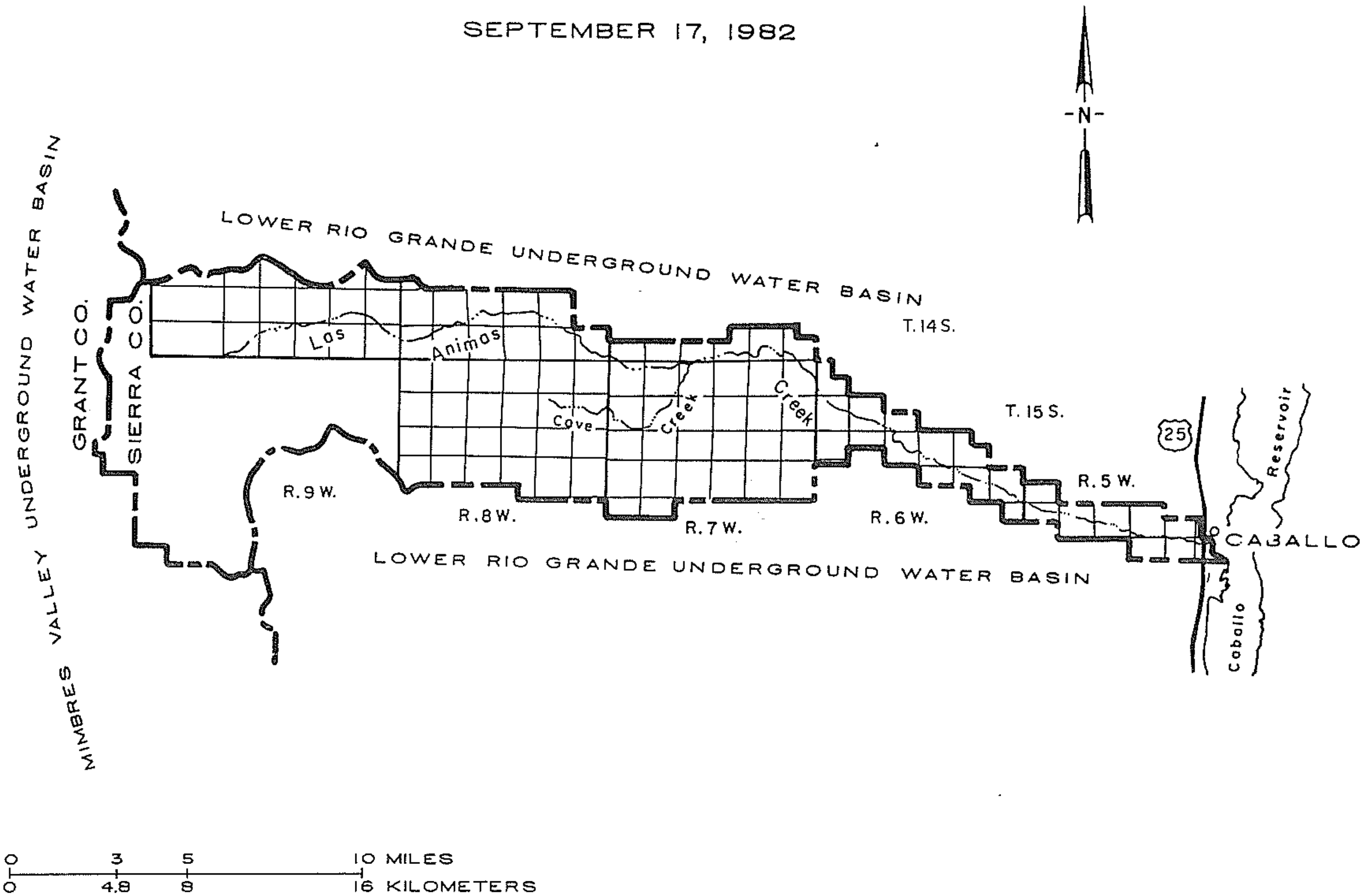
State Engineer of the State of New Mexico
Rule No. 2, Amendment No. 20

