PROJECTIONS OF WATER AVAILABILITY IN THE AWR AND PECOS RIVER BASINS TO THE YEAR 2005

by
John C. Tysseling
Principal Investigator
Bureau of Business and Economic Research

and

Brian McDonald
Director
Bureau of Business and Economic Research

TECHNICAL COMPLETION REPORT
Project No. 1423609
April 1984

New Mexico Water Resources Research Institute

in cooperation with

Bureau of Business and Economic Research
University of New Mexico

The research on which this report is based was financed in part by the U.S. Department of the Interior as authorized by the Water Research and Development Act of 1978 (P.L. 95-467), and by the State of New Mexico through state appropriations.

Project Numbers: A-055-NMEX, 1423609

DISCLAIMER

The purpose of WRRI technical reports is to provide a timely outlet for research results obtained on projects supported in whole or in part by the institute. Through these reports, we are promoting the free exchange of information and ideas and hope to stimulate thoughtful discussion and action which may lead to resolution of water problems. The WRRI, through peer review of draft reports, attempts to substantiate the accuracy of information contained in its reports, but the views expressed are those of the author(s) and do not necessarily reflect those of the WRRI or its reviewers.

Contents of this publication do not necessarily reflect the views and policies of the U.S. Department of the Interior, nor does mention of trade names or commercial products constitute their endorsement or recommendation for use by the U.S. government.

ABSTRACT

The management of New Mexico water resources requires an understanding of the magnitude of future water scarcity conditions so that planning can be provided which attempts to mitigate social costs associated with competition for available water supplies. Current and projected water supply and demand conditions are analyzed here for the Arkansas, White and Red rivers (AWR) and the Pecos River basins in eastern New Mexico based on 1980 economic, demographic, and water use information.

The combination of 1980 water use data reported by the State Engineer Office and economic and demographic data (provided by several sources) allows calculation of water use coefficients per unit of economic activity and per capita water demand requirements. The analysis is provided for each county served by the water resources of the two basins. Future water scarcity conditions are assessed at both the county and basin-wide level in relation to 1980 water supplies and potential increases in those supplies as identified by the State Engineer Office.

Evident from the analysis is the limited growth and corresponding limited increased water scarcity conditions, which are expected to be found in the AWR Basin by 2005. In contrast, growth in the economy and population of the Pecos River Basin, and particularly the southern portion of that basin, results in significant demand increases in a region that for many years has been experiencing water scarcity conditions. Uncertainties with respect to future water supplies and demand are also identified for these two water basins.

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

TABLE OF CONTENTS
(Continued)

LIST OF TABLES

LIST OF TABLES
(Continued)

LIST OF TABLES
(Continued)

LIST OF TABLES
(Continued)

LIST OF TABLES
(Continued)

LIST OF MAPS

CHAPTER I

INTRODUCTION

For many years there has been concern that the water supplies of the Arkansas, White, and Red rivers Basin (AWR Basin) and the Pecos River Basin will become insufficient to satisfy all water demands within each region and that water scarcity will at some time constrain economic development of these regions in New Mexico. Substantial water law has resulted from attempts to define ownership and property right limitations to the water resources of the AWR and Pecos River basins in New Mexico. Yet, the water resources of these two hydrologic basins are certain to become more scarce and valuable as additional new uses, resulting from increased economic and human water demands, compete for the limited available supplies. Thus, the challenge for the future in water resource management is to derive the maximum social benefit from the use of the limited water resources of the regions. One must not too hastily ascribe economic criteria to the maximization calculus, for many social values, such as community acequias, demand and have been provided protection under the water laws of New Mexico.

Water resource management requires an understanding of the magnitude of water resource scarcity. Water right markets have been shown to function well in allocating water to more economically productive uses in New Mexico. If the problems of water resource scarcity are to be resolved exclusively by market mechanisms, control over the allocative solution is limited. But New Mexico has not limited its attention only to efficiency

of water right transfer concerns, and there has been much public expenditure on research to develop techniques allowing better use of the available water resources. It is the hope that research such as described here will allow more precise identification of critical water scarcity conditions prior to the market expression of this scarcity--that is, prior to the sale and transfer of water rights to higher valued use. Resource managers, who anticipate regional water scarcity issues, will be better able to mitigate competing values such that the public welfare may be better served. As noted, economic values find clear expression in water right markets, but public welfare concerns of noneconomic content (e.g., the preservation of an agrarian community) may limit the extent to which "economic rationality" is allowed to strictly dictate a market solution.

The future water scarcity problems of the AWR and Pecos River basins have been investigated previously from numerous perspectives. The majority of these analyses have focused on the specific availability of groundwater resources, feasibility assessments for various water development projects, and water quality assessments. More recently, there has been substantial concern with the management of the water resources from a basinwide perspective, with the most complete (and only) basin-wide management planning document provided by the 1976 New Mexico Water Resources Assessment for Planning Purposes,[1] and the 1974-1975 County Profile[2] series, which preceded the 1976 summary report. These two series of reports provided the most complete, consistent, and exhaustive analysis of water resource constraints relating to present and projected availability in each of the hydrologic basins in the state. The majority of the data relied upon for these reports are 1965 through 1970 observations. Population projections

were based on 1970 census information, and these analyses served as the first source of water use data reporting provided by the State Engineer Office (SEO).

Available data have improved significantly since this 1975 assessment for planning purposes. Water use reports for 1975 and 1980 have been prepared by the SEO,[3] 1980 census data are now available, and new population projections are available based on the 1980 census data.[4] In each edition of the SEO water use data reports, both the quantity and quality of the information has improved. Likewise, techniques for projection of population and employment also have been improved, and thus it can be concluded that the projections presented herein are based on significantly better information than was available for the 1975 planning assessments.

Additionally, the assessment contained herein attempts to extend the methodology for projection of future water demands, with the projections of water demands provided here based upon predictions of both future population levels and specific economic growth projections. In the past, water demand projections have assigned the majority of differing economic uses of water to the consumption demands of regional populations. If the population of one community derived its principal incomes from a bottling plant, (i.e., high water use), while another community derived its principal incomes from a clothing factory, (i.e., low water use), the differences in city water uses associated with the differing economic activities was reflected in the differing gallon per capita per day (GPCD) requirements associated with the population of each community. Obviously, this aggregation technique masks the impact of changing economic development patterns with respect to present and future water demand requirements. If the communities of New Mexico could be generally asserted to expand

uniformly (in the sense that no economic sector becomes increasingly or decreasingly important with respect to total water use), then no problems arise with the aggregate GPCD method for projecting future water demands. Far more defensible is an assumption that the economy of the state, the economies of individual counties, and individual communities as well, are subject to unique and specific development trends. These trends are normally dependent upon specific resource bases or exogenous economic influences, and future economic changes can frequently be predicted with some accuracy if these specific economic conditions can be identified.

Thus, the method of this analysis attempts to profile the economics of each county within a hydrologic basin in as specific a manner as possible, associate specific county water use data with the economic activities identified, and then project changes in water use demands based on both changing population levels and changing economic activity within each of these counties. All projections of economic output growth assumed constant (real) 1980 dollars, and projections of future output levels ignore value of output increases associated with price level inflation. The methodology will be described in greater detail, and at this point the specific water demand projection method can be summarized as containing six parts: (1) determination of county and county/basin population and economic activities from the available 1980 census data; (2) estimation of the value of output from each of the economic sectors identified in each county; (3) survey reported water use data for each county and basin; (4) derive water use coefficients per dollar unit of output estimated for each economic sector, and water use per capita coefficients such that the 1980 water use reported by the SEO is entirely accounted for

by the output estimates and population levels and their corresponding water use coefficients; (5) adopt assumptions of economic and population growth reflecting average annual changes over the next 25 years for each county included within the analyzed basins; and (6) project economic and population growth with corresponding changes in water use demands.

The accuracy of the projections done in this manner is improved due to the accounting of both changes in population and changes in economic bases of counties. Water use in economic activities is dependent on output, employment, productivity, and technology. All of these factors may be adjusted in projections of water demands based on both economic and population water demands to conform with expectations regarding changes in these variables. Not to lose sight of the objective to which this research is directed--although very specific quantitative projections of changing water demands can be made by this method--it is the magnitude of future water resource demand increases which will be summarized at a county and basin-wide level and compared to corresponding available water supplies. We now turn to a more detailed description of the data and methods used in the projections of future water supply and demand conditions in the AWR and Pecos River basins.

Basin Population and Economic Output Estimates

The 1980 census of population provides significant data with respect to population and employment in subdivisions of counties, with these subdivisions identified as enumeration districts. Based on a matching of enumeration district boundaries to hydrologic basin boundaries, data can

be extracted from the census that defines specific populations and sectoral employment for each county which is wholly or partially included within a hydrologic basin. The identification of economic activity in this fashion must acknowledge that employment data is "residence based"--that is, sectoral employment reported for an enumeration district reflects the place of the employees residence, not the place of work.

An additional caveat to census data based economic analysis is that sectoral definitions do not conform precisely with sectoral definitions upon which other important economic data is based (e.g., New Mexico Employment Security Department employment data, which is "established based"). This inconsistency is not such a severe problem that adjustments must be made, except in acknowledging that there may not be one-to-one correspondence between data sources with respect to economic sector analysis.

Derivation of Output Estimates

The derivation of output estimates for the specific economic sectors of a county and/or basin economy must rely on several different data sources, and are, in part, based upon economic information derived from the census data. The economic sectors upon which this analysis is based are presented in table 1.1. Agricultural outputs for each county may be derived directly from a combination of several New Mexico State University Agricultural Experiment Station Research Reports, including Irrigated Acreage in New Mexico and Estimated Crop Value by County, 1980,[5] Analysis of Differences in Irrigated Crop Values for New Mexico, 1979 to 1980,[6] and Sources of Irrigation Water and Irrigated and Dry Cropland

TABLE 1.1

SUMMARY ECONOMIC AND DEMOGRAPHIC SECTORS
FOR WATER SUPPLY AND DEMAND ANALYSIS AND PROJECTIONS.

Sector Number	Sector Description
1.0	Harvested crops
2.0	Irrigated pasture & all hay
3.0	Livestock
4.0	Forestry and fisheries
5.1	Metal mining
5.2	Coal mining
5.3	Crude petroleum and natural gas extraction
5.4	Nonmetallic mining and quarrying
5.5	Petroleum refining and related industries
6.0	Construction
7.1	Nondurable manufacturing
7.2	Durable manufacturing
8.0	Transportation, communications and utilities
9.1	Wholesale trade
9.2	Retail trade
10.0	Finance, insurance & real estate
11.0	Services
12.0	Government and public administration
	Population
	Urban
	Rural

Acreages in New Mexico, by County, 1977-1982.[7] Also important to the allocation of agricultural output to basin and county areas was the water use data of the SEO, with the summary reporting of this data provided in Water Use by Categories in New Mexico Counties and River Basins, and Irrigated Acreage in 1980.[8]

The agricultural sectors were separated into three categories: harvested crops, irrigated pasture and all hays, and all livestock. The grouping conveys several differences in the agricultural use of water in New Mexico, and most importantly, reflect differences in agricultural markets, water use patterns, and relative values of water in use. The harvested crops sector consists of all crops harvested for grain or silage and includes corn, sorghum, other small grains, cotton, miscellaneous vegetables, and all orchard crops. The irrigated pasture and all hays sector include acreage in pasture, whether planted or native, and all hay production. The sector does not include secondary use of harvested crop areas as temporary pasture, which was considered double counting of agricultural values. The value of pasture was based on regional leased pasture values, while the value of all other crops was derived from regional agricultural market prices and reported quantities delivered to market in 1980. All crop prices and delivered quantities, as well as all livestock values, are those reported in New Mexico Agricultural Statistics, 1982,[9] with livestock inventories allocated to the basin areas based upon SEO water use inventory data.

The value for output from forestry and fisheries in New Mexico counties is based on reported state-wide gross receipts in Standard Industrial Classification (SIC) sector 800, with allocations to the county and county/basin level based on employment data derived from the 1980 census.

The value of output from the metal mining sector is based on reported state-wide value of production provided by Census of Mineral Industries data, with allocation to the county/basin level based on 1980 census employment data. Output values in the coal mining sector are based on several differing data sources, and allocates statewide value of sales data for 1980 to the county/basin level based on relative value data reported in the Keystone Coal Manual, 1980. Reported values of sales for oil and gas production is the source of output data for each county, and allocation to basin level output estimates was based on 1980 census oil and gas employment data. Output data for the nonmetal mining sector is based on total value of production data reported by the State Mine Inspector for 1980, and is allocated to the county/basin level based on employment data reported there, and as reported by the 1980 census. The value of output estimates for the petroleum refining and related industries sector is based on the SIC coded 2900, that is normally reported as a part of manufacturing output, but because of the close relationship between the petroleum extractive sector and the petroleum refining sector, it was decided to treat this as a separate sector. The output estimate for the sector was derived based on the 1977 ratio of county reported value of shipments and gross receipts, and 1980 gross receipts data for the SIC sector, and was allocated to the county/basin level based on Employment Security Department (ESD) employment data.

The value of output in the construction sector was derived directly from reported gross receipts data for each county, and allocated based on county/basin employment reported in the 1980 census data. For both the durable and nondurable manufacturing sectors, a state-wide 1980 output estimate was derived from gross receipts data and Census of Manufacturers

data, with allocations to the county/basin level based on ESD employment data. The value of output for the transportation, communication and utilities (TCU) sector was derived directly from 1980 gross receipts data, and was allocated to county/basin regions based on 1980 census ratios. County level data for the two trade sectors was derived from 1977 Census of Wholesale Trade and 1977 Census of Retail Trade data, combined with 1977 and 1980 gross receipts data for the sector and allocated to county/basin regions based on ESD data. The 1980 value of output for the finance, insurance, and real estate (FIRE) sector relied on county gross receipts data, and was allocated to county/basin regions based on ESD employment data. The 1980 value of output for the service sector is derived from county data reported by the 1977 Census of Service Industries reflecting value of receipts, combined with New Mexico Taxation and Revenue Department gross receipts data for 1977 and 1980, and allocated to the county/-basin level based on ESD employment data.

The remaining two sectors are treated entirely different in the projections of water demands. The water coefficient for the government sector is based on employment levels associated with specific water use. In the tables that report water use projections, employment will be listed as the "output" of the government sector, and similarly, population water use coefficients will be based on aggregate population data depicted as "output" for the population sector.

Water Use Data and Water Use Coefficients

The water use is entirely derived from the SEO reporting of water use provided by Water Use by Categories in New Mexico Counties and River

Basins, and Irrigated Acreage in 1980,[10] and there was some additional reliance on the unpublished SEO data files that supported the SEO water use report. From this reporting of 1980 water use by the SEO data were extracted for specific uses, including urban use, rural use, irrigated agricultural use, livestock use, stockpond evaporation, self-supplied commercial and industrial uses, minerals use, power use, and recreation uses categories. Two additional categories are provided in this SEO data: fish and wildlife and reservoir evaporation, but no productive value could be assessed for these water uses, and the specific levels of use seem unrelated to any projection variable. Thus, the uses were not considered in the projection of water demands, and in like manner, the uses were excluded from the available water supply. The future available supply of water for each county and basin is assumed defined by 1980 appropriations, with all additional supplies available (by development of rights to use waters not appropriated in 1980) assumed to have been identified by the state engineer in his September 1983 memo to the governor's Water Law Study Committee (appendix A). The specific quantities of water supplies available to meet projected demands are presented in conjunction with the county and basin summaries which follow.

The allocation of water use, both withdrawals and depletions, to the specific economic sectors for derivation of water coefficients per unit of output was made with varying degrees of accuracy and precision. With respect to the agricultural and mining sectors, very good data were available upon which specific water use could be assigned to the county/basin areas. Data for water use in mineral production provided for a smiliar degree of accuracy. The remainder of the use categories were problematic, and assignment to specific uses was based on several rather broad assumptions.

The first assumption was that all reported power or recreation water use must be reflected within the total water use of the TCU and services sector, respectively. Table 1.2 reflects the second set of assumptions, which can be generally described as assigning human population withdrawal requirements to the urban and rural populations of each county. The assumed necessary human consumption requirements recognize that water use by urban residents includes many more uses than found in more rural settings, including larger lawns, more pools per capita, etc., as well as a greater awareness on the part of rural residents of water scarcity due to a generally higher cost of providing GPCD water requirements.[11] It must be recognized that the method for derivation of population water requirments used here is the same as the method employed by the SEO in calculating water use requirements. Only these GPCD use factors are here reduced to reflect only the human consumption needs, ignoring the economic use activities which the SEO accounting normally assigns to the water demands of regional populations. The balance of the SEO reported water use was distributed to the economic sectors based on water use coefficients derived for the middle Rio Grande (i.e., Albuquerque) region in The Economic Impact of Alternative Resolutions of Pueblo Indian Water Rights in the Upper Rio Grande Basin.[12] Although the withdrawal coefficients do not reflect the unique water use patterns of each county's economic activities, no alternative set of water use coefficients are available that would provide better data on specific water use activities in New Mexico. The assumption embodied in this technique can be summarized as asserting that relative water use patterns found among sectors in the middle Rio Grande region are the same as relative sectoral water use patterns in the counties that comprise the present analysis. This may or

TABLE 1.2

ASSUMED 1980 URBAN AND RURAL POPULATION WATER REQUIREMENTS.

	Urban GPCD Requirement	Rural GPCD Requirement
Colfax County	100 GPCD	80 GPCD
Mora County	NUP	75
Harding County	NUP	75
Union County	90	55
San Miguel County		
AWR Basin	NUP	30
Pecos River Basin	110	50
Quay County		
AWR Basin	110	65
Pecos River Basin	NUP	45
Guadalupe County		
AWR Basin	NUP	40
Pecos River Basin	NUP	40
Torrance County	NUP	100
De Baca County	NUP	80
Lincoln County	100	50
Chaves County	120	80
Otero County	NUP	40
Eddy County	100	70
Lea County	100	70

GPCD - Gallons Per Capita Per Day (i.e., withdrawals).
NUP - No Urban Population.

may not be accurate, but the analysis is at least able to rely on specific water use coefficients derived for New Mexico industries.

The 1980 water withdrawal and depletion data provided by the SEO and allocated among the sectors as described above, were then divided by the county/basin output estimates for 1980 to provide for the water use coefficients used in the projections of water demand conditions. The projections hypothesized some increases in the efficiency of water use by several of the economic sectors during the period of projection. Although the efficiency improvement assumptions were rather arbitrary, they reflect some conservative expectations of (economic) responses to increasingly scarce water resource availability. In the harvested crop sector it was assumed that economic motivations of increased pumping costs (for groundwater) and increased ditch maintenance costs (for surface water) will result in a total improvement in water use efficiency during the 25-year projection of 5 percent for surface water and 10 percent for groundwater. That is to say, groundwater use (both withdrawals and depletions) in 2005 will be 10 percent less per unit of output than was the case in 1980. For the irrigated pasture and all hay sector, it was assumed that both surface and groundwater use efficiency will improve a total of 5 percent during the 25-year projection period, with the lower level of efficiency improvement for groundwater due to lower crop values per unit of water use, which is assumed to provide lesser motivation for implementing efficiency improvements. No other improvements in the efficiency of use is projected with the exception of urban and rural water use, where it was projected that increasing water prices would induce some consumption response. The

assumed improvement in urban water use efficiency was 10 percent, if 1980 use was greater than 80 GPCD, with improvements in rural water use efficiency assumed to be 5 percent if 1980 use was greater than 60 GPCD.

Growth Rates and Projections

Growth rate projections for the assessment of future water demands were based principally on population, employment, and per capita income projections provided by John Temple and Lynn Wombold in Population, Employment and Income for Counties in New Mexico: Historic Data 1970-1980 and Projections 1980-200.[13] The projections put out by Temple and Wombold are the only population and employment forecasts currently available on a county-basis. Recent economic activities in eastern New Mexico appear somewhat less robust than described by the January 1983 Temple and Wombold analysis; thus, the projections of future water demands provided here may be best described as an upper bound on anticipated future demands.

From the Temple and Wombold reporting of future population, employment and income levels, long-term average annual growth rates were derived for each of the counties included within the present analysis. These growth rates are presented in table 1.3. Population growth projections for each county/basin region were derived directly based on the growth projections of Temple and Wombold. It was further assumed that growth in urban populations of county/basin regions would be twice the level of rural population growth; thus, two-thirds of population increases projected for each county/basin were assigned to urban areas (in county/basin areas with urban populations in 1980), with the remainder of the projected population increases assigned to rural areas.

TABLE 1.3

POPULATION AND EMPLOYMENT GROWTH RATES.
(AVERAGE ANNUAL PERCENTAGE GROWTH)

	Population Growth Rate	Employment Growth Rate	Real Per Capita Income Growth Rate
Colfax County	1.441%	1.373%	1.541%
Mora County	-0.244	-1.637	0.374
Harding County	2.493	2.408	1.212
Union County	1.634	2.286	1.294
San Miguel County	1.122	1.614	1.883
Quay County	1.291	0.724	0.925
Guadalupe County	1.008	0.391	0.948
Torrance County	1.793	2.455	1.701
De Baca County	0.916	1.178	1.562
Lincoln County	0.800	2.280	2.051
Chaves County	1.222	2.583	1.967
Otero County	1.352	2.268	1.530
Eddy County	1.470	2.834	1.604
Lea County	3.581	3.733	1.919
Long-Term National Productivity Growth			1.906

Source: John Temple and Lynn Wombold, Population, Employment and Income for Counties in New Mexico: Historical Data: 1970-1980 and Projections: 1980-2000, Bureau of Business and Economic Research, Albuquerque: University of New Mexico, 1983: and for National Productivity Data, Data Resources, Inc., U.S. Long Term Review, Winter 1983-1984, Lexington, Mass: McGraw-Hill, 1983.

It was assumed that limited agricultural output growth would occur, and that all output increases would be due to improved farm management techniques and production technologies without introduction of new irrigated acreages. The value of harvested crops was assumed to increase a total of 10 percent during the projection period for areas with largely surface water irrigation; and the value of harvested crops was projected to increase a total of 15 percent for those county/basin regions where groundwater use dominates water supplies to this sector. Likewise, for the irrigated pasture and hay sector it was assumed that those areas largely dependent on surface water supplies would experience a total increase in output value of 5 percent during the projection period; for the county/-basin areas with predominant dependence on groundwater supplies, the value of irrigated pasture and hay output would increase a total of 10 percent during the 25-year projection period. A 5 percent increase in the value of livestock sales was assumed for the purposes for projection, with this limited increase primarily the result of an assumed constant carrying capacity for grazing land. The differences in anticipated output growth associated with alternative sources of water supply reflect the differences in costs of water to the users, with the higher costs associated with the pumping of groundwater assumed to provide greater incentive for the implementation of improved agricultural production technologies.

The projections of increased output from the mining sectors also relied upon exogenous assumptions. Growth in output from the metal mining, coal mining, and petroleum refining sectors were based on anticipated national average productivity changes projected by Data Resources, Inc.[14] Growth in the output of the crude petroleum and gas extraction sector was based on projected oil and gas production data provided by the

New Mexico Energy and Minerals Department.[15] Finally, growth in output from the nonmetallic mining and quarrying sector was assumed to increase a total of 5 percent during the 25-year period of projected growth.

Growth in the remaining economic sectors (sector numbers 6.0 through 11.0) was based on the multiplicative product of projected county employment growth rates and real per capita income growth rates as provided by the Temple/Wombold projections. The multiplicative growth factor assumes that employment growth is directly reflected in output increases, and that changes in real per capita income reflect changes in labor productivity only. Thus, the Temple/Wombold projections are used as measures of both increased economic production activity and increased labor productivity. Growth in government employment (i.e., "output") is projected based on Temple/Wombold projections of county employment changes, while the projections of county/basin population growth are based on their county population projections.

Projection of future water use demands based on this methodology are likely to be accurate to the extent that they correctly portray the magnitude of expected demand changes. This methodology also has the added benefit of allowing identification of the specific source of water use demand increases. Due to improved data and accounting for water use in specific economic activities and due to the availability of recently completed economic and demographic projections for New Mexico counties, the projections of water demands in the AWR and Pecos River basins presented in the following represents the best available information regarding increases in water use demands associated with anticipated economic and demographic growth within the basins.

CHAPTER I

ENDNOTES

1 Bureau of Reclamation, New Mexico Water Resources for Planning Purposes. U.S. Department of Interior, in cooperation with the State of New Mexico, 1976, Volumes I-IV.

2 New Mexico Interstate Stream Commission and New Mexico State Engineer Office. County Profile (by County), Water Resources Assessment for Planning Purposes, New Mexico State Engineer, Santa Fe, New Mexico, 1974 and 1975; herein after cited as 1975 County Profile where referenced in the text.

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

4 The primary difference between current Bureau of Business and Economic Research projections and previous series of projections used in water resources planning (i.e., BBR 1968, OBERS 1968, and BEA-BBR 1972) is the use of demographic cohort component model in conjunction with economic projections. Previous projection methods have calculated population totals directly from projections of employment via population: employment ratios or labor force participation rates. The current methodology uses employment projections to derive projections of one component of population change, migration. The other two components of population change, fertility and mortality, are projected independently and combined with migration in a demographic model to project total population. (Lynn Wombold, Demographer, Bureau of Business and Economic Research, June 1984).

5 Tom Clevenger and Paula Carpenter, Irrigated Acreage in New Mexico and Estimated Crop Value by County, 1980, Research Report 498, New Mexico Agricultural Experiment Station, Las Cruces, New Mexico: New Mexico State University, 1983.

6 Tom Clevenger, Paula Carpenter and Morris Southward, Analysis of Difference in Irrigated Crop Values for New Mexico, 1979-1980, Research Report 527, New Mexico Agricultural Experiment Station, Las Cruces, New Mexico: New Mexico State University, 1984.

7 Rober R. Lansford, ET AL., Sources of Irrigation Water and Irrigated and Dry Cropland Acreages in New Mexico, by County, 1977-1982, Research Report 514, New Mexico Agricultural Experiment Station, Las Cruces, New Mexico: New Mexico State University, 1984.

8 Sorensen, op. cit., Technical Report 44.

9 U.S. Department of Agricultural and New Mexico Crop and Live stock Reporting Service, New Mexico Agricultural Statistics, 1982, New Mexico Department of Agriculture, Las Cruces, New Mexico: New Mexico State University, 1983; Note: 1980 data revised in this 1982 report, and there was also direct reliance on 1980 and 1982, Agricultural Statistics Reports when required.

10 Sorensen, loc. cit.

11 Urban and rural water requirements are derived based on GPCD requirements reported in the SEO 1980 Water Use by Categories, (Technical Report 44, see endnote 3 for citation), with reduction in these reported requirements to account for economic activities included in the SEO GPCD requirements. The higher cost of rural water delivery is due to economics of scale in public water utility service, including a greater number of wells per capita.

12 John C. Tysseling and Brian McDonald, The Economic Impact of Alternative Resolutions of Pueblo Indian Water Rights in the Upper Rio Grande Basin, (Forthcoming), New Mexico Water Resources Research Institute, Las Cruces, New Mexico: New Mexico State University.

13 John Temple and Lynn Wombold, Population Employment and Income for Counties in New Mexico: Historic Data 1970-1980 and Projections 1980-2000, Bureau of Business and Economic Research, Albuquerque: Univesity of New Mexico, 1983. Hereinafter cited as Temple and Wombold.

14 Data Resources, Inc., U.S. Long-Term Review, Winter 1983-1984, Lexington, Mass.: McGraw-Hill, Inc., 1983. Table 8.4.

15 Energy and Minerals Department, Annual Resources Report, State of New Mexico. Santa Fe, New Mexico, 1982.

CHAPTER II

AWR BASIN PROFILE

The Arkansas, White, and Red (AWR) rivers are generally considered a single hydrologic basin tributary to the Missouri River Basin. In New Mexico two principal river drainages contribute to the AWR Basin: the Canadian River and the Dry Cimarron River, as is shown in map 2.1. The water resources of the Canadian River Basin in New Mexico are subject to provisions of the Canadian River Compact, ratified by Congress on May 17, 1952, with New Mexico, Texas and Oklahoma as signatory participants in the compact agreement. The principal provision of the compact as its affects New Mexico water resources is that a maximum conservation storage below Cochas Dam of 200,000 acre-feet is allowed. Conservation storage refers to the storage of water during winter and spring months for agricultural releases, typically from the first of October through the end of April.

The other major regulation of the legally available water supplies in the AWR basin is the result of the state engineer's declaration of underground water basins. The two declared basins in the AWR Basin are the Canadian River Underground Water Basin and the Tucumcari Underground Water Basin, with the declaration of the basins providing for control of all new surface and groundwater appropriations such that no existing rights are impaired by the new appropriation.[1] The Canadian River Underground Water Basin includes the majority of Colfax County, all of Mora County, and a portion of San Miguel County. The Tucumcari Underground Water Basin includes only a small geographic area near Tucumcari in Quay County, but encompasses

a significant portion of the water users in that region of the AWR Basin. See the SEO maps of declared underground water in Appendix B.

Economic and Demographic Profile

The total population of the AWR Basin in New Mexico during 1980 was 35,673, with slightly more than 50 percent of this total population considered urban (according to the census definition of places with populations of 2,500 or greater). The fact that 50 percent of the basin's population is urban, reflects how little population is found in the geographically dominant rural areas that comprise the AWR Basin in New Mexico. The largest economic sector in the basin, livestock production, also illustrates the extremely rural character of the region. In 1980, livestock production provided more than $175.1 million of the AWR basin's total estimated $625.7 million econmic output, or nearly 28 percent of the total econmic output of the region (see table 2.1 and 2.2). The next largest economic sector found in the basin is retail trade with a 1980 output of more than $158.4 million.

Colfax and Quay counties, located at either end of the Canadian River in New Mexico, are the two dominant economic areas of the AWR Basin. The combined estimated total output of Colfax County ($203.8 million) and Quay County ($197.4 million), accounted for more than 64 percent of the total output estimate for the AWR Basin in 1980. Union County is the only other county in the AWR Basin with more than $100 million estimated output in 1980. The combined value of outputs

TABLE 2.1

1980 COUNTY/BASIN OUTPUT AND WATER USE
AWR BASIN.

	Total Value Of Output ($1000)	Total Wd	Total Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp
Colfax County	203,821.3	57,244.0	36,731.0	56,458.0	36,188.0	786.0	543.0
Mora County	27,984.4	44,040.0	20,691.0	43,378.0	20,268.0	662.0	423.0
Harding County	27,992.3	3,727.0	3,299.0	1,910.0	1,910.0	1,817.0	1,389.0
San Miguel County	20,397.9	10,004.0	5,096.0	9,723.0	4,853.0	281.0	243.0
Guadalupe County	4,078.4	102.0	99.0	36.0	36.0	66.0	63.0
Quay County	197,436.2	91,058.0	40,496.0	77,000.0	31,760.0	14,058.0	8,736.0
Union County	144,013.4	106,418.0	67,092.0	12,642.0	7,932.0	93,776.0	59,160.0
AWR Basin Total	625,723.9	312,593.0	173,504.0	201,147.0	102,947.0	111,446.0	70,557.0

Dp Depletions in acre-feet.
Wd Withdrawals in acre-feet.

TABLE 2.2

1980 SECTORAL OUTPUTS AND WATER USE
AWR BASIN.

Sector Number	Sector Description	Total Value Of Output ($1000)	Total Wd	Total Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp
1.0	Harvested crops	15,603.4	113,802.4	61,785.8	39,704.0	15,102.2	74,098.4	46,683.6
2.0	Irrigated pasture & all hay	14,062.5	177,657.6	93,814.2	146,306.0	73,907.8	31,351.6	19,906.4
3.0	Livestock	175,137.4	14,937.0	14,928.0	12,854.0	12,854.0	2,083.0	2,074.0
5.2	Coal mining	20,331.9	312.8	113.4	312.8	113.4	0.0	0.0
5.3	Crude petroleum & nat. gas extract.	226.1	3.0	1.0	0.0	0.0	3.0	1.0
5.4	Non-metallic mining & quarrying	224.5	38.0	7.2	0.0	0.0	38.0	7.2
6.0	Construction	53,145.3	490.3	251.4	145.6	65.5	344.7	185.9
7.0	Manufacturing	30,132.1	101.6	50.6	39.2	17.7	62.4	32.9
8.0	Transportation, comm. & utilities	30,271.7	367.1	243.9	157.8	154.1	209.3	89.8
9.1	Wholesale trade	88,480.0	242.1	122.0	35.8	16.1	206.3	105.9
9.2	Retail trade	158,410.0	428.8	210.9	175.6	79.0	253.2	131.9
10.0	Finance, insurance & real estate	9,956.7	50.2	22.6	44.2	19.9	6.0	2.7
11.0	Services	29,742.3	447.4	233.2	73.4	33.4	374.0	199.8
12.0	Govenrment & public admin.	2,804 [1]	286.4	165.1	40.8	18.4	245.6	146.7
	Population	35,673 [2]	3,427.5	1,554.5	1,257.6	565.9	2,169.9	988.6
	Urban	17,958 [2]	2,054.1	924.1	921.3	414.6	1,132.8	509.5
	Rural	17,715 [2]	1,373.4	630.4	336.3	151.3	1,037.1	479.1
	TOTALS	625,723.9 [3]	312,592.0	173,503.8	201,146.8	102,947.4	111,445.4	70,556.4

Dp Depletions in acre-feet.
Wd Withdrawals in acre-feet.
1 Note: government sector employment is used as output surrogate in projections.
2 Pecos River Basin population, not output data.
3 Total output value (excludes government and population values).

from Mora, Harding, San Miguel and Guadalupe counties in the AWR Basin contributed less than 13 percent of the total estimated output in 1980 for the basin region.