LAS ANIMAS CREEK
UNDERGROUND WATER BASIN

WITHIN SIERRA COUNTY

STATE ENGINEER OFFICE

SEPTEMBER 17, 1982



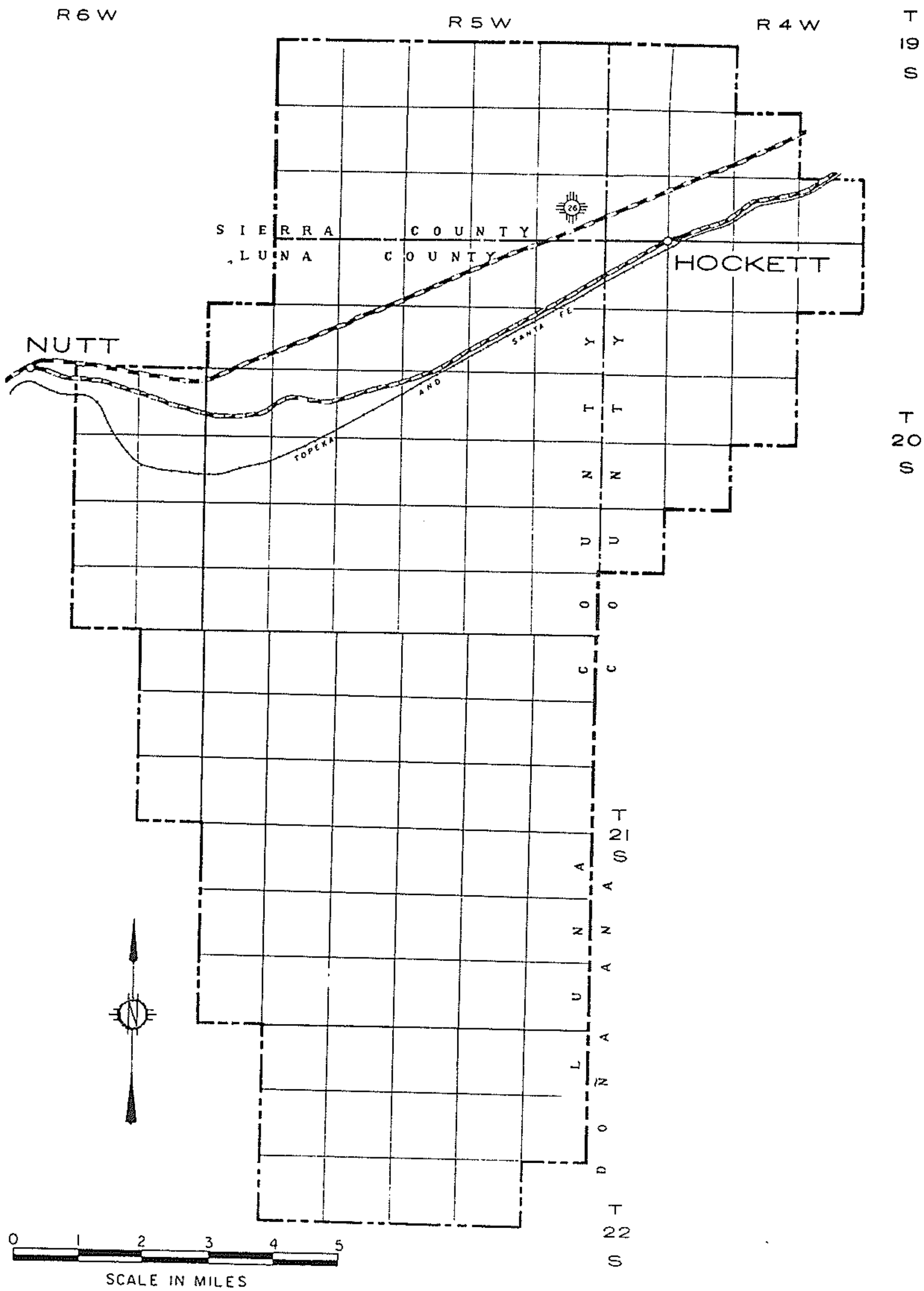
CHANGE 1
SEPTEMBER 17, 1982

State Engineer of the State of New Mexico
Rule No. 2, Amendment No. 20

NUTT-HOCKETT UNDERGROUND WATER BASIN

N. MEX. STATE ENGINEER

AUGUST 1966

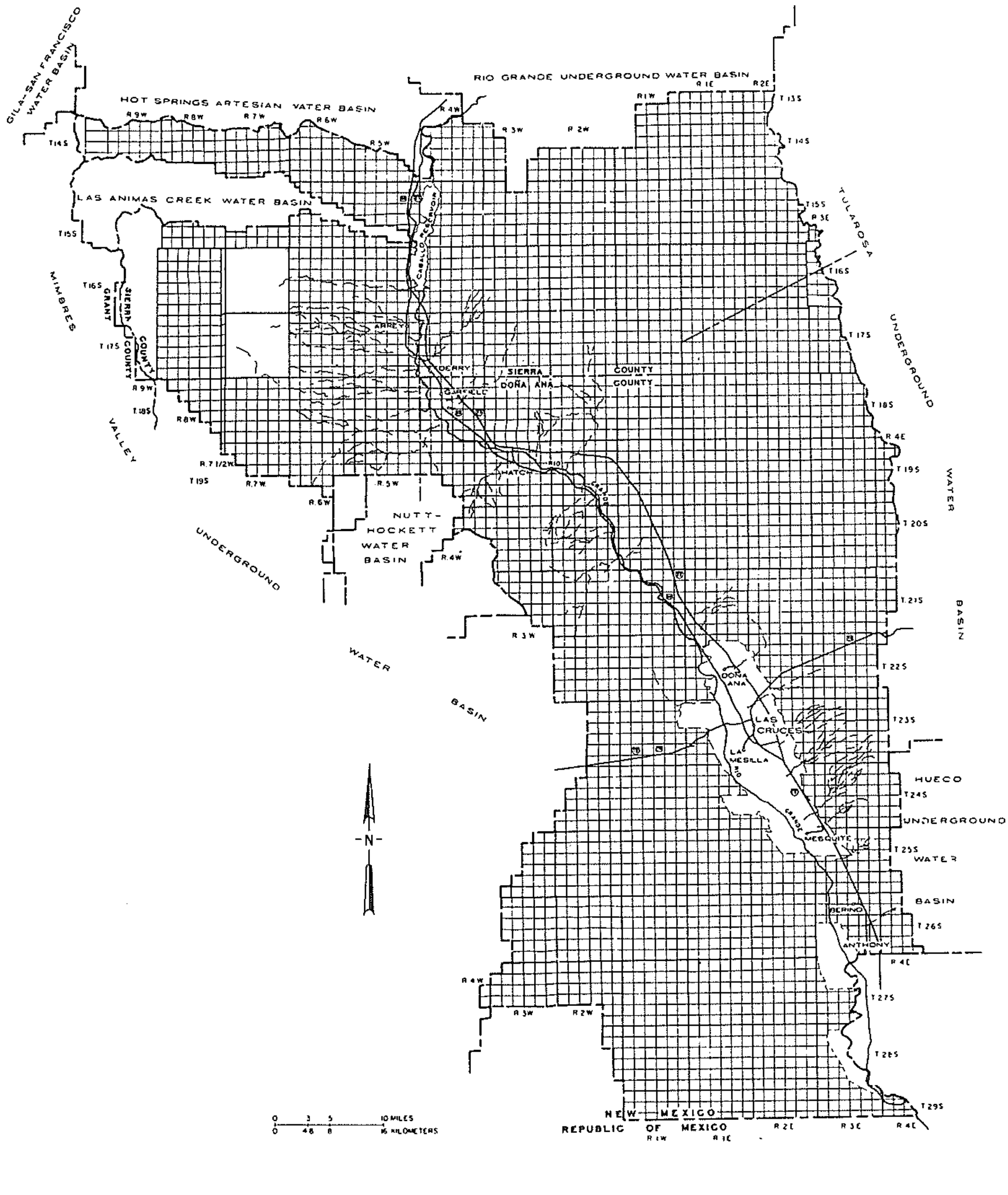


LOWER RIO GRANDE
UNDERGROUND WATER BASIN