Water Use Profile

During 1980, the SEO reports water use for the AWR Basin in New Mexico to have been 312,593 acre-feet of water withdrawn, with a corresponding 173,504 acre-feet of depletions. Of the total withdrawals, 201,147 acre-feet were from surface water sources (more than 64 percent of total withdrawals), and 11,446 acre-feet were from groundwater sources of supply. These 1980 water uses shall be used to define the available water supplies of the AWR Basin in New Mexico, with the addition of water supplies described as available for appropriation by the September 1983 memo from the state engineer to the governor's Water Law Study Committee (Appendix A). The additional water supplies are found in Quay and Union counties and amount to an estimated maximum 38,800 acre-feet per year.

Nearly 99 percent of the surface water withdrawals were for agricultural purposes, while more than 96 percent of the groundwater withdrawals served agricultural water demands. See table 2.3 for summary of 1980 agricultural water uses in the AWR Basin. Total depletions in 1980 for the AWR Basin were 173,504 acre-feet, with just less than 60 percent of these depletion demands served by surface water sources of supply. Of the 102,947 acre-feet of surface water depletions in 1980, nearly 99 percent of these surface water depletions were in agricultural production activities. There were

TABLE 2.3

1980 IRRIGATED AGRICULTURE WATER USE
ARKANSAS-WHITE-RED RIVERS BASIN.

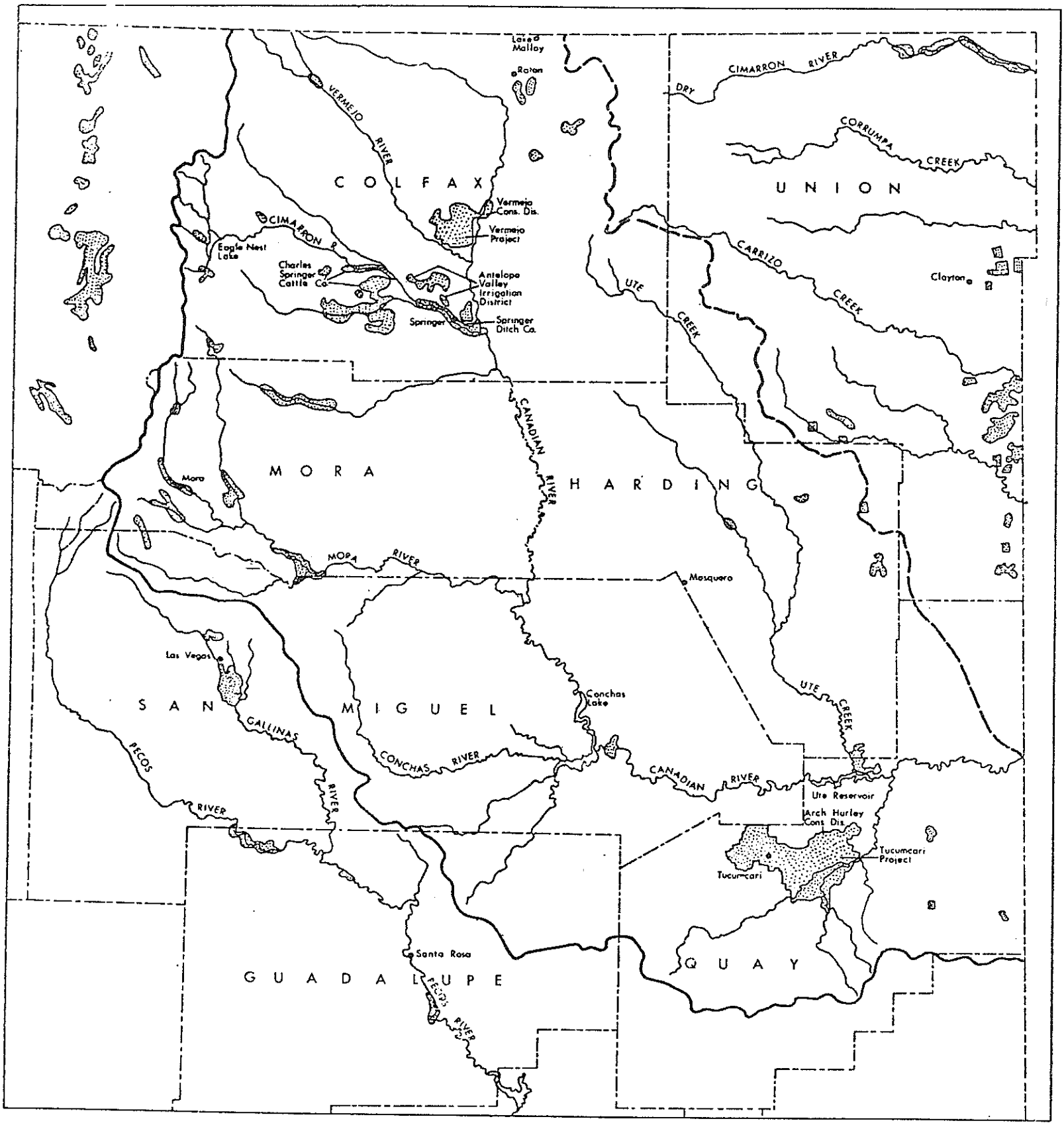
			Surface Water Source Of Supply Only				Groundwater Source of Supply Only				Combine (surface & groundwater) Source of Supply						Pecos River Basin Totals		
	Total Irrigable Acres	Total Irrigated Acres	Total Irrigable Acres	Total Irrigated Acres	Surface Wd	Surface Dp	Total Irrigable Acres	Total Irrigated Acres	Ground Wd	Ground Dp	Total Irrigable Acres	Total Irrigated Acres	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Total Surface Wd	Total Surface Dp	Total Ground Wd
Colfax County	33,200	23,580	33,200	23,580	51,680	32,610	0	0	0	0	0	0	0	0	0	0	51,680	32,610	0
Vermejo Consrv. Dist.	5,800	4,070	5,800	4,070	7,290	3,310	0	0	0	0	0	0	0	0	0	0	7,290	3,310	0
Scattered	27,400	19,510	27,400	19,510	44,390	29,300	0	0	0	0	0	0	0	0	0	0	44,390	29,300	0
(near Springer)	(17,400)	(12,380)																	
(near Maxwell)	(10,000)	(7,130)																	
Mora County-(scattered)	15,460	13,760	15,460	13,760	42,660	19,550	0	0	0	0	0	0	0	0	0	0	42,660	19,550	0
Harding County-(scattered)	4,670	570	0	0	0	0	4,670	570	1,390	1,040	0	0	0	0	0	0	0	0	1,390
San Miguel County	3,120	2,800	3,120	2,800	9,180	4,310	0	0	0	0	0	0	0	0	0	0	9,180	4,310	0
Bell Ranch	1,000	900	1,000	900	3,330	1,630	0	0	0	0	0	0	0	0	0	0	3,330	1,630	0
Sabinosa	165	145	165	145	580	270	0	0	0	0	0	0	0	0	0	0	580	270	0
Sapello Creek	1,955	1,755	1,955	1,755	5,270	2,410	0	0	0	0	0	0	0	0	0	0	5,270	2,410	0
Quay County	47,490	38,060	40,550	32,870	72,750	27,510	6,940	5,190	11,680	7,360	0	0	0	0	0	0	72,750	27,510	11,680
Arch Hurley Conservancy Dist.	40,550	32,870	40,550	32,870	72,750	27,510	0	0	0	0	0	0	0	0	0	0	72,750	27,510	0
Scattered	6,940	5,190	0	0	0	0	6,940	5,190	11,680	7,360	0	0	0	0	0	0	0	0	11,680
Union County	57,700	52,720	8,310	4,370	9,170	4,640	49,000	47,970	91,830	57,840	390	380	570	390	550	350	9,740	5,030	92,380
Clayton & Vicinity	47,890	46,890	0	0	0	0	47,890	46,890	89,090	56,120	0	0	0	0	0	0	0	0	89,090
Tramperos Creek	850	800	770	720	1,440	720	80	80	240	150	0	0	0	0	0	0	1,440	720	240
Dry Cimarron	8,040	4,200	7,040	3,220	6,440	3,380	610	600	1,750	1,100	390	380	570	390	550	350	7,010	3,770	2,300
Scattered	920	830	500	430	1,290	540	420	400	750	470	0	0	0	0	0	0	1,290	540	750
Total AWR Rivers Basin	161,640	131,490	100,640	77,380	185,440	88,620	60,610	53,730	102,160	66,240	390	380	570	390	550	350	186,010	89,010	105,450

Wd Withdrawals in acre-feet.
Dp Depletions in acre-feet.
Source: Earl F. Sorensen, Water Use by Categories in New Mexico Counties and River Basins, and Irrigated Acreage in 1980, Technical report 44, Santa Fe: New Mexico State Engineer, 1982; also the detail files which support this technical report.

70,557 acre-feet of groundwater depletions in the AWR Basin during 1980, and more than 97 percent of these groundwater depletions were in agricultural production.

The greatest water use in the AWR Basin during 1980 was in Union County, which was served predominantly by groundwater supplies. As can be seen in table 2.1, Quay and Colfax counties had the second and third highest water use in the AWR Basin during 1980. The largest surface water use can be observed in Quay County, largely the product of extensive irrigation development by Arch Hurley Conservancy District and the Bureau of Reclamation's Tucumcari Project. More than 85 percent of the surface water use in the AWR Basin during 1980 occurred in Quay, Colfax, and Mora counties. Almost all groundwater use in the AWR Basin was in Quay and Union counties during 1980, with more than 96 percent of total groundwater use in the basin region provided by groundwater in these two counties.

The majority of the AWR Basin in New Mexico can be characterized as rangeland, with a limited population composed of nearly equal urban and rural constituants. Economic activity is dominated by agriculture and retail trade, with the bulk of this economic activity found in Colfax, Quay and Union counties. Water use patterns in 1980 can be summarized as having strong agricultural servitude, with approximately two-thirds of the water supplies derived from surface water sources. Quay, Colfax and Mora counties dominated surface water use, while Union and Quay counties dominated groundwater uses.



ARKANSAS, WHITE, & RED RIVERS BASIN
In New Mexico

CHAPTER II

ENDNOTES

1 This is a very simplistic statement with respect to the protections provided existing appropriators and rights of new appropriators under New Mexico water law. The discussion of water supply and demand conditions in the surface water drainage basins contained herein assumes all SEO reported surface and groundwater appropriations existing in 1980 possessed valid water right entitlements and rights which would persist in legal validity and physical availability through 2005. The availability of water in many of the declared underground water basins of the AWR and Pecos River Basins is declining; that is, a groundwater mining situation exists where aquifer depletions exceeds recharge. The declaration of an underground water basin by the state engineer generally suggest that additional, unregulated appropriations from the groundwater supplies are likely to impair existing rights. Where a groundwater mining circumstance exists, there is a presumption that at some future time even existing rights may be diminished by aquifer depletions. Thus, the analysis of water supply conditions is naive to the extent that available supplies are diminished by groundwater mining, and therefore conservative in estimation of the magnitude of future water scarcity conditions.

CHAPTER III

PECOS RIVER BASIN PROFILE

For many years the water supplies of the Pecos River Basin have been fully appropriated and subject to extensive regulation of flows and water right entitlements.[1] Most demographic and economic characteristics of the Pecos River Basin in New Mexico reflect the importance of the water supplies provided by the river, with nearly all population and economic development centered geographically around the mainstem of the river and its major tributaries. As surface water supplies have become increasingly scarce in the Pecos River Basin, there has been groundwater development in the alluvium of the river. Many of the future problems faced by appropriators of the Pecos River are related to the hydrologic interdependence of the surface and groundwater supplies of the stream system.

The irrigation history of the region dates to the first Spanish explorers in the sixteenth century. The Pecos River Compact was first agreed to in 1924, but was not ratified until June 9, 1949. The compact provides for the apportionment of flows between Texas and New Mexico, limits the construction of additional storage reservoirs, and provides for means of resolving conflicts over provisions of the compact. Unfortunately, it is the later of these characteristics that has proved to be most significant to the administration of compact provisions. On June 26, 1974, the state of Texas filed a complaint with the U.S. Supreme Court asserting that over the years extending from 1950 to 1972 New Mexico had failed to comply with the provisions of compact delivery obligations. The litigation continues

today, and, in the 10 years since the suit was filed, the litigants have disposed of all procedural and factual questions, save the determination of the under-deliveries, if any, which New Mexico owes Texas under the compact provisions. The litigation could substantially impact existing rights within the Pecos River Basin, although there is no attempt herein to estimate the impacts of alternative resolutions of Texas' claims.

Economic and Demographic Profile

In 1980 there were 147,272 people residing within the boundaries of the Pecos River Basin in New Mexico. The urban population of this region was 100,733. More than two-thirds of the Pecos River Basin's population was located in towns with more than 2,500 inhabitants. The largest urban area within the region is Roswell, with a 1980 population of 39,676; other significant urban areas include Las Vegas in the northern part of the basin, Ruidoso and Ruidoso Downs in the western portion of the basin, and Carlsbad in the southern portion of the Pecos River Basin (map 3.1). Total economic output for the Pecos River Basin in New Mexico is estimated to be more than $5 billion in 1980, as is shown in table 3.1 and 3.2

The economy of the Pecos River Basin is highly dependent upon several economic sectors, but sector dependencies are not consistent throughout the basin and are determined by specific natural resource bases found in differing regions of the basin. Approximately $2.1 billion of the basin's total estimated output in 1980 was provided by

TABLE 3.1

1980 COUNTY/BASIN OUTPUT AND WATER USE
PECOS RIVER BASIN.

	Total Value Of Output ($1000)	Total Wd	Total Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp
San Miguel County	138,459.0	22,715.0	10,893.0	21,439.0	10,118.0	1,276.0	775.0
Guadalupe County	70,924.7	17,599.0	9,433.0	15,238.0	8,008.0	2,361.0	1,425.0
Quay County	5,924.1	13,939.0	9,314.0	1,368.0	1,368.0	12,571.0	7,946.0
Torrance County	4,355.9	666.0	652.0	588.0	588.0	78.0	64.0
De Baca County	36,649.3	56,616.0	23,827.0	42,748.0	15,038.0	13,868.0	8,789.0
Roosevelt County	1,129.0	2,032.0	1,601.0	119.0	119.0	1,913.0	1,482.0
Lincoln County	161,797.4	24,981.0	11,729.0	16,509.0	7,349.0	8,472.0	4,380.0
Chaves County	1,111,319.5	308,971.0	219,925.0	36,595.0	24,085.0	272,376.0	195,840.0
Otero County	16,291.5	6,951.0	3,271.0	5,582.0	2,541.0	1,369.0	730.0
Eddy County	1,983,511.8	256,651.0	164,220.0	97,153.0	56,713.0	159,498.0	107,507.0
Lea County	1,474,353.9	25,248.0	6,671.0	358.0	358.0	24,890.0	6,313.0
Pecos River Basin Total	5,004,716.1	736,369.0	461,536.0	237,697.0	126,285.0	498,672.0	335,251.0

Dp Depletions in acre-feet.
Wd Withdrawals in acre-feet.

TABLE 3.2

1980 SECTORAL OUTPUTS AND WATER USE
PECOS RIVER BASIN.

Sector Number	Sector Description	Total Value Of Output ($1000)	Total Wd	Total Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp
1.0	Harvested crops	29,635.8	156,055.1	103,285.2	44,998.5	23,593.9	111,056.6	79,691.3
2.0	Irrigated pasture & all hay	46,524.0	489,754.9	313,704.8	178,361.5	90,056.1	311,393.4	223,648.7
3.0	Livestock	245,069.0	13,837.6	13,785.0	10,803.0	10,803.0	3,034.6	2,982.0
4.0	Forestry & fisheries	52.1	0.2	0.1	0.0	0.0	0.2	0.1
5.1	Metal mining	675.6	0.0	0.0	0.0	0.0	0.0	0.0
5.3	Crude petroleum & nat. gas extract.	2,105,621.3	18,094.0	220.0	0.0	0.0	18,094.0	220.0
5.4	Non-metallic mining & quarrying	252,103.1	16,563.0	8,652.0	0.0	0.0	16,563.0	8,652.0
5.5	Petroleum refining & related ind.	191,055.9	2,793.0	2,322.0	0.0	0.0	2,793.0	2,322.0
6.0	Construction	223,938.2	2,888.1	1,481.7	243.6	116.3	2,644.5	1,365.4
7.0	Manufacturing	429,261.2	2,099.1	1,065.0	22.9	10.4	2,076.2	1,054.6
8.0	Transportation, comm. & utilities	232,318.4	4,952.3	2,515.9	578.9	469.5	4,373.4	2,046.4
9.1	Wholesale trade	370,808.5	1,323.1	673.2	58.0	26.2	1,265.1	647.0
9.2	Retail trade	653,227.2	2,475.4	1,243.6	172.1	77.4	2,303.3	1,166.2
10.0	Finance, insurance & real estate	17,496.7	151.4	73.8	17.1	7.8	134.3	66.0
11.0	Services	206,929.1	2,863.7	1,457.9	224.3	127.3	2,639.4	1,330.6
12.0	Government & public admin.	11,434.0[1]	1,727.5	872.1	359.9	162.1	1,367.6	710.0
	Population	147,272[2]	20,790.1	10,183.4	1,856.5	835.0	18,933.6	9,348.4
	Urban	100,733[2]	16,342.5	8,027.0	1,822.4	819.8	14,520.1	7,207.2
	Rural	46,539[2]	4,447.6	2,156.4	34.1	15.2	4,413.5	2,141.2
		5,004,716.1[3]	736,368.5	461,535.7	237,696.3	126,285.0	498,672.2	335,250.7

Dp Depletions in acre-feet.
Wd Withdrawals in acre-feet.
1 Note: government sector employment is used as output surrogate in projections
2 Pecos River Basin population, not output data.
3 Total output value (excludes government and population values).

oil and gas extraction, accounting for more than 42 percent of the total output. The vast majority of oil and gas production is provided by the Permian Basin wells found in Eddy and Lea counties. Combined retail and wholesale trade activities within the basin amounted to more than $1 billion during 1980, with the combined outputs of oil and gas production and the trade sectors providing nearly 63 percent of the total output of the Pecos River Basin in 1980. Although the value of agricultural production in the Pecos Basin during 1980 was more than $321.2 million, it represented less than 7 percent of the basin's economic output. However, this belies the fact that some regions of the basin have an entirely agricultural--principally livestock production--economic base upon which other economic sectors rely. It must also be noted that livestock production represented more than 76 percent of the total value of agricultural production in the Pecos Basin during 1980, and that manufacturing output in the region in 1980 was more than $100 million greater than output from the agricultural sectors. Thus, it can be concluded that the importance of agriculture in the region is limited from an economic standpoint, but has served as the cultural basis upon which most nonmining economic activities have developed.

Water Use Profile

The water resource constraints imposed by the limited surface and groundwater supplies of the Pecos River Basin have long been a public concern. The Lea County Underground Water Basin was first

declared by the state engineer on August 21, 1931. In that same year the Roswell Underground Water Basin was first declared, and this basin has been extended nine separate times since its original declaration. In total, nine separate underground water basins have been declared by the state engineer in the Pecos River Basin, with the SEO maps for each of these basins (as they exist today) provided in appendix B. In addition to the declaration of underground water basins in the Pecos Basin, there has been significant water law developed as a result of water scarcity circumstances found in the basin.

The most significant of these cases that has developed from the decreasing availability of water in the basin is Templeton v. Pecos Valley Artesian Conservancy District (65 N.M. 59, 332 P. 2d 465 (1958)), which can be generally said to provide a senior appropriator the right to transfer a surface water right to a groundwater appropriation within the valley fill of the Pecos River. The significance of the case lies in the relationship between surface and groundwater appropriations in a stream connected aquifer. Surface water appropriators are protected from junior groundwater appropriators, with this protection allowing senior surface water appropriators to "chase" surface waters to their underground sources of supply. The declaration of underground water basins in the Pecos River Basin protects existing users and provides the SEO significant authority for the administration of water resources with the basins.[2]

Total water withdrawals for 1980 in the Pecos River Basin amounted to 736,369 acre-feet, and total depletions were 461,536

acre-feet, as can be seen in tables 3.1 and 3.2. Groundwater withdrawals in 1980 were 498,672 acre-feet, nearly 68 percent of all withdrawals. Groundwater depletions in 1980 were 335,251 acre-feet, or nearly 73 percent of all depletions in the Pecos River Basin during that year. The importance of the agricultural sector in Pecos River water use data is dramatic in light of the agricultural output information previously reported. In 1980 nearly 90 percent of all withdrawals were for agricultural uses, while more than 93 percent of all water depletions reported by the SEO in 1980 were for agricultural uses. Agricultural water use in the Pecos River Basin during 1980 is summarized in table 3.3. More than 98 percent of the surface water used in the Pecos River Basin was for agricultural activities. Chaves and Eddy counties, with large irrigated areas, accounted for the largest total water use among the counties which comprise the Pecos Basin in New Mexico, with the groundwater use in Chaves County alone providing for more than 50 percent of the groundwater use within the Pecos River Basin.

Water resources of the Pecos River Basin can be summarized as subject to significant administrative, hydrologic, and historic (i.e., senior agricultural rights) use constraints. The complexity of the stream-related aquifer system provides for substantial disputes relative to priorities, impairment, and assurance of available supplies. The dominant agricultural water uses provide only a fraction of the total economic output of the Pecos Basin in New Mexico, yet it is the influence of the agricultural sector which will mandate future water scarcity conditions throughout the basin. The conflict

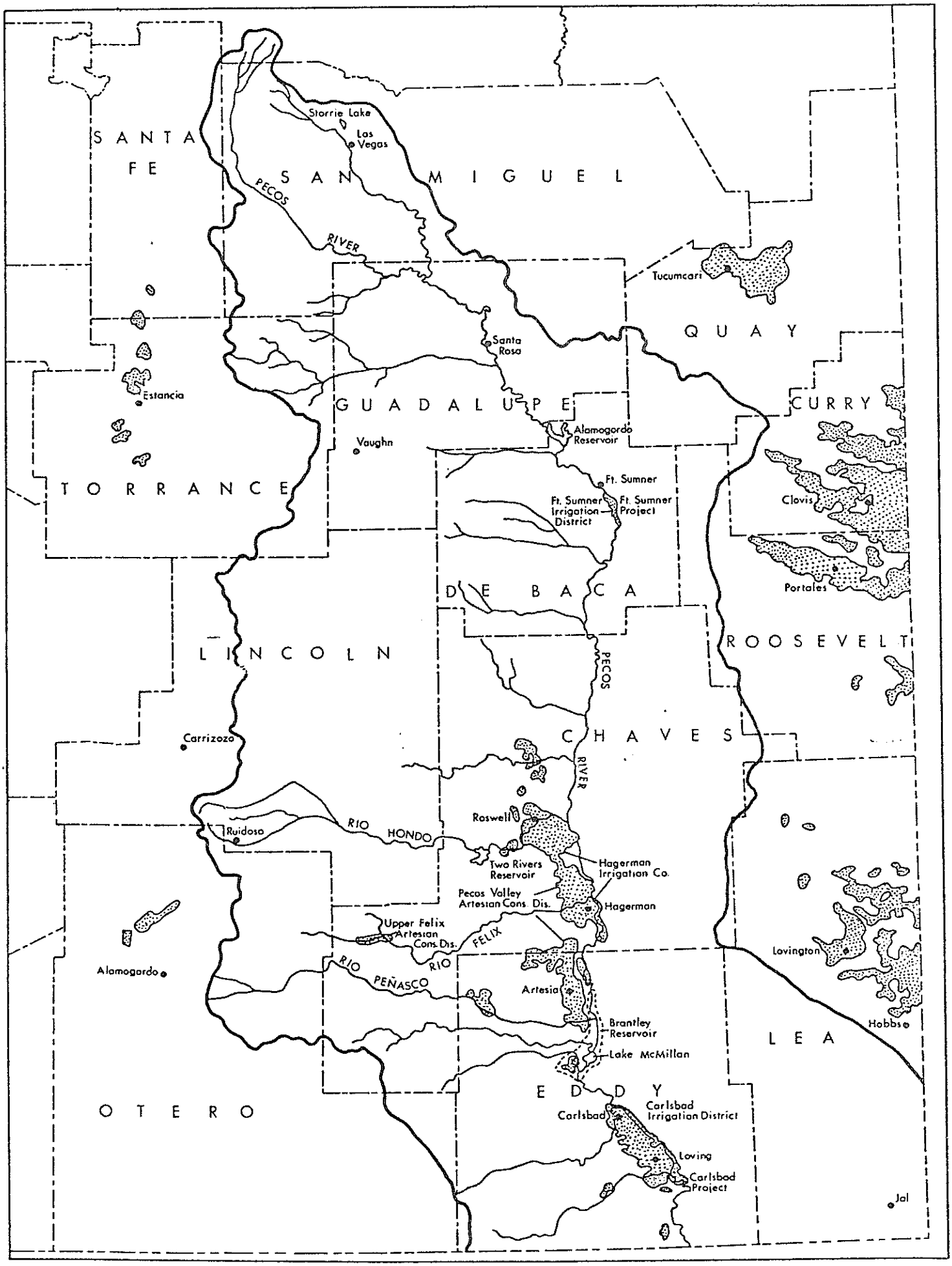
TABLE 3.3

1980 IRRIGATED AGRICULTURE WATER USE
PECOS RIVER BASIN.

			Surface Water Source Of Supply Only				Groundwater Source of Supply Only				Combine (source & groundwater) Source of Supply						Pecos River Basin Totals			
	Total Irrigable Acres	Total Irrigated Acres	Total Irrigable Acres	Total Irrigated Acres	Surface Wd	Surface Dp	Total Irrigable Acres	Total Irrigated Acres	Ground Wd	Ground Dp	Total Irrigable	Total Irrigated	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Total Surface Wd	Total Surface Dp	Total Ground Wd	To Gr
an Miguel County	10,400	7,770	10,250	7,620	18,220	8,370	150	150	440	250	0	0	0	0	0	0	18,220	8,370	440	
orrie Project	6,520	4,350	6,520	4,350	6,870	3,000	0	0	0	0	0	0	0	0	0	0	6,870	3,000	0	
ecos River Mainstem	2,530	2,220	2,380	2,070	7,750	3,700	150	150	440	250	0	0	0	0	0	0	7,750	3,700	440	
allinas River & Other Trib.	1,350	1,200	1,350	1,200	3,600	1,670	0	0	0	0	0	0	0	0	0	0	3,600	1,670	0	
uadalupe County	4,180	3,480	3,730	3,130	14,240	7,010	450	350	1,200	690	0	0	0	0	0	0	14,240	7,010	1,200	
ecos M. Stem Above Puerto de Luna	3,070	2,530	3,070	2,530	11,510	5,666	0	0	0	0	0	0	0	0	0	0	11,510	5,666	0	
uerto de Luna	660	600	660	600	2,730	1,344	0	0	0	0	0	0	0	0	0	0	2,730	1,344	0	
olinas & Alr. Santa Rosa	450	350	0	0	0	0	450	350	1,200	690	0	0	0	0	0	0	0	0	1,200	
uay County (scattered)	7,500	5,560	0	0	0	0	7,500	5,560	12,510	7,890	0	0	0	0	0	0	0	0	12,510	7,
e Baca County	13,220	10,480	6,140	6,060	41,990	14,280	7,080	4,420	13,260	8,360	0	0	0	0	0	0	41,990	14,280	13,260	8
ort Sumner Project	6,140	6,060	6,140	6,060	41,990	14,280	0	0	0	0	0	0	0	0	0	0	41,990	14,280	0	
cattered	7,080	4,420	0	0	0	0	7,080	4,420	13,260	8,360	0	0	0	0	0	0	0	0	13,260	8
oosevelt County (scattered)	1,530	1,130	0	0	0	0	1,530	1,130	1,880	1,460	0	0	0	0	0	0	0	0	1,880	1
Incoln County	5,350	4,870	2,150	1,850	8,520	3,400	1,060	1,060	3,390	1,830	2,140	1,960	6,300	2,490	1,900	980	14,820	5,890	5,290	2
to Hondo Valley	4,910	4,470	1,950	1,690	7,780	3,140	820	820	2,620	1,460	2,140	1,960	6,300	2,490	1,900	980	14,080	5,630	4,520	2
Rio Bonito)	(1,300)	(1,200)																		
Rio Hondo)	(1,440)	(1,330)																		
Rio Ruidoso)	(2,170)	(1,940)																		
cattered	440	400	200	160	740	260	240	240	770	370	0	0	0	0	0	0	740	260	770	
haves County	98,720	92,580	3,190	2,840	10,640	6,340	80,170	75,340	230,530	169,250	14,360	14,400	22,440	14,230	25,260	18,270	33,080	20,570	255,790	187
oswell-Artesia Area	95,390	89,640	2,080	1,960	6,860	4,750	80,060	75,230	230,200	169,040	13,250	12,450	17,430	12,070	22,860	16,790	24,290	16,820	253,060	185
to Hondo	1,050	840	1,050	840	3,610	1,520	0	0	0	0	0	0	0	0	0	0	3,610	1,520	0	
to Penasco	1,440	1,300	60	40	170	70	60	60	150	90	1,320	1,200	4,130	1,590	610	360	4,300	1,660	760	
cattered	840	800	0	0	0	0	50	50	180	120	790	750	880	570	1,790	1,120	880	570	1,970	1
oro County-(Rio Penasco Valley)	2,200	1,700	1,720	1,300	5,200	2,160	480	400	1,130	590	0	0	0	0	0	0	5,200	2,160	1,130	5
dy County	76,440	61,130	15,180	8,400	38,410	22,270	36,240	33,050	102,280	74,540	25,020	19,680	57,400	33,100	26,320	17,490	95,810	55,370	128,600	92
oswell-Artesia Area	34,470	32,350	0	0	0	0	33,720	31,650	96,850	71,120	750	700	1,230	850	1,070	790	1,230	850	97,920	71
arlsbad Irrigation Area	24,090	21,300	7,090	6,200	28,090	16,470	0	0	0	0	17,000	15,160	51,260	29,220	14,890	10,170	80,150	45,690	14,890	10
arlsbad Basin	14,060	6,220	4,270	1,000	4,270	2,630	2,520	1,400	5,430	3,420	7,270	3,820	4,910	3,030	10,360	6,530	9,180	5,660	15,790	9
ope Area	3,820	1,200	3,820	1,200	5,250	3,170	0	0	0	0	0	0	0	0	0	0	5,250	3,170	0	
ea County (scattered)	1,830	1,000	0	0	0	0	1,830	1,000	2,350	1,740	0	0	0	0	0	0	0	0	2,350	1
otal Pecos River Basin	222,840	190,710	42,360	31,280	137,220	63,830	137,960	123,470	370,650	267,730	42,520	36,040	86,140	49,820	53,480	36,740	233,360	113,650	424,130	304

'd Withdrawals in acre-feet.
'p Depletions in acre-feet.
Source: Earl F. Sorensen, Water Use by Categories in New Mexico Counties and River Basins, and Irrigated Acreage in 1980, Technical report 44, Santa Fe: New Mexico State Engineer, 1982; also the detail files which support this technical report.

among competing users presently finds expression in numerous water rights litigations, and as future development proceeds these conflicts can be anticipated to increase.



PECOS RIVER BASIN
In New Mexico

CHAPTER III

ENDNOTES

1 A recent statement of this full appropriation condition can be found in the state engineer's memo to the governor's Water Law Study Committee (September 1983), which is reproduced in appendix A.

2 This is a very simplistic statement with respect to the protections provided existing appropriators and rights of new appropriators under New Mexico water law. The discussion of water supply and demand conditions in the surface water drainage basins contained herein assumes all SEO reported surface and groundwater appropriations existing in 1980 possessed valid water right entitlements and rights which would persist in legal validity and physical availability through 2005. The availability of water in many of the declared underground water basins of the AWR and Pecos River Basins in declining: that is, a groundwater mining situation exists where aquifer depletions exceeds recharge. The declaration of an underground water basin by the state engineer generally suggest that additional, unregulated appropriations from the groundwater supplies are likely to impair existing rights. Where a groundwater mining circumstance exists there is a presumption that at some future time even existing rights may be diminished by aquifer depletions. Thus, the analysis of water supply conditions is naive to the extent that available supplies are diminished by groundwater mining, and therefore conservative in estimation of the magnitude of future water scarcity conditions.