WITHIN DOÑA ANA, GRANT AND SIERRA COUNTIES

STATE ENGINEER OFFICE

SEPTEMBER 17, 1982



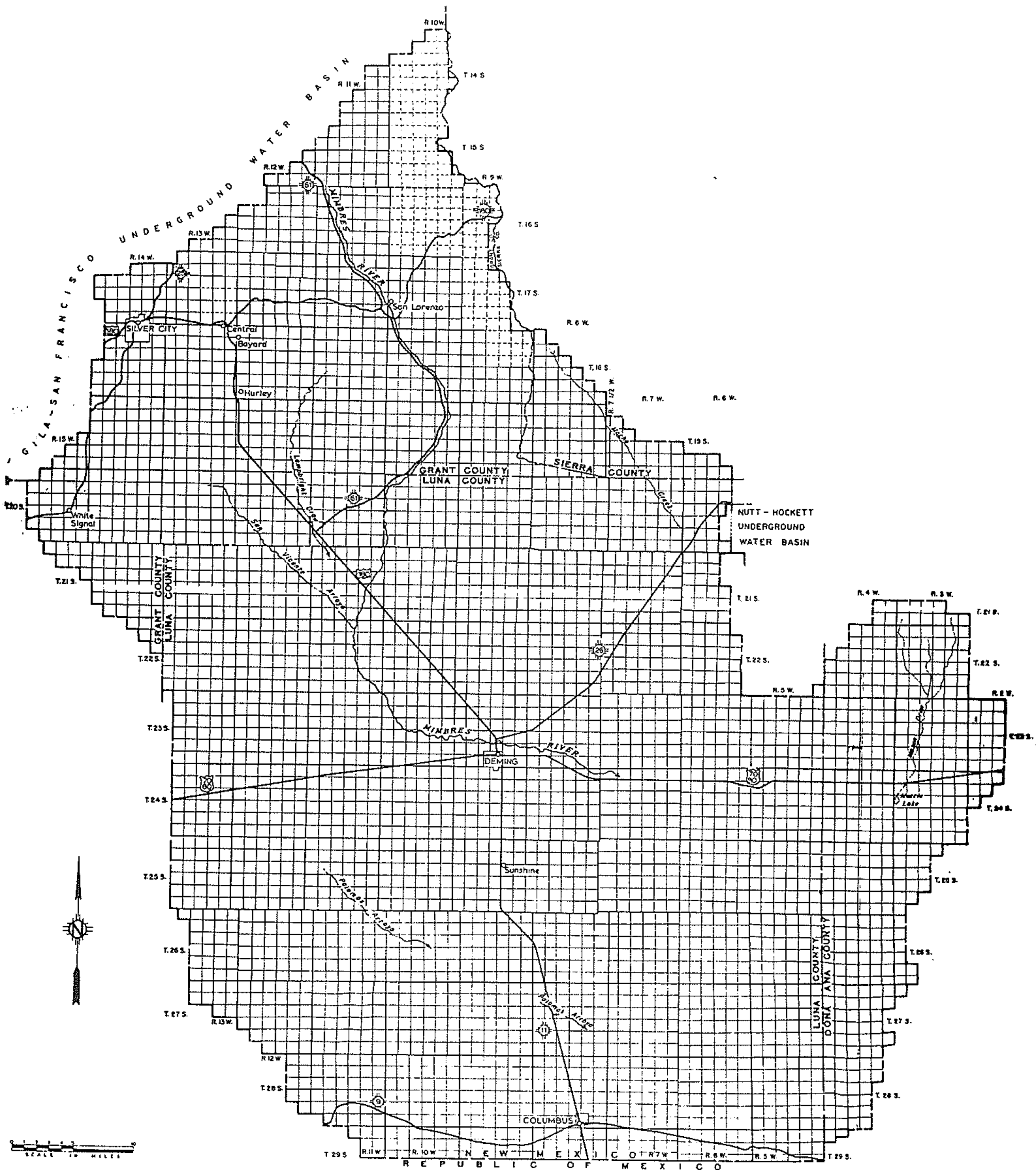
CHANGE I SEPTEMBER 17, 1982

State Engineer of the State of New Mexico
Rule No. 2, Amendment No. 21

MIMBRES VALLEY UNDERGROUND WATER BASIN

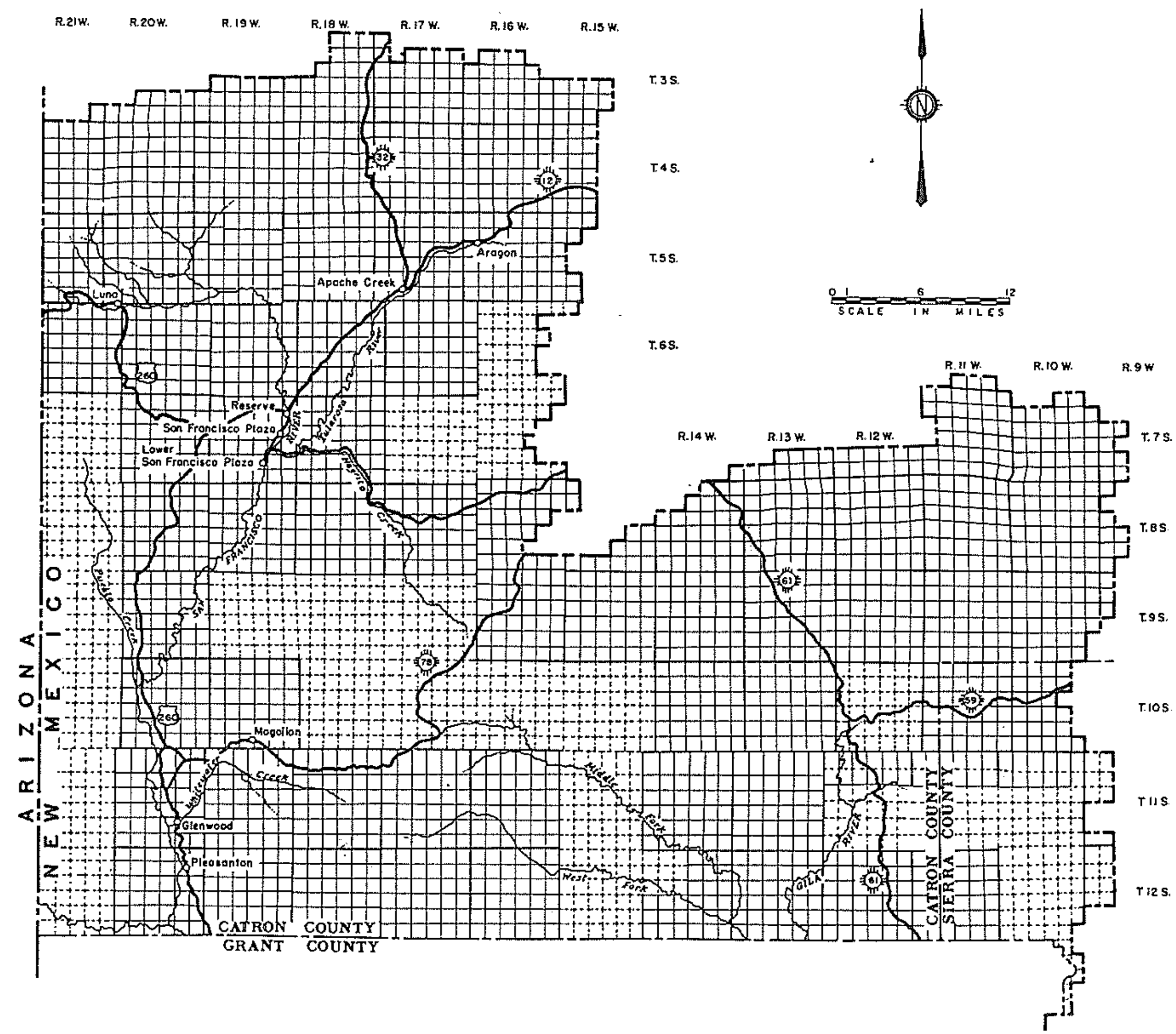
N. MEX. STATE ENGINEER

1970



GILA – SAN FRANCISCO UNDERGROUND WATER BASIN
WITHIN CATRON AND SIERRA COUNTIES