CHAPTER IV

COLFAX COUNTY

Of all the counties discussed in these projections of water supply and demand conditions, Colfax County possesses the most uncertain potential for significant economic growth. This potential is the result of large coal resources reserves, which have not been committed to specific development at this time. The specific plans for the coal resources' development are presently clouded due to the recent sale of Kaiser Steel to a group of investors doing business as Perma Resources, but early indications suggest a more aggressive development plan than was the case under Kaiser's ownership of the coal resource. This potential development will be further explored in the county water use projections, and we first turn to discussion of the economic and demographic profile of the county as it exists today.

Economic and Demographic Profile

The population of Colfax County has increased slowly since 1970, with the 1980 census showing a population of 13,667 for the county. Raton is the only urban area in the county, with a population of 8,225 in 1980, and the rural communities of Springer, Cimarron, Maxwell, and Eagle Nest are of economic significance. Although the county ranked 20th in population in 1980, it ranked 17th in nonagricultural employment and 19th in agricultural employment. The county possesses significant agricultural resources, but the economic prosperity which the county enjoys (as compared to several of its

neighbors) is largely the product of the substantial coal resources found in the Raton Basin.

Total employment in 1980 was 5,554 with 5,012 nonagricultural jobs and 542 agricultural jobs. Total economic output for all sectors of the county's economy is estimated to be $203.8 million in 1980. Nearly 14 percent of this estimated output is provided by agricultural activities, which are dominated by livestock sales; more than 10 percent of the county's economic output is provided by the mining sector. The largest sector of the Colfax County economy in terms of value of output is the retail trade sector, with the largest employment sector being services where more than 1,200 jobs were found in 1980. See table 4.1 for details of the economic activity in Colfax County for 1980.

Colfax County has a long history of settlement and economic development. The agricultural lands of the Cimarron River and its tributaries, and particularly those served by the regulated flows from the privately owned Eagle Nest Reservoir, have provided a stable agricultural base in the county since the turn of the century. The privately owned coal resource has been recognized for years to be of regional significance, with the high Btu content and other physical characteristics of the coal ranking the resource among the most valuable coals found in the western United States. Raton now serves as the dominant center for economic activity in the county, and the recreation related developments in the Eagle Nest/Angel Fire area have recently provided some diversity to the continued economic development of the county.

TABLE 4.1

1980 OUTPUT AND WATER USE COEFFICIENTS COLFAX COUNTY.

Sector Number	Sector Description	1980 Employment	1980 Output ($1000)	Total Wd	Total Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	AF Total Wd/$1000 Ouput	AF Total Dp/$1000 Ouput	AF Surface Wd/$1000 Output	AF Surface Dp/$1000 Output	AF Ground Wd/$1000 Output	AF Ground Dp/$1000 Output
1.0	Harvested crops		368.7	2,271.5	1,433.3	2,271.5	1,433.3	0.0	0.0	6.16010	3.88700	6.16010	3.88700	0.0	0.0
2.0	Irrigated pasture & all hay	542	3,568.0	49,408.5	31,176.7	49,408.5	31,176.7	0.0	0.0	13.84770	8.73790	13.84770	8.73790	0.0	0.0
3.0	Livestock		24,510.0	2,871.0	2,870.0	2,495.0	2,495.0	376.0	375.0	0.11720	0.11710	0.10180	0.10180	0.01540	0.01530
5.2	Coal mining	*	20,331.9	312.8	113.4	312.8	113.4	0.0	0.0	0.01538	0.00560	0.01538	0.00560	0.0	0.0
5.4	Non-metalic mining & quarrying	*	192.4	15.0	2.2	0.0	0.0	15.0	2.2	0.0	0.0	0.0	0.0	0.07800	0.01140
6.0	Construction	292	16,617.4	162.4	73.1	145.6	65.5	16.8	7.6	0.00977	0.00440	0.00876	0.00394	0.00101	0.00046
7.1	Non-durable manufacturing	39	5,419.3	18.0	8.1	16.1	7.3	1.9	0.8	0.00332	0.00149	0.00297	0.00135	0.00035	0.00001
7.2	Durable manufacturing	358	7,723.2	25.8	11.6	23.1	10.4	2.7	1.2	0.00334	0.00150	0.00299	0.00135	0.00035	0.00016
8.0	Transporation, Comm & utilities	196	13,778.0	158.3	154.3	157.8	154.1	0.5	0.2	0.01149	0.01120	0.01145	0.01118	0.00004	0.00001
9.1	Wholesale trade	117	14,979.6	40.0	18.0	35.8	16.1	4.2	1.9	0.00267	0.00120	0.00239	0.00107	0.00028	0.00013
9.2	Retail trade	946	73,478.2	196.0	88.2	175.6	79.0	20.4	9.2	0.00267	0.00120	0.00239	0.00108	0.00028	0.00013
10.0	Finance, insurance & real estate	233	9,270.3	49.3	22.2	44.2	19.9	5.1	2.3	0.00532	0.00239	0.00477	0.00215	0.00055	0.00025
11.0	Services	1,769	13,584.3	261.8	106.0	73.4	33.4	188.4	72.6	0.01927	0.00780	0.00540	0.00246	0.01387	0.00534
12.0	Government & public admin.	1,069		44.5	20.5	40.8	18.4	3.7	2.1	0.04163	0.01918	0.03817	0.01721	0.00346	0.00196
	Population	13,667		1,408.9	634.0	1,257.6	565.9	151.3	68.1	0.10309	0.04639	0.09202	0.04141	0.01107	0.00498
	Urban	8,225		921.3	414.6	921.3	414.6	0.0	0.0	0.11201	0.05041	0.11201	0.05041	0.0	0.0
	Rural	5,442		487.6	219.4	336.3	151.3	151.3	68.1	0.08960	0.04039	0.06180	0.02780	0.02780	0.01251

* Disclosure - employment included in services.
Dp Depletions in acre-feet.
Wd Withdrawal in acre-feet.

The economic future of the county largely will be determined by the further development of the coal resource. The coal resource is considered to be of metallurgical quality, although it is also mined as a fuel for eletric power generation. The New Mexico Energy and Minerals Department has recently estimated that there remains 4,709 million tons of strippable and deep coal resources that can be mined from the Raton Basin. At the average annual rate of extraction over the last six years (table 4.2), this represents nearly 3,800 years of continued coal mining in the county, although the increasing energy demands of the nation (and world) may significantly accelerate the pace of this extraction in Colfax County.

Land and Water Use Profile

Nearly 20 percent of the total land area of the county is described as private commercial forest area, a large portion of which overlies the coal resources found in the northwest quadrant of the county. The mountainous western boundary of the county is also the hydrologic boundary between the Rio Grande Basin and the AWR Basin. The legacy of the Maxwell Land Grant, which in 1843 conveyed to private ownership 1.7 million acres of the county's 2,413,440 acres, has provided for limited public land ownership and administration in Colfax County. The 1980 pattern of land ownership in Colfax County is provided in table 4.3.

TABLE 4.2

RATON BASIN COAL PRODUCTION.
(Tons)

Mine	1977	1978	1979	1980	1981	1982
Potato Canyon	NP	NP	NP	5,202	NA	18,887
West York	95,641	134,100	577,517	600,000	510,000	599,015
Upper York Prospect	NP	NP	NP	NP	NP	3,446
York Canyon	1,005,123	803,056	766,459	900,000	763,000	689,010
TOTAL	1,100,764	937,156	1,343,976	1,505,202	1,273,000	1,310,358

NA Not available at time of publication.
NP No production.
Source: Energy and Minerals Department, Annual Resources Report, 1983 Update, Table 44, Santa Fe: State of New Mexico, 1983.

TABLE 4.3

COLFAX COUNTY LAND USE.

	1977	1980	1982
Cropland			
Cropped	36,580	26,840	25,470
Idle	13,620	23,360	23,970
National Forests	9,058	9,058	70,061[1]
Wilderness areas	0	0	0
National grasslands	2,560	2,560	2,560
Public Rangeland			
BLM	1,215	1,215	1,215
State	289,493	289,493	289,493
National Forest	8,154	8,154	38,805[2]
Bureau of Rec.	0	0	0
Commercial Forest Area			
Public	58,370	58,370[3]	58,370[3]
Private	474,063	474,063[3]	474,063[3]
Parks			
State	0	0	0
Game & Fish	38,351	38,351	38,351
Federal	3,101	3,101	3,101
Defense	0	0	0
Urban & Built-Up	5,000	5,000[3]	5,706[3]
Airports	1,433	1,433	1,433
Highways & Roads	14,094	14,115	14,117[3]
Energy Transmission Corridors	2,064	2,064	2,064
Railroads	1,750	1,750	1,750
Population	13,100	13,667	12,500[3]
Assessed Valuations of:			
Real Estate ($000s)	$50,112	$74,154	$81,313
Percent Residential			34.1
Percent Nonresidential			65.9
Percent Oil/Gas			0.0

Note: Total Area: 2,413,440 Acres.
Water Area: 7,176 Acres.

1 New additions to Carson National Forest.

2 Valle Vidal land acquisition.

3 Best available data.

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

There are five major irrigation organizations located in Colfax County, with these listed below with their corresponding irrigable areas:

Organization	Acres
Antelope Valley Irrigation District	5,240
Charles Springer Cattle Company	1,691
Miami Water Users Association	6,500
Vermejo Conservancy District	7,170

Total irrigated area in the county was 23,580 acres in 1980, of which 1,650 acres were planted in harvested crops and the remaining 21,930 acres being used for irrigated pasture and hay production. The SEO reported that 54,551 acre-feet of water were withdrawn for agricultural purposes (including livestock) in 1980, with 35,480 acre-feet of depletion associated with these withdrawals. The county had a total 1980 withdrawal of 69,303 acre-feet and a total depletion of 48,567 acre-feet. Thus, agricultural uses accounted for more than 78 percent of water withdrawals and more than 73 percent of depletions in 1980. The dominance of agricultural water use is not soon likely to be displaced, although there can be observed significant litigation of late over the change and protection of these agricultural uses with respect to the increasing municipal and industrial water requirements associated with nonagricultural economic development of the county.[1]

The only potential economic development that could significantly change the patterns of water use in Colfax County would result from expanded coal mining activities. In 1980 approximately 71 gallons of

water were diverted for each ton of coal mined, and approximately 30 gallons depleted per ton mined in these coal mining activities. The satisfaction of the water requirements associated with coal washing, dust suppression and mine reclamation cannot be ignored in projections of future water requirments, and it is to these projections which we now turn our attention.

Economic Development and Water Use Projections

The growth of Colfax County during the next 25 years seems principally determined by the further expansion of coal mining activities in the county, a link that provides significant uncertainty to the projections presented here. There is little, if any, prospect for the expansion of agricultural lands in the county; and due to the predominance of livestock production in the agricultural sector, the prospects for substantial shifts in agricultural water use from low valued pasture and hay production to a higher valued harvested crop must also be considered constrained. Any future urban water requirements seem to have been satisfied by the acquisition of agricultural water rights in the Cimarron River by the city of Raton, and the completion of a water delivery pipeline that provides the city with an additional 3,600 acre-feet diversion as the need arises in the future. This additional water supply is more than 2.5 times greater than the total diversions by the city water system in 1980, and will provide for all foreseeable water requirements for municipal and industrial development in the county's urban area.

This demand circumstance is more clearly shown in table 4.4. The projections of future water demands presented in this table reflect both increased demands associated with population increases as well as those associated with expanded economic activities, and at the same time incorporate increased water use efficiency by agricultural, urban, and rural water users. The growth in coal output value results from increased labor productivity only, and assumes no substantial expansion of mine operations. The projections show an increase in total annual withdrawals of 1,738 acre-feet over the 25-year projection period, with an increased depletion requirement of 1,077 acre-feet. Expanded livestock use and domestic use requirements provide for much of the additional water use requirments. It must also be noted that the recently acquired water rights of the city of Raton in the Cimarron River will more than fulfill the anticipated increase water requirments for all sectors of the Colfax County economy. Thus, it can be concluded that limited water scarcity can be anticipated if the rights to all 1980 water uses are maintained through the 25-year projection period.

The Supreme Court decision of June 4, 1984, in the Colorado v. New Mexico case provides much greater assurance to the future water supplies available in Colfax County. In that decision the Court determined that CF&I Steel Corporation could not exercise a new water right appropriation to the detriment of existing (i.e., New Mexican) water users, and in particular the Vermejo Conservancy District. Although the Colorado firm had asserted that the Vermejo Conservancy District would not be impacted if they had instituted significant

TABLE 4.4

WATER USE PROJECTIONS
COLFAX COUNTY
AWR BASIN.

Sector Number	Sector Description	1980 Output ($1000)	Growth Rate	2005 Output ($1000)	Total Wd	Total Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Net Change (Total Wd)	Net Change (Total Dp)
1.0	Harvested crops	368.7	0.3820%	405.6	2,123.8	1,340.1	2,123.8	1,340.1	0.0	0.0	-147.4	93.0
2.0	Irrigated pasture & all hay	3,568.0	0.1954	3,746.4	49,285.1	31,098.9	49,285.1	31,098.9	0.0	0.0	-123.5	77.9
3.0	Livestock	24,510.0	0.1954	25,735.5	3,016.2	3,013.6	2,619.9	2,619.9	396.3	393.8	521.2	518.6
5.2	Coal mining	20,331.9	1.0076	32,596.6	501.3	182.5	501.3	182.5	0.0	0.0	188.5	69.1
5.4	Non-metallic Mining & quarrying	192.4	0.1954	202.0	15.8	2.3	0.0	0.0	15.8	2.3	0.8	0.1
6.0	Construction	16,617.4	2.9352	34,249.7	334.6	150.7	300.0	134.9	34.6	15.8	172.2	77.6
7.1	Non-durable manufacturing	5,419.3	2.9352	11,169.6	37.1	16.6	33.2	15.1	3.9	1.6	19.1	8.5
7.2	Durable manufacturing	7,723.2	2.9352	15,918.1	53.2	23.9	47.6	21.5	5.6	2.5	27.4	12.3
8.0	Transportation, comm & utilities	13,778.0	2.9352	28,397.5	326.3	318.1	325.2	317.5	1.0	0.4	168.0	163.8
9.1	Wholesale trade	14,979.6	2.9352	30,874.0	82.4	37.0	73.8	33.0	8.6	4.0	42.4	19.0
9.2	Retail trade	73,478.2	2.9352	151,443.9	404.4	181.7	362.0	163.6	42.4	19.7	208.4	93.5
10.0	Finance, insurance & real estate	9,270.3	2.9352	19,106.8	101.6	45.7	91.1	41.1	10.5	4.8	52.3	23.5
11.0	Services	13,584.3	2.9352	27,998.2	539.5	218.4	151.2	68.9	388.3	149.5	277.7	112.4
12.0	Government & public admin.	1,069	1.3730	1,503	62.6	28.8	57.4	25.9	5.2	2.9	18.1	8.3
	Population	13,667	1.4410	19,544	1,854.1	834.4	1,658.7	746.4	195.4	87.9	445.2	200.4
	Urban	8,225	1.5589	12,145	1,224.3	551.0	1,224.3	551.0	0.0	0.0	303.0	136.4
	Rural	5,442	1.2288	7,399	629.8	283.4	434.4	195.4	195.4	87.9	142.2	64.0
											1,870.4	1,136.2

Dp Depletions in acre-feet.
Wd Withdrawal in acre-feet.

water conservation measures, the Court ruled that Colorado had not sufficiently provided this to be the case and that the hypothetical benefits for the equitable apportionment sought by Colorado were not convincingly demonstrated. It seems now assured that the water uses reported in 1980 for Colfax County represents an assured and demonstrated supply of water to the county, although additional development of the county's coal resources may significantly perturb future water scarcity conditions. The assumption that 1980 water use defines valid water right appropriations, and full appropriation circumstances, suggest that the expanded demands predicted can be met by Raton's transfer of agricultural rights to municipal and industrial purposes. The assessment is stated with the caveat that new large scale coal mining developments may substantially exasperate the water scarcity conditions faced by the county during the next 25 years.

CHAPTER IV

ENDNOTES

1 Noteworthy are two recent cases in Colfax County District Court. The 1982 application of the city of Raton to change the point of diversion and place and purpose of use (Application 71-D, New Mexico State Engineer) of an adjudicated agricultural water in the Cimarron River. The change met with significant protests with respect to impariment, and the state engineers hearing decision was appealed to district court by several protestants.

In the September 1983 C.S. Cattle Company v. Angel Fire Corp. (No. 81-51-CV) it was held that the groundwater appropriation for Angel Fire impaired the existing rights of C.S. Cattle Company, although all parties in this suit are appealing this District Court opinion.

2 Colorado v. New Mexico, 52 U.S. Law Week 4700, June 4, 1984.

CHAPTER V

MORA COUNTY

Mora County is geographically a diverse county, possessing forests, mountains, and an alpine environment in its western reaches, as well as broad open range expanses in its eastern reaches. The geographic diversity of the county is not reflected in the social and economic environment of the county. The county must be characterized as entirely rural and largely dependent upon an agricultural base. The potential for either economic or demographic growth is highly constrained, with no significant mineral resources, fully appropriated and limited water resources, and extremely limited alternative development potential.

Economic and Demographic Profile

The 1980 census count for Mora County was 4,025, with the 1980 population reflecting a decrease from 1970 of almost 500. The outmigration from this county reflects the extremely limited resources which the county can draw upon for development. The 1980 population ranked Mora County second to last in size as compared to the other counties in the state, and more than 46 percent of the county's employment was provided by agriculture. Mora County has traditionally been the poorest county in New Mexico. In fact, according to Survey of Current Business, Mora County is the second poorest in the nation, behind Jefferson County, Mississippi. Between 1970 and 1981 the unemployment rate averaged 30.3 percent, and in 1980 government transfer payments amounted to more than 32 percent of total income.

Agriculture and government are the largest employers in the county, with these two employment categories accounting for more than 83 percent of total employment in 1980. Total value of agricultural output for 1980 was just less than $15.5 million, with more than 88 percent of this output derived from livestock sales (table 5.1). Total agricultural employment is observed to have increased slightly during the last decade, although government employment between 1976 and 1981 has declined at an average annual rate of 4.3 percent.

Wholesale and retail trade dominate the nonagricultural sectors with respect to 1980 output estimates. Of the total 1980 estimated output of nearly $28 million, more than 55 percent was derived from agricultural products and nearly 30 percent was derived from wholesale and retail trade. Output estimated for the construction sector is the only other sector that can be considered of economic significance, with the total value of receipts amounting to slightly more than $2 million in 1980.

Land and Water Use Profile

Mora County is comprised of 1,244,160 acres, with 13,760 acres of this total irrigated in 1980. As can be seen in table 5.2, public lands (National Forests, parks, and rangelands) amount to more than 16 percent (nearly 200,000 acres) of the total area, with the next largest single land use category being private commercial forest area. The 1975 County Profile reported total private and miscellaneous lands to be 1,054,880 acres, or nearly 85 percent of the total

TABLE 5.1

1980 OUTPUT AND WATER USE COEFFICIENTS
MORA COUNTY.

Sector Number	Sector Description	1980 Employment	1980 Output ($1000)	Total Wd	Total Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	AF Total Wd/$1000 Output	AF Total Dp/$1000 Output	AF Surface Wd/$1000 Output	AF Surface Dp/$1000 Output	AF Ground Wd/$1000 Output	AF Ground Dp/$1000 Output
1.0	Harvested crops		157.3	536.9	246.1	536.9	246.1	0.0	0.0	3.41294	1.56440	3.41294	1.56440	0.0	0.0
2.0	Irrigated pasture & all hay	405	1,643.2	42,123.1	19,303.9	42,123.1	19,303.9	0.0	0.0	25.63558	11.74811	25.63558	11.74811	0.0	0.0
3.0	Livestock		13,656.0	950.0	948.0	718.0	718.0	232.0	230.0	0.06957	0.06942	0.05258	0.05258	0.01699	0.01684
6.0	Construction	19	2,054.1	14.0	6.3	0.0	0.0	14.0	6.3	0.00682	0.00307	0.0	0.0	0.00682	0.00307
7.2	Durable manufacturing	*	277.2	0.7	0.3	0.0	0.0	0.7	0.3	0.00253	0.00108	0.0	0.0	0.00253	0.00108
8.0	Trans., comm. & utilities	38	1,410.0	15.9	7.1	0.0	0.0	15.9	7.1	0.01128	0.00504	0.0	0.0	0.01128	0.00504
9.1	Wholesale trade	2	5,740.1	10.9	4.9	0.0	0.0	10.9	4.9	0.00190	0.00085	0.0	0.0	0.00190	0.00085
9.2	Retail trade	22	2,622.0	5.1	2.3	0.0	0.0	5.1	2.3	0.00195	0.00088	0.0	0.0	0.00195	0.00088
11.0	Services	70	424.5	2.0	0.9	0.0	0.0	2.0	0.9	0.00471	0.00212	0.0	0.0	0.0	0.0
12.0	Government & public admin.	325		28.1	12.6	0.0	0.0	28.1	12.6	0.08646	0.03877	0.0	0.0	0.00471	0.00212
	Population	4,205		353.3	158.6	0.0	0.0	353.3	158.6	0.84020	0.03772	0.0	0.0	0.08646	0.03877
	Rural	4,205		353.3	158.6	0.0	0.0	353.3	158.6	0.84020	0.03772	0.0	0.0	0.08402	0.03772
													0.0	0.03402	0.03772

* Disclosure-employment included in services.
Dp Depeltions in acre-feet.
Wd Withdrawal in acre-feet.

TABLE 5.2

MORA COUNTY LAND USE.

	1977	1980	1982
Cropland			
Cropped	16,520	15,010	15,470
Idle	8,890	10,400	9,910
National Forests	98,299	98,299	98,597[2]
Wilderness areas	63,100	65,110	65,110[2]
National grasslands	5,773	5,773	5,773
Public Rangeland			
BLM	7,561	7,561	7,561
State	52,282	52,282	52,282
National Forest	36,190	36,190	36,190
Bureau of Rec.	0	0	0
Commercial Forest Area[1]			
Public	6,435	6,435[2]	6,311[2]
Private	125,860	125,860[2]	125,860[2]
Parks			
State	348	348	348
Game & Fish	0	0	0
Federal	721	721	721[2]
Defense	0	0	0
Urban & Built-Up	578	578	578[2]
Airports	0	0	0
Highways & Roads	6,497	6,497	6,497[2]
Energy Transmission Corridors	399	403	411
Railroads	430	430	430
Population	4,800	4,205	4,400
Assessed Valuations of:			
Real Estate ($000s)	$7,977	$11,054	$11,923
Percent Residential			40.1
Percent Nonresidential			59.9
Percent Oil/Gas			0.0

Note: Total Area: 1,244,160 Acres.
Water Area: 1,411 Acres.

1 State and Private Forest Resources, Mora County, New Mexico Department of State Forestry, 1970. Figures for 1981 from USDA Intermountain Station, Ogden, Utah.

2 Best available data.

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

area of Mora County. As previously mentioned, livestock production dominates the output from agricultural sectors in Mora County, and this is directly reflected in the fact that more than 98 percent of the irrigated acres are devoted to irrigated pasture and hay production. There are no organized conservancy or irrigation districts located in Mora County, and more than 98 percent of water use in the county reported in table 5.1 is from surface water sources.

The overwhelming agricultural water use (more than 99 percent) provides for future flexibility with respect to development limitations imposed by a water availability constraint. The significant irrigated areas of the county are located in the valleys of the tributaries to the Canadian River. There is potential for shift from lower valued pasture and hay cropping patterns to higher valued harvested crops, but this possibility is substantially limited by the need to provide pasture and hay to the livestock sector.

Economic Development and Water Use Projections

Economic development in Mora County during the next 25 years appears highly constrained, and will largely depend on improved efficiency in the agricultural sector and potential development of the county's recreational resources. The population of Mora County is projected to decline at a 0.244 percent annual rate, and employment in the county is anticipated to decline at a 1.637 percent annual rate during the 25-year projection period. There is anticipated some slight real per capita income growth at a 0.374 percent

annual rate, but the trends in population and employment negate the effects of this productivity surogate. Changes in agricultural water demands are based in part on changes in water use efficiency. For these projections it is assumed that a 10 percent increase in the efficiency of groundwater use, and a 5 percent increase in the efficiency of surface water use will be realized by the harvested crop sector. In the irrigated pasture and hay sector there is assumed a 5 percent increase in the efficiency of both surface and groundwater use. The projection of rural population water demands is based on a 5 percent increase in the efficiency of use.

The impact of these projected declines in population and employment are not particularly significant, with a projected total net decline in withdrawals of 63.7 acre-feet and a decline in depletions of 3.4 acre-feet (table 5.3). Although harvested crops and livestock show increases in water demands associated with their increased outputs, the increase in the efficiency of use by the irrigated pasture and hay sector provides for essentially no net change in total agricultural water demands. Obviously water scarcity becomes less significant in Mora County by the year 2005 than was the case in 1980 according to these projections.

TABLE 5.3

WATER USE PROJECTIONS
MORA COUNTY
AWR BASIN.

Sector Number	Sector Description	1980 Output ($1000)	Growth Rate	2005 Output ($1000)	Total Wd	Total Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Net Change (Total Wd)	Net Change (Total Dp)
1.0	Harvested Crops	157.3	0.381%	173.0	560.9	257.1	560.9	257.1	0.0	0.0	24.0	11.0
2.0	Irrigated pasture & all hay	1,643.2	0.195	1,725.4	42,020.0	19,256.5	42,020.0	19,256.5	0.0	0.0	-103.1	- 47.4
3.0	Livestock	13,656.0	0.195	14,338.8	997.5	995.4	753.9	753.9	243.6	241.5	47.5	47.4
6.0	Construction	2,054.1	-1.269	1,492.6	10.2	4.6	0.0	0.0	10.2	4.6	- 3.8	- 1.7
7.2	Durable manufacturing	277.2	-1.269	201.4	0.5	0.2	0.0	0.0	0.5	0.2	- 0.2	- 0.1
8.0	Trans. comm. & utilities	1,410.0	-1.269	1,024.6	11.6	5.2	0.0	0.0	11.6	5.2	- 4.3	- 1.9
9.1	Wholesale trade	5,740.1	-1.269	4,171.0	7.9	3.5	0.0	0.0	7.9	3.5	- 3.0	- 1.4
9.2	Retail trade	2,622.0	-1.269	1,905.3	3.7	1.7	0.0	0.0	3.7	1.7	- 1.4	- 0.6
11.0	Services	424.5	-1.269	308.5	1.5	0.7	0.0	0.0	1.5	0.7	- 0.5	- 0.2
12.0	Government & public admin.	325	-0.062	320	27.7	12.4	0.0	0.0	27.7	12.4	- 0.4	- 0.2
	Population	4,205	-0.010	4,195	334.8	150.3	0.0	0.0	334.8	150.3	- 18.5	- 8.3
	Rural	4,205	-0.010	4,195	334.8	150.3	0.0	0.0	334.8	150.3	- 18.5	- 8.3
											-63.7	-3.4

Dp Depletions in acre-feet.
Wd Withdrawal in acre-feet.

CHAPTER VI

HARDING COUNTY

Harding County is the least populated and most economically restricted of the full counties included in the AWR Basin. Indeed, the county was characterized in the County Profile series of the 1976 state water resources assessment "...as essentially one vast cattle range, dotted here and there with farms."[1] The agricultural structure of the Harding County economy is made clear by the fact that almost 60 percent of total employment in 1980 is defined as agricultural employment. Thus, the economy of the county is closely tied to the health of agricultural and livestock markets. The Canadian River, which forms the western boundary of the county, and Ute Creek are the two principal surface water sources, although significant groundwater resources are available and are important to these ranching operations.

Economic and Demographic Profile

Harding County is the state's least populous county, with the 1980 census showing 1,090 residents in the county. Historically, the county has lost population since it was first established in 1921 with a population of approximately 5,000. The 1980 employment data ranks Harding County as having the highest percentage of agricultural employment (as related to total county employment) in New Mexico. Of course, the county's 1980 agricultural output of nearly $17.3 million does not rank the county anywhere near the top of agricultural output

on a statewide basis. Of the county's total $28.8 million estimated output in 1980, agricultural production accounted for nearly 62 percent.

Between 1970 and 1981 Harding County continued to experience declines in population; however, during this same period the county's unemployment rate averaged nearly half of the state's,[1] with unemployment during the period averaging 3.9 percent. Adding to these somewhat mixed economic and demographic trends is the observation that nonagricultural employment increased between 1970 and 1981 at a 3.46 percent average annual rate, while total agricultural employment declined from 1970 to 1976 and then increased to a 1980 employment level equal to 1970 employment. A substantial portion of the nonagricultural employment changes can be associated with the carbon dioxide (CO_2) wells in the Bueyeros Fields at the upper reaches of Ute Creek. The susceptibility of the county personal income levels to fluctuations in cattle market prices and weather conditions provides for significant instability in all private sectors of the county's economy. The government sector is the second largest employer, next to agriculture, providing nearly 18 percent of the jobs in 1980 (table 6.1). Construction and wholesale and retail trade must be mentioned as leading private sector employers, but the combined value of output from these three sectors amounts to less than one-third of the total county economic output estimate for 1980.

TABLE 6.1

1980 OUTPUT AND WATER USE COEFFICIENTS
HARDING COUNTY.

Sector Number	Sector Description	1980 Employment	1980 Output ($1000)	Total Wd	Total Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	AF Total Wd/$1000 Output	AF Total Dp/$1000 Output	AF Surface Wd/$1000 Output	AF Surface Dp/$1000 Output	AF Ground Wd/$1000 Output	AF Ground Dp/$1000 Output
1.0	Harvest crops	338	37.0	53.3	39.9	0.0	0.0	53.3	39.9	1.44054	1.07838	0.0	0.0	1.44054	1.07838
2.0	Irrigated pasture & all hay		105.0	1,336.7	1,000.1	0.0	0.0	1,336.7	1,000.1	12.73048	9.52476	0.0	0.0	12.73048	9.52476
3.0	Livestock		17,142.0	2,199.0	2,198.0	1,910.0	1,910.0	289.0	288.0	0.12828	0.12822	0.11142	0.11142	0.01686	0.01680
5.3	Crude petroleum & nat. gas extract.	*	226.1	3.0	1.0	0.0	0.0	3.0	1.0	0.01327	0.00442	0.0	0.0	0.01327	0.00442
6.0	Construction	*	1,062.9	7.6	3.4	0.0	0.0	7.6	3.4	0.00715	0.00320	0.0	0.0	0.00715	0.00320
7.1	Non-durable manufacturing	55	841.4	2.3	1.0	0.0	0.0	2.3	1.0	0.00273	0.00119	0.0	0.0	0.00273	0.00119
8.0	Transportation, Comm. & utilities	*	594.3	7.0	3.1	0.0	0.0	7.0	3.1	0.01178	0.00522	0.0	0.0	0.01178	0.00522
9.1	Wholesale trade	22	4,807.9	9.7	4.3	0.0	0.0	9.7	4.3	0.00202	0.00089	0.0	0.0	0.00202	0.00089
9.2	Retail trade		2,774.0	5.6	2.5	0.0	0.0	5.6	2.5	0.00202	0.00090	0.0	0.0	0.00202	0.00090
11.0	Services	55	401.7	2.0	0.9	0.0	0.0	2.0	0.9	0.00498	0.00224	0.0			
12.0	Government & public admin.	101		9.2	4.1	0.0	0.0	9.2	4.1	0.09109	0.04059	0.0			
	Population	1,090		91.6	40.7	0.0	0.0	91.6	40.7	0.08404	0.03734	0.0	0.0	0.00498	0.00224
	Urban												0.0	0.09109	0.04059
	Rural	1,090		91.6	40.7	0.0	0.0	91.6	40.7	0.08404	0.03734	0.0	0.0	0.08404	0.03734
													0.0	0.08404	0.03734

* Disclosure - employment included in services
Dp Depletions in acre-feet.
Wd Withdrawal in acre-feet.

TABLE 6.2

HARDING COUNTY LAND USE.

	1977	1980	1982
Cropland			
Cropped	41,430	40,010	45,209
Idle	23,520	24,960	20,351
National Forests	0	0	0
Wilderness areas	0	0	0
National grasslands	70,545	70,545	70,545
Public Rangeland			
BLM	603	603	603
State	338,059	338,059	338,059
National Forest	59,454	59,454	59,454
Bureau of Rec.	0	0	0
Commercial Forest Area			
Public	0	0	0
Private	0	0	0
Parks			
State	640	640	640
Game & Fish	1,145	1,145	1,145
Federal	0	0	0
Defense	0	0	0
Urban & Built-Up	1,795	1,795[1]	778[1]
Airports	30	30	30
Highways & Roads	7,621	7,829	7,829
Energy Transmission Corridors	945	952	955
Railroads	0	0	0
Population	1,200	1,090	1,000
Assessed Valuation of:			
Real Estate ($000s)	$5,503	$6,150	$6,801
Percent Residential			11.5
Percent Nonresidential			88.5
Percent Oil/Gas			1.8

Note: Total Area: 1,368,320 Acres.
Water Area: 240 Acres.