N. MEX. STATE ENGINEER
AUGUST 1966

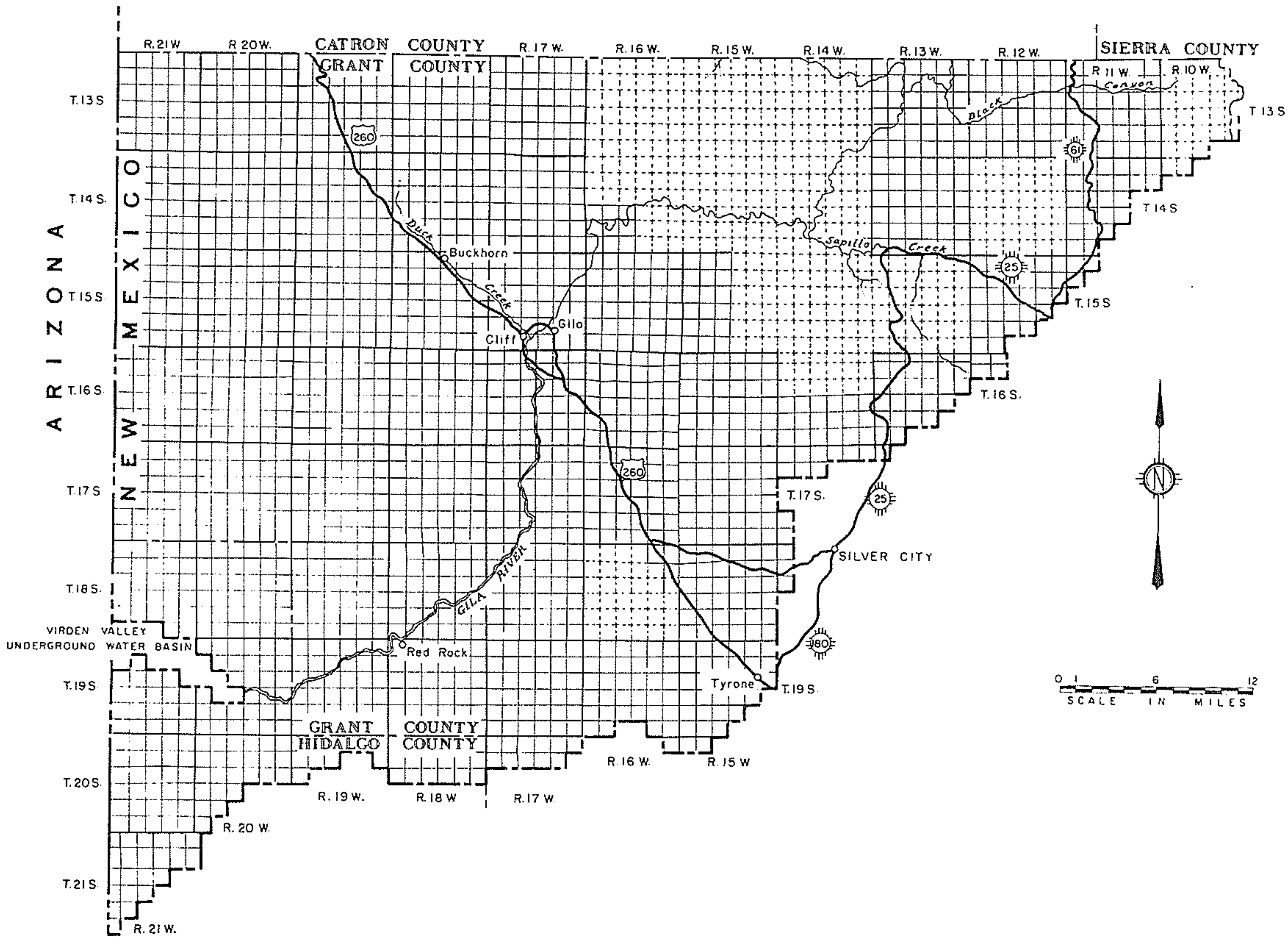


GILA – SAN FRANCISCO UNDERGROUND WATER BASIN

WITHIN GRANT AND HIDALGO COUNTIES

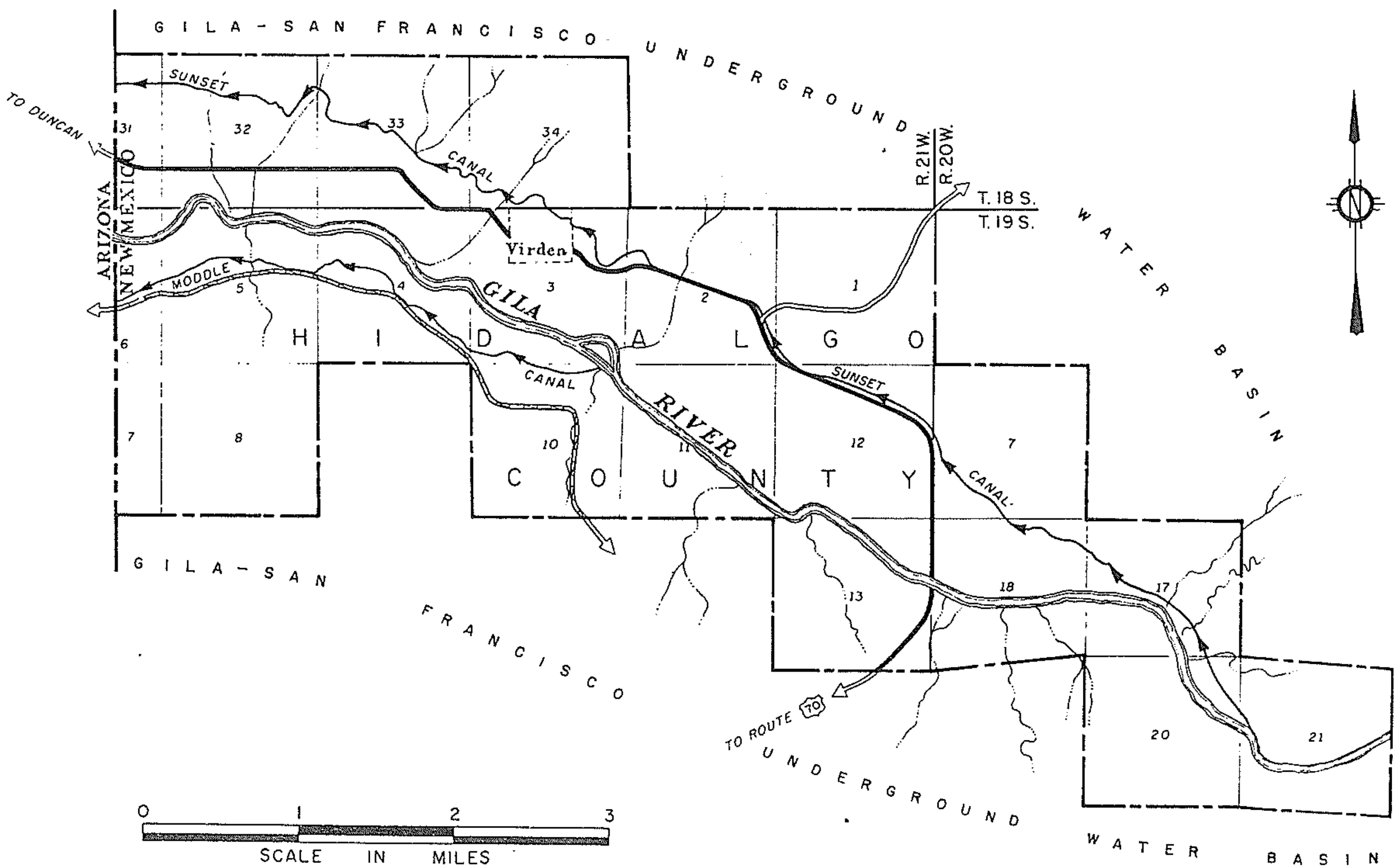
N. MEX. STATE ENGINEER

AUGUST 1966



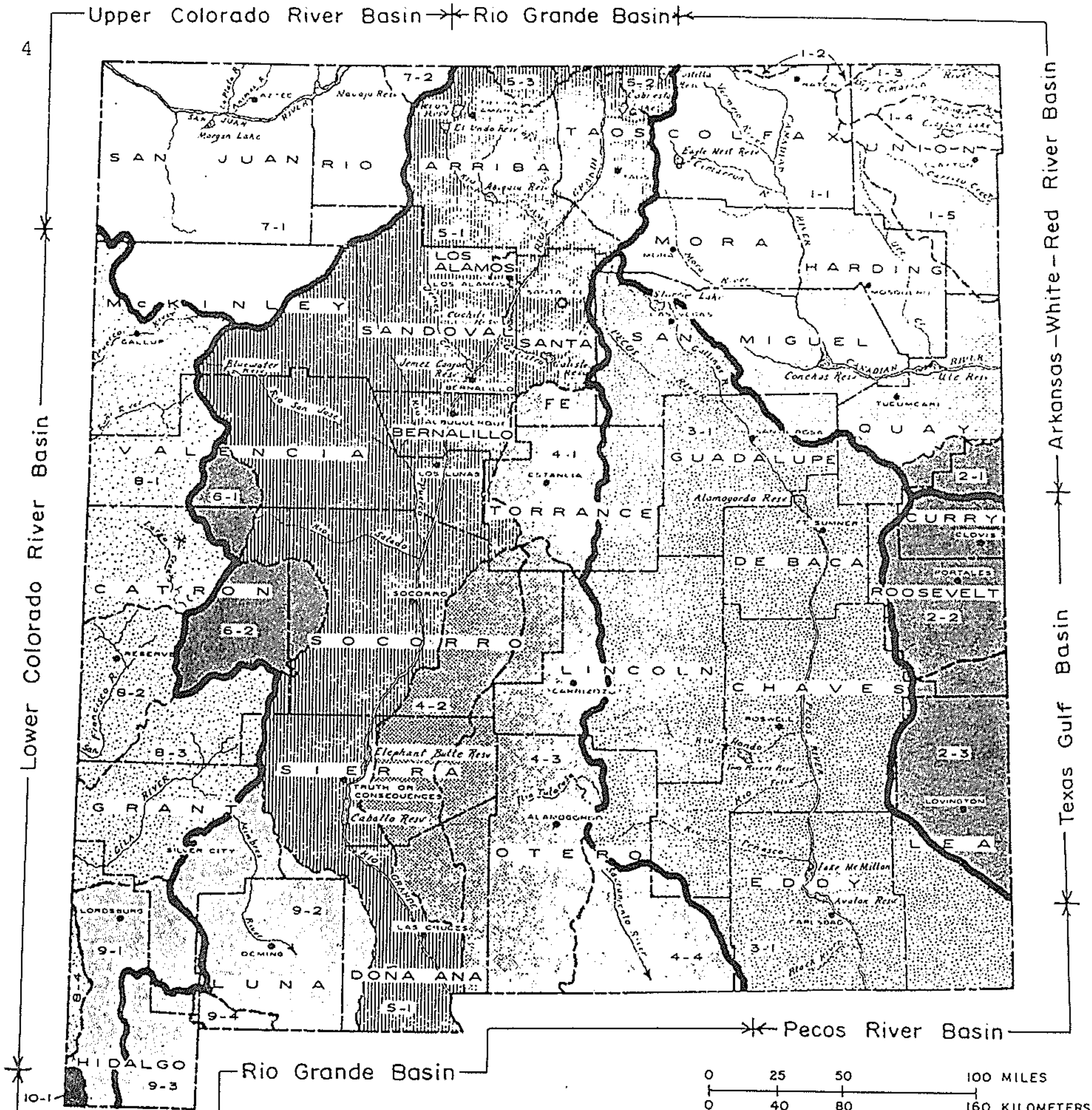
VIRDEN VALLEY UNDERGROUND WATER BASIN

N. MEX. STATE ENGINEER
AUGUST 1966



APPENDIX C

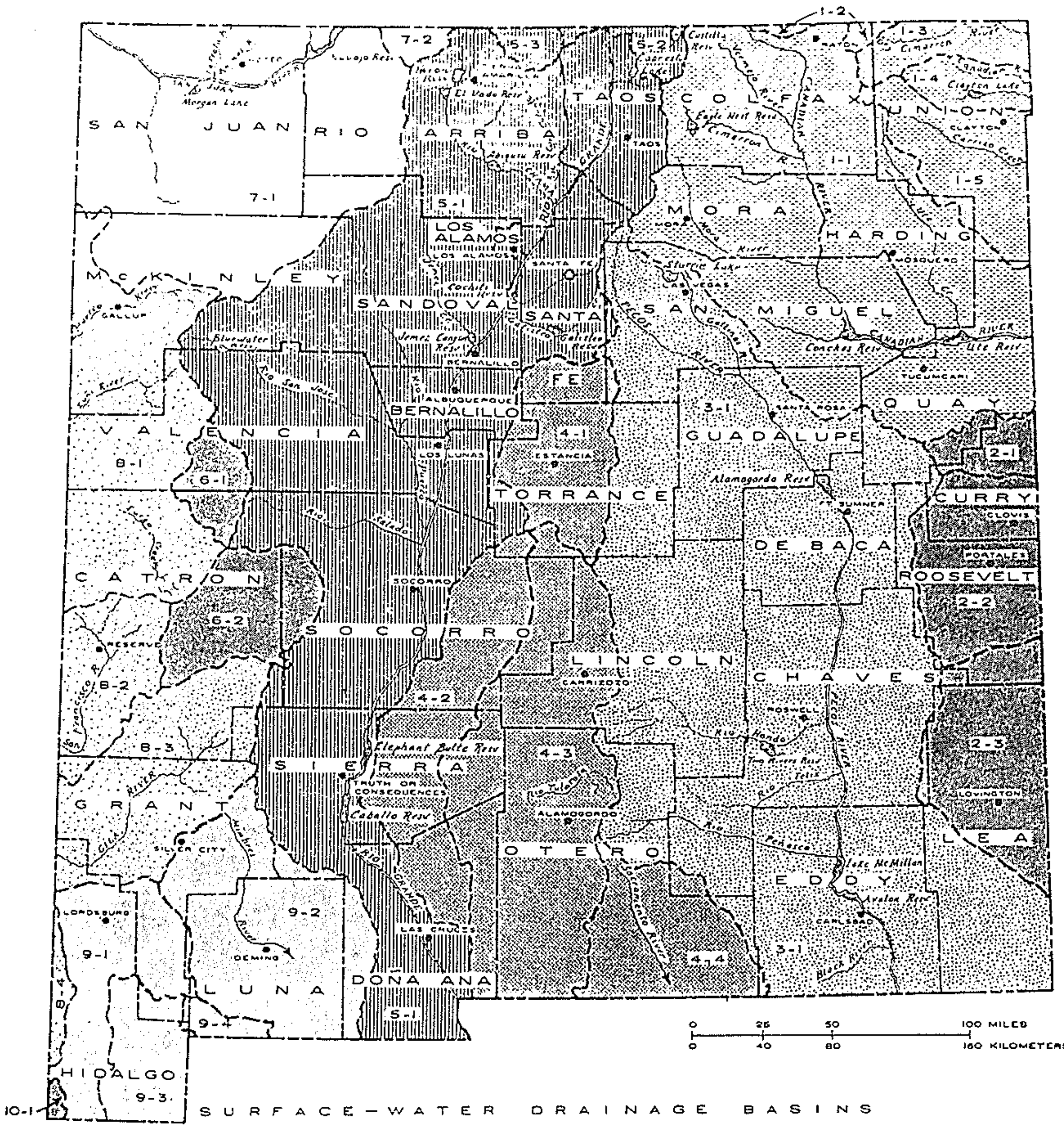