1 Best available data.

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

Land and Water Use Profile

The landscape of Harding County consists of vast and relatively flat mesas and plains with more than 34 percent of the total area of the county held in state of federal public rangeland and national grasslands. These data, along with other Harding County land uses are shown in table 6.2. The dominance of the agricultural sector is shown clearly in 1980 water use data for Harding County, where more than 96 percent of the total withdrawals and more than 98 percent of the total depletions in the county were attributable to agricultural uses (table 6.1). The production of livestock, and its associated irrigation of pasture and hay, accounted for all but 191.3 acre-feet of withdrawals and 100.9 acre-feet of the 1980 depletions reported in table 6.1. In short, this water use reflects land use which is also mirrored in employment and output data; that is, agriculture, and particularly livestock production, is the mainstay of the Harding County economy.

The absence of significant mineral resource deposits, natural recreation opportunities, or other cultural resources that would attract additional population or visitors significantly limits the use of the county's land and water resouces. Although substantial groundwater resouces are available in the aquifer that underlies the county, the economics of agriculture and livestock production prohibit development of these water resources at this time. The specific availability of these waters is, of course, dependent upon determination of nonimpairment of existing appropriators related to the particular place and purpose of the new use. Yet is would also seem

that the availability of these groundwater resources could be considered to be the brightest prospect for expanded economic development of the county.

Economic Development and Water Use Projections

The future economic development of Harding County appears largely dependent on improved conditions in the agricultural markets, particularly in livestock markets, as well as the development of the county's CO_2 reserves. Recent trends in the agriclutral sector have been extremely unfavorable, and in the past several years drought conditions have forced many ranches out of business in Harding County. Temple and Wombold anticipated increases in population for the county, with their projection predicted upon net in-migration to the county. Corresponding to this population trend, there is also anticipated employment growth associated with the trend observed in the historical data as well as anticipated development of the county's CO_2 resources. Based on the Temple/Wombold projections, this economic and water use projection utilizes a 2.5 percent average annual population growth rate and a 2.4 percent employment growth rate for Harding County.

Although the growth projections are based on relatively high rates of growth, the size of each sector and of county population as a whole limit the quantitative impact of the anticipated expansion of economic and human water requirements. There is projected a total increase withdrawal demand of 216.9 acre-feet, and a total increased

TABLE 6.3

WATER USE PROJECTIONS
HARDING COUNTY
AWR BASIN.

Sector Number	Sector Description	1980 Output ($1000)	Growth Rate	2005 Output ($1000)	Total Wd	Total Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Net Change (Total Wd)	Net Change (Total Dp)
1.0	Harvested crops	37.0	0.5606%	42.6	55.2	41.3	0.0	0.0	55.2	41.3	1.9	1.4
2.0	Irrigated pasture & all hay	105.0	0.3820	115.5	1,323.3	990.1	0.0	0.0	1,323.3	990.1	-13.4	-10.0
3.0	Livestock	17,142.0	0.1954	17,999.1	2,308.9	2,307.8	2,005.5	2,005.5	303.5	302.4	110.9	109.8
5.3	Crude petroleum & nat. gas extract	226.1	1.2110	305.5	4.1	1.4	0.0	0.0	4.1	1.4	1.1	0.4
6.0	Construction	1,062.9	3.6492	2,604.0	19.6	8.3	0.0	0.0	19.6	8.3	12.0	4.9
7.1	Non-durable manufacturing	841.4	3.6492	2,061.3	5.6	2.5	0.0	0.0	5.6	2.5	3.3	1.5
8.0	Transporation, Comm. & Util.	594.3	3.6492	1,455.9	17.2	7.6	0.0	0.0	17.2	7.6	10.2	4.5
9.1	Wholesale trade	4,807.9	3.6492	11,778.8	23.8	10.5	0.0	0.0	23.8	10.5	14.1	6.2
9.2	Retail trade	2,774.0	3.6492	6,796.0	13.7	6.1	0.0	0.0	13.7	6.1	8.1	3.6
11.0	Services	401.7	3.6492	984.1	4.9	2.2	0.0	0.0	4.9	2.2	2.9	1.3
12.0	Government & public admin.	101	2.4080	183	16.7	7.4	0.0	0.0	16.7	7.4	7.5	3.3
	Population	1,090	2.4930	2,017	161.0	71.5	0.0	0.0	161.0	71.5	69.4	30.8
	Rural	1,090	2.4930	2,017	161.0	71.5	0.0	0.0	161.0	71.5	69.4	30.8
											216.9	157.7

Dp Depletions in acre-feet.
Wd Withdrawal in acre-feet.

depletion demand of 157.7 acre-feet (table 6.3). More than 51 percent of the increased withdrawal demands come from livestock production, with this sector constituting nearly 70 percent of the increased depletion demands. The other substantial demand increase occurs due to population increases, with rural users projected to increase withdrawals by more than 69 acre-feet and depletions by nearly 31 acre-feet over the 25-year projection period. Because all water use in Harding County currently comes from groundwater sources, the increased demand requirements likely will be accommodated through increased groundwater pumpage from existing wells and new wells, drilled as existing wells are retired.

CHAPTER VI

ENDNOTES

1 New Mexico Interstate Stream Commission and New Mexico State Engineer Office, County Profile, Harding County, Water Resources Assessment for Planning Purposes, Santa Fe, New Mexico: New Mexico State Engineer, 1975, p. 12.

CHAPTER VII

UNION COUNTY

Unlike the other counties in the AWR Basin, Union County draws substantially upon the groundwater resouces of the basin to supply the water demands of the county's population and economy. Although the county has historically shown declining population trends, the development of Clayton and the expanded development prospects for CO_2 mining provide for anticipated reversal of these trends. Yet this county must be characterized as rural and dependent upon the health of agricultural markets and climatic vagrancies in assessing specific economic and demographic conditions affecting future development of the county.

Economic and Demographic Profile

The 1980 census count for Union County was 4,725, with the county ranking 27th in the state in 1980 population. Although the population of the county has varied since 1970 due to both in-migration and out-migration, the overall trend since 1970 reflects a slight decline in the county's total population. Employment is dominated by agriculture, with 1980 employment data showing agriculture providing nearly twice as many jobs as any other sector of the economy. Table 7.1 presents 1980 employment and ouput data for Union County, and the data presented there shows agriculture providing more than 40 percent of the employment and more than 67 percent of the total output estimate for Union County in 1980.

TABLE 7.1

1980 OUTPUT AND WATER USE COEFFICIENTS
UNION COUNTY.

Sector Number	Sector Description	1980 Employment	1980 Output ($1000)	Total Wd	Total Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	AF Total Wd/$1000 Output	AF Total Dp/$1000 Output	AF Surface Wd/$1000 Output	AF Surface Dp/$1000 Output	AF Ground Wd/$1000 Output	AF Ground Dp/$1000 Output
1.0	Harvested crops		10,653.1	68,940.6	42,679.4	6,575.5	3,395.7	62,365.1	39,283.7	6.47141	4.00629	0.61724	0.13875	5.85417	3.68754
2.0	Irrigated pasture & all hay	732	4,524.0	33,179.4	20,540.6	3,164.5	1,634.3	30,014.9	18,906.3	7.33408	4.54036	0.69949	0.36125	6.63459	4.17911
3.0	Livestock		81,376.0	3,573.0	3,570.0	2,902.0	2,902.0	671.0	668.0	0.04391	0.04387	0.03566	0.03566	0.00825	0.00821
5.4	Nonmetallic mining & quarrying	*	32.1	23.0	5.0	0.0	0.0	23.0	5.0	0.71651	0.15576	0.0	0.0	0.71651	0.15576
6.0	Construction	30	1,788.8	21.6	9.7	0.0	0.0	21.6	9.7	0.01208	0.00542	0.0	0.0	0.01208	0.00542
7.1	Nondurable manufacturing	8	559.0	2.5	1.1	0.0	0.0	2.5	1.1	0.00447	0.00197	0.0	0.0	0.00447	0.00197
7.2	Durable manufacturing	10	1,513.7	6.5	2.9	0.0	0.0	6.5	2.9	0.00429	0.00192	0.0	0.0	0.00429	0.00192
8.0	Trans., comm. & Utilities	63	5,509.4	56.7	7.2	0.0	0.0	56.7	7.2	0.01029	0.00131	0.0	0.0	0.01029	0.00131
	Transportation & Comm.		854.5	2.7	1.2	0.0	0.0	2.7	1.2	0.0	0.0	0.0			
	Utilities		4,654.9	54.0	6.0	0.0	0.0	54.0	6.0	0.0	0.0	0.0			
9.1	Wholesale trade	59	17,844.9	61.1	27.4	0.0	0.0	61.1	27.4	0.00342	0.00154	0.0	0.0	0.00342	0.00154
9.2	Retail trade	209	16,647.6	57.0	25.6	0.0	0.0	57.0	25.6	0.00342	0.00154	0.0	0.0	0.00342	0.00154
10.0	Finance, insurance & real estate	89	106.2	0.7	0.3	0.0	0.0	0.7	0.3	0.00659	0.00282	0.0	0.0	0.00659	0.00282
11.0	Services	235	3,458.6	29.6	13.3	0.0	0.0	29.6	13.3	0.00856	0.00385	0.0	0.0	0.00856	0.00385
12.0	Government & public admin.	383		58.9	26.4	0.0	0.0	58.9	26.4	0.15379	0.06893	0.0	0.0	0.15379	0.06893
	Population	4,725		407.4	183.0	0.0	0.0	407.4	183.0	0.08622	0.03873	0.0	0.0	0.08622	0.03873
	Urban	2,968		299.2	134.4	0.0	0.0	299.2	134.4	0.10081	0.04528	0.0	0.0	0.10081	0.04528
	Rural	1,757		108.2	48.6	0.0	0.0	108.2	48.6	0.06158	0.02766	0.0	0.0	0.06158	0.02766

* Disclosure-employment included in services.
Dp Depletions in acre-feet.
Wd Withdrawal in acre-feet.

Significant production of both corn and wheat must be noted, but by far the dominant agricultural output was livestock production.

Unemployment in Union county has been approximately half the statewide unemployment rate since 1970, with the average unemployment rate between 1970 and 1981 at 4.0 percent for the county. The non-agricultural sectors of significance in Union county include government, wholesale and retail trade, and services. The Clayton power plant provided significant employment in the TCU sector, with associated water use also worthy of mention. During the 1970 through 1982 period, the strongest growth has been observed in the government and trade sectors, while at the same time there was observed a slight decline in service sector employment.

The most significant potential development, and one which has been heralded for several years as extremely important to expansion of the Union County economy generally, is the development and extraction of CO_2 from the fields located in the southern portion of the county. Although the value of production presently is not high (estimated at $32,100 in 1980), the potential for use of the CO_2 resource in tertiary oil recovery in the Permian Basin and as a transport medium in coal slurry pipelines provides for substantial interest in the resource. Of particular note to this research is the fact that the only water use associated with CO_2 extraction is in well drilling, which is an extremely limited and temporary use of water resources.

Land and Water Use Profile

Less than 22 percent of the more than 2.4 million acres that comprise Union County are held in either federal or state ownership, with nearly all of these public lands subject to grazing lease provisions (table 7.2). The topography of the county consists of high mesas, dissected plateaus, deep canyons, and some volcanic mountains in the northern portion of the county, giving way to plains, prairies, and intermittent arroys in the southern portion of the county. Several recreation areas in Union County, include Capulin Mountain National Monument and Clayton Lake State Park.

Rangeland is, of course, the predominant land use, and irrigated agriculture accounts for more than 99 pecent of total water withdrawals and depletions in 1980. The next largest water use in the county is to provide the consumption needs of the populous. Approximately 88 percent of the agricultural water requirements are provided by groundwater sources, while all other sectors of the Union County economy are supplied entirely by groundwater. The quality of water resources in Union County is a concern, with groundwater taken from the Dakota Sandstone, the Morrison Formation, and sandstone beds of Triassic age yielding water which is undesirable for domestic use, yet considered potable if no other water is available.[1] Several geologic formations provide water suitable for agricultural or industrial uses only, and even some spring water which has been characterized as "poison-water holes."

TABLE 7.2

UNION COUNTY LAND USE.

	1977	1980	1982
Cropland			
Cropped	69,890	75,430	82,057
Idle	54,580	49,070	38,263
National Forests	0	0	0
Wilderness areas	0	0	0
National grasslands	57,534	57,534	57,534
Public Rangeland			
BLM	758	758	758
State	413,453	413,453	413,453
National Forest	60,908	60,908	60,908
Bureau of Rec.	0	0	0
Commercial Forest Area			
Public	0	0	0
Private	0	0	0
Parks			
State	587	587	587
Game & Fish	175	175	175
Federal	775	775	775
Defense	0	0	0
Urban & Built-Up	1,476	1,476	1,476[1]
Airports	960	960	960[1]
Highways & Roads	16,151	16,182	16,182[1]
Energy Transmission Corridors	3,249	3,363	3,445
Railroads	1,006	1,006	1,006
Population	5,000	4,725	5,200[1]
Assessed Valuation of:			
Real Estate ($000s)	$16,829	$21,232	$22,348
Percent Residential			18.6
Percent Nonresidential			81.4
Percent Oil/Gas			0.0

Note: Total Area: 2,442,880 Acres.
Water Area: 317 Acres.

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

1 Best available data.

Economic Development and Water Use Projections

The expansion and development of the Union County economy will be largely dependent upon the health of the agricultural markets, although the potential development of the CO_2 resources significantly adds to the county's economy. The recent troubles experienced by ranchers in eastern New Mexico and West Texas, associated with both depressed market conditions and drought conditions, provides for some current pessimism, but is also likely to be of a cyclic or stochastic nature. The projections here assume that the population of Union County will grow at a 1.6 percent average annual rate, and that employment will grow at a slightly greater rate of 2.3 percent. The stronger employment growth reflects the continued nonagricultural growth of the county, and in particular, Clayton, and is also based on the trends observed since 1970 and the anticipated development of the CO_2 resources.

The projections of increased economic output, presented in table 7.3, combined with increased efficiency of use suggest that 3,355.5 acre-feet of additional withdrawals and 1,973.5 acre-feet of additional depletions can be associated with economic and population growth in Union County. The majority of the increased demands comes from the harvested crops sector. In that sector, output is projected to increase a total of 15 percent, and during the 25-year projection period a 15 percent improvement is anticipated in the efficiency of groundwater use combined with a 10 percent improvement in the efficiency of surface water use. The declines in water demands associated with the irrigated pasture and hay sector are essentially

TABLE 7.3

WATER USE PROJECTIONS
UNION COUNTY
AWR BASIN.

Sector Number	Sector Description	1980 Output ($1000)	Growth Rate	2005 Output ($1000)	Total Wd	Total Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Net Change (Total Wd)	Net Change (Total Dp)
1.0	Harvest crops	10,653.1	0.5606%	12,251.1	71,731.8	44,368.6	7,183.8	3,709.8	64,548.0	40,658.8	2,791.2	1,689.2
2.0	Irrigated pasture & all hay	4,524.0	0.3820	4,976.4	33,021.6	20,425.0	3,306.9	1,707.8	29,714.7	18,717.2	-159.8	-115.0
3.0	Livestock	81,376.0	0.1954	85,444.8	3,751.9	3,748.5	3,047.0	3,047.0	704.9	701.9	178.9	178.5
5.4	Non-metallic mining & quarrying	32.1	0.1954	33.7	24.1	5.2	0.0	0.0	24.1	5.2	1.1	0.2
6.0	Construction	1,788.8	3.6096	4,340.7	52.4	23.5	0.0	0.0	52.4	23.5	30.8	13.8
7.1	Non-durable manufacturing	559.0	3.6096	1,356.5	6.1	2.7	0.0	0.0	6.1	2.7	3.6	1.6
7.2	Durable manufacturing	1,513.7	3.6096	3,673.1	15.8	7.1	0.0	0.0	15.8	7.1	9.3	4.2
8.0	Transporiation, comm. & utilities transporation & comm. utilities	5,509.4	3.6096	13,369.1	137.6	17.5	0.0	0.0	137.6	17.5	80.9	10.3
9.1	Wholesale trade	17,844.9	3.6096	43,302.4	148.1	66.7	0.0	0.0	148.1	66.7	87.0	39.3
9.2	Retail trade	16,647.6	3.6096	40,397.0	138.2	62.2	0.0	0.0	138.2	62.2	81.2	36.6
10.0	Finance, insurance & real estate	106.2	3.6096	257.7	1.7	0.7	0.0	0.0	1.7	0.7	1.0	0.4
11.0	Services	3,458.6	3.6096	8,611.0	73.7	35.2	0.0	0.0	73.7	35.2	44.1	21.9
12.0	Government & public admin.	383	2.2860	674.0	103.7	46.5	0.0	0.0	103.7	46.5	44.8	20.1
	Population	4,725	1.6340	7,086	568.8	255.4	0.0	0.0	568.8	255.4	161.4	72.4
	Urban	2,968	1.7174	4,543	412.2	185.1	0.0	0.0	412.2	185.1	113.0	50.7
	Rural	1,757	1.4899	2,543	156.6	70.3	0.0	0.0	156.6	70.3	48.4	21.7
											3,355.5	1,973.5

Dp Depletions in acre-feet.
Wd Withdrawal in acre-feet.

offset by the increased demands of livestock production. The only other major increased demand comes from the consumption requirements of the growing populous of Union County.