NEW MEXICO STATE ENGINEER RIVER BASIN AND SURFACE DRAINAGE BASIN MAPS



Basin	Area/Sq. Mi.
Arkansas-White-Red River	17,636
Texas Gulf	5,409
Pecos River	25,962
Rio Grande	49,755
Upper Colorado River	9,530
Lower Colorado River	13,338
Rio Yaqui	36
State Total	121,666

FIGURE I — RIVER BASINS IN NEW MEXICO.

REVISED 1981



SURFACE—WATER DRAINAGE BASINS

BASIN	AREAS IN SQ. MILES
ARKANSAS RIVER BASIN	
1-1, CANADIAN RIVER	12,885
1-2, PURGATOIRE RIVER	132
1-3, DRY CIMARRON RIVER	1,000
1-4, NORTH CANADIAN RIVER	736
1-5, CARRIZO CREEK	2,205
TOTAL	16,958
SOUTHERN HIGH PLAINS	
2-1, RED RIVER	678
2-2, BRAZOS RIVER	2,727
2-3, LEA PLATEAU	2,682
TOTAL	6,087
PECOS RIVER BASIN	
3-1, PECOS RIVER TOTAL	25,962

BASIN	AREAS IN SQ. MILES
CENTRAL CLOSED BASINS	
4-1, ESTANCIA BASIN	2,239
4-2, JORNADA DEL MUERTO	3,344
4-3, TULAROSA BASIN	6,749
4-4, SALT BASIN	2,375
TOTAL	14,707
RIO GRANDE BASIN	
5-1, RIO GRANDE	25,731
5-2, COSTILLA CREEK	277
5-3, RIO SAN ANTONIO	287
TOTAL	26,295
WESTERN CLOSED BASINS	
6-1, NORTH PLAINS	697
6-2, SAN AGUSTIN PLAINS	1,989
TOTAL	2,686

BASIN	AREAS IN SQ. MILES
SAN JUAN RIVER BASIN	
7-1, SAN JUAN RIVER	9,276
7-2, NAVAJO RIVER	254
TOTAL	9,530
LOWER COLORADO RIVER BASIN	
8-1, LITTLE COLORADO RIVER	5,325
8-2, SAN FRANCISCO RIVER	1,836
8-3, GILA RIVER	3,549
8-4, SAN SIMON CREEK	240
TOTAL	10,950
SOUTHWESTERN CLOSED BASINS	
9-1, ANIMAS BASIN	2,388
9-2, MIMBRES BASIN	4,387
9-3, PLAYAS BASIN	1,390
9-4, WAMEL BASIN	290
TOTAL	8,455
RIO YAQUI BASIN	
10-1, RIO YAQUI TOTAL	36
STATE TOTAL	121,666

FIGURE 2 — SURFACE-WATER DRAINAGE BASINS IN NEW MEXICO.

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