In September 1983, the state engineer estimated that there is available in the Dry Cimarron River of Union County approximately 18,800 acre-feet per annum of unappropriated water. These flows are intermittent and are not considered a dependable source of supply at this time. The use of this water is not regulated under provisions of the Canadian River Compact, and it may be possible for it to be developed as a dependable supply with the construction of a reservoir. Little interest has been expressed in the past for development of this reservoir, yet it is quite conceivable that this development could occur, particularly as a result of large scale CO_2 production activities and associated economic and demographic developments.

CHAPTER VII

ENDNOTES

1 J.B. Copper and L.V. Davis, General Occurrance and Quality of Ground Water in Union County, New Mexico, Ground Water Report 8, State Bureau of Mines and Mineral Resources, Socorro, New Mexico: New Mexico Institute of Mining and Technology, 1967, p. 152.

CHAPTER VIII

SAN MIGUEL COUNTY

For many years economic conditions in San Miguel County have been significantly depressed even though the county possesses many diverse natural and cultural resources. In the past several years a new attitude has been observed in the county, a new outlook which replaces the former pessimism with renewed optimism regarding the future. In part, this new optimism has resulted from the opening of the Montana de Fibre fiberboard plant and the refurbishing of Montezuma Castle for the Armand Hammer United World College of the American West, two recent developments that have benefitted the Las Vegas area significantly.

In the following analysis of demography, economic activity, and water use for San Miguel County data will be presented separately for the portions of the county located in the two surface water basins that provide for the county's water supplies. The rural economic and demographic conditions of the AWR Basin region of the county will be presented apart from the far more urban Pecos River Basin region of San Miguel County, and comparison of each region to county aggregates will be provided when appropriate. There will be some overlap between the separate descriptions of the two hydrologic regions, and the assumptions employed in the projections of water use and economic activities will be largely the same due to their derivation from county-wide data and trends. The first section of this discussion will be devoted to the AWR Basin located in San Miguel County, followed by a discussion of the Pecos River Basin in the county.

SAN MIGUEL COUNTY--AWR BASIN

Economic and Demographic Profile

Total 1980 population for the AWR Basin portion of San Miguel County was 1,527, amounting to less than 7 percent of the total population of the county. For the county as a whole, there was essentially no population change between the 1970 and 1980 censuses, and in the AWR Basin region it is quite probable that the population declined during the decade. The AWR Basin in San Miguel County is entirely rural and derives nearly 40 percent of its total employment from agricultural activities (table 8.1). The next largest employment sector in this region of the county is in the government sector, which provided for almost 27 percent of the total 1980 employment in the AWR Basin region.

Total output for the AWR Basin region is estimated to be nearly $20.4 million in 1980, with more than 46 percent of this output provided by the agricultural sectors. Agricultural activities within the region are principally livestock production, which provided for more than 93 percent of total agricultural output in the region in 1980. Trade, construction, and services are also significant employment sectors in the AWR Basin region of the county, with the wholesale and retail trade sectors providing the largest nonagricultural output in this region of San Miguel County. Construction output also provides a substantial contribution to output in this region; yet the combined outputs of the trade, services, and construction sectors is still less than the total output of the agricultural lands located in

TABLE 8.1

1980 OUTPUT AND WATER USE COEFFICIENTS
SAN MIGUEL COUNTY
AWR RIVERS BASIN.

Secter Number	Sector Description	1980 Employment	1980 AWR Employment	1980 Output ($1000)	1980 AWR Output ($1000)	Total AWR Wd	Total AWR Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	AF Total Wd/$1000 Output	AF Total Dp/$1000 Output	AF Surface Wd/$1000 Output	AF Surface Dp/$1000 Output	AF Ground Wd/$1000 Output	AF Ground Dp/$1000 Output
1.0	Harvested crops			465.8	123.4	722.6	339.3	722.6	339.3	0.0	0.0	5.85575	2.74959	5.85575	2.74959	0.0	0.0
2.0	Irrigated pasture & all hay	304	92	1,848.6	489.7	8,457.4	3,970.7	8,457.4	3,970.7	0.0	0.0	17.27057	8.10843	17.27057	8.10843	0.0	0.0
3.0	Livestock			17,521.4	8,831.4	710.0	710.0	543.0	543.0	167.0	167.0	0.08039	0.08039	0.06149	0.06149	0.01891	0.01891
6.0	Construction	256	27	26,821.4	2,828.8	5.7	2.5	0.0	0.0	5.7	2.5	0.00201	0.00088	0.0	0.0	0.00201	0.00088
7.1	Non-durable manufacturing	45	2	3,796.2	168.7	0.2	0.1	0.0	0.0	0.2	0.1	0.00119	0.00059	0.0	0.0	0.00119	0.00059
7.2	Durable manufacturing	44	6	4,085.7	557.1	0.5	0.2	0.0	0.0	0.5	0.2	0.00090	0.00036	0.0	0.0	0.00090	0.00036
8.0	Transporation, comm. & utilities	180	14	12,086.3	942.2	2.9	1.3	0.0	0.0	2.9	1.3	0.00308	0.00138	0.0	0.0	0.00308	0.00138
9.1	Wholesale trade	122	12	19,134.5	1,882.1	1.1	0.5	0.0	0.0	1.1	0.5	0.00058	0.00027	0.0	0.0	0.00058	0.00027
9.2	Retail trade	842	50	58,760.0	3,489.3	2.0	0.9	0.0	0.0	2.0	0.9	0.00057	0.00026	0.0	0.0	0.00057	0.00026
10.0	Finance, insurance & real estate	185	18	2,375.8	231.2	0.2	0.1	0.0	0.0	0.2	0.1	0.00087	0.00043	0.0	0.0	0.00087	0.00043
11.0	Services	784	57	11,716.5	854.0	1.1	0.5	0.0	0.0	1.1	0.5	0.00129	0.00059	0.0	0.0	0.00129	0.00059
12.0	Government & public admin.	3,698	148			49.4	47.5	0.0	0.0	49.4	47.5	0.33378	0.32095	0.0	0.0	0.33378	0.32095
	Population	22,751	1,527			51.3	22.8	0.0	0.0	51.3	22.8	0.03360	0.01493	0.0	0.0	0.03360	0.01493
	Urban	14,322	0			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Rural	8,429	1,527			51.3	22.8	0.0	0.0	51.3	22.8	0.03360	0.01493	0.0	0.0	0.03360	0.01493

Dp Depletions in acre-feet.
Wd Withdrawal in acre-feet.

the AWR Basin region of San Miguel County. In short, the AWR Basin region of the county is a rural region economically dependent upon agricultural.

Land and Water Use Profile

There are 1,779,200 acres of San Miguel County located within the AWR Basin, with this area comprising more than 58 percent of the total land area of the county. The topography of the AWR Basin in San Miguel County is characterized as plains and rangeland with numerous arroyos and intermittent streams. The Canadian River flows into the county from the north and joins the Conchas River, which rises in the county southeast of Las Vegas, at Conchas Lake. More than 94 percent of the total land area of the AWR Basin portion of the county is held in private ownership according to data gathered by the SEO and reported in the 1975 County Profile, with the limited public ownerhsip due to the large Pablo Montoya Land Grant, which generally encompasses all of the county east of and including Conchas Lake. See tables 8.2 and 8.3 for details of land ownership and use in San Miguel County.

Of the 2,800 acres of irrigated cropland reported by the SEO in 1980, slightly more than 2,450 acres were in irrigated pasture and hay. All irrigation water was taken from surface water sources and 1,755 acres of the total were found on Sapello Creek, a tributary to the Mora River directly north of Las Vegas. The Bell Ranch in eastern San Miguel County is served by regulated flows from Conchas Lake

TABLE 8.2

SAN MIGUEL COUNTY LAND USE.

	1977	1980	1982
Cropland			
Cropped	12,460	11,620	13,210
Idle	3,060	3,900	2,380
National Forests	339,242	340,193[1]	340,449[3]
Wilderness areas	43,218	59,518[1]	59,518[3]
National grasslands	0	0	0
Public Rangeland			
BLM	47,692	47,692	47,692
State	169,311	169,311	169,311
National Forest	124,700	124,700	124,700
Bureau of Rec.	0	0	0
Commercial Forest Area			
Public	2,246	2,246[3]	2,246[3]
Private	75,436	75,436	75,436[3]
Parks			
State	13,400	13,400	13,400
Game & Fish	623	623	623
Federal	9,037	9,037	9,037
Defense	5	0[2]	0
Urban & Built-Up	4,231	4,231	4,231[3]
Airports	1,350	1,350	1,350
Highways & Roads	13,706	14,016	14,059[2]
Energy Transmission Corridors	1,061	1,112	1,133
Railroads	945	945	945
Population	23,200	22,751	24,600[3]
Assessed Valuation of:			
Real Estate ($000s)	$49,062	56,118	$62,625
Percent Residential			44.7
Percent Nonresidential			55.3
Percent Oil/Gas			0.0

Note: Total Area: 3,050,880 Acres.
Water Area: 11,977 Acres.

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

1 In 1980, 16,300 acres was added to the Pecos Wilderness in the Santa Fe National Forest.

2 Information regarding acreage changes not available.

3 Best available data.

TABLE 8.3

SAN MIGUEL COUNTY LAND USE AND ADMINISTRATION.
(1966-1970 DATA)

	San Miguel County (Acres)	AWR Basin (Acres)	AWR Basin As a Percent Of County	Pecos River Basin (Acres)	Pecos Basin As a Percent Of County
Land Use					
Total area	3,050,880	1,779,200	58.3%	1,224,960	40.2%
Inland waters	11,977	10,843	90.5	1,134	9.5
Urban & built-up	17,249	2,740	15.9	14,509	84.1
Roads	13,629	5,948	43.6	7,661	56.2
Cropland (total)	14,900	3,720	25.0	11,180	75.0
(Irrigated)	(12,900)	(3,720)	28.8	(9,180)	71.2
(Dry)	(2,000)	(0)	0.0	(2,000)	100.0
Defense	5	5	100.0	0	0.0
Parks, F & W.L.	11,388	1,557	13.7	9,831	86.3
Commercial timber	361,721	167,795	46.4	193,926	53.6
Grazing lands (total)	2,620,011	1,586,592	60.6	986,719	37.7
(Non-com. timber)	(760,925)	(489,536)	64.3	(256,969)	33.8
(Range lands)	(1,859,086)	(1,097,056)	59.0	(729,750)	39.3
Land Ownership & Admin.					
Total area	3,050,880	1,779,200	58.3	1,224,960	40.2
Federal lands (total)	394,215	76,616	19.4	300,303	76.2
(Forest Service)	(322,503)	(16,644)	5.2	(289,123)	89.6
(BLM)	(65,273)	(53,533)	82.0	(11,180)	17.1
(Defense)	(5)	(5)	100.0	(0)	0.0
(Miscellaneous)	(6,434)	(6,434)	100.0	(0)	0.0
State lands	173,308	24,253	14.0	139,455	80.5
Private & other misc.	2,482,857	1,678,331	67.6	785,202	31.6

Note: Rio Grande Basin area in San Miguel County 46,720 acres.
Source: Interstate Stream Commission and N.M. State Engineer Office, County Profile, Torrance County, New Mexico (1974), Tables 1 and 2.

and accounted for 900 acres of the total irrigated acres in 1980. The agricultural base of the AWR Basin region of San Miguel County has remained relatively stable through many years, and the development of Conchas Lake as a recreation site has provided a significant diversification of the regional economy. The pattern of water use is clear with more than 98 percent of withdrawals and depletions in 1980 from agricultural uses. The only nonagricultural sector with significant use was the government sector, while the consumption needs of the region's populous can also be mentioned--yet neither of these uses are of any order of magnitude similar to the water use of the agricultural sector.

Economic Development and Water Use Projections

The two major economic activities, agriculture and recreation, will provide for the growth and expansion of the AWR Basin economy on San Miguel County over the next 25 years. The demand for water based recreation can only be expected to increase during the period, particularly because most of the demand will come from populations located outside the AWR Basin region of San Miguel County. The agricultural sector in this region of San Miguel County will be subject to the same vagrancies of climate and markets faced by all agricultural enterprises in this region of the state, yet pressures from the nonagricultural activities found in the AWR Basin area of San Miguel County do not appear to significantly constrain continuation of agricultural dominance of the region. In the AWR Basin

portion of San Miguel County population projections are based on a 1.1 percent annual growth rate, with employment growth projected at a slightly stronger 1.6 percent annual rate.

The impact of this growth on the water supplies of the region, as described in table 8.4, is almost insignificant. Total withdrawals are anticipated to increase 106.6 acre-feet, and total depletions are expected to increase 79.9 acre-feet annually by the end of the 25-year projection period. Increases in the water demands of livestock, government and population account for more than 70 percent of withdrawal increases and more than 80 percent of depletion increases. The distribution of these increases between surface and groundwater sources is somewhat unclear, yet the limited total quantity of the increased demands suggest only limited impacts associated with the availability of water supplies in the AWR Basin portion of San Miguel County.

SAN MIGUEL COUNTY--PECOS RIVER BASIN

Economic and Demographic Profile

Total 1980 population for the Pecos River Basin portion of San Miguel County was 21,224, representing more than 93 percent of the total county population. More than two-thirds of this population was found in the county's only urban area, with the population of Las Vegas reported to be 14,322 in 1980 (table 8.5). There was almost no population growth for the county during the period between 1970 and 1980 censuses, with the total population change during that period

TABLE 8.4

WATER USE PROJECTIONS
SAN MIGUEL COUNTY
AWR RIVER BASIN.

Sector Number	Sector Description	1980 Output ($1000)	Growth Rate	2005 Output ($1000)	Total Wd	Total Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Net Change (Total Wd)	Net Change (Total Dp)
1.0	Harvested crops	123.4	0.3820%	135.7	754.9	354.5	754.9	354.5	0.0	0.0	32.3	15.2
2.0	Irrigated pasture & all hay	489.7	0.1954	514.2	8,436.5	3,960.9	8,436.5	3,960.9	0.0	0.0	-20.9	-9.8
3.0	Livestock	8,831.4	0.1954	9,273.0	745.5	745.5	570.2	570.2	175.4	175.4	35.5	35.5
6.0	Construction	2,828.8	3.5274	6,729.5	13.5	5.9	0.0	0.0	13.5	5.9	7.8	3.4
7.1	Non-durable manufacturing	168.7	3.5274	401.3	0.5	0.2	0.0	0.0	0.5	0.2	0.3	0.1
7.2	Durable manufacturing	557.1	3.5274	1,325.3	1.2	0.5	0.0	0.0	1.2	0.5	0.7	0.3
8.0	Transporation, Comm. & utilities	942.2	3.5274	2,241.4	6.9	3.1	0.0	0.0	6.9	3.1	4.0	1.8
9.1	Wholesale trade	1,882.1	3.5274	4,477.4	2.6	1.2	0.0	0.0	2.6	1.2	1.5	0.7
9.2	Retail trade	3,489.3	3.5274	8,300.8	4.7	2.2	0.0	0.0	4.7	2.2	2.7	1.3
10.0	Finance, insurance & real estate	231.2	3.5274	550.0	0.5	0.2	0.0	0.0	0.5	0.2	0.3	0.1
11.0	Services	854	3.5274	2,031.6	2.6	1.2	0.0	0.0	2.6	1.2	1.5	0.7
12.0	Government & public admin.	148	1.6140	221	73.8	70.9	0.0	0.0	73.8	70.9	24.4	23.4
	Population	1,527	1.1220	2,018	67.8	30.1	0.0	0.0	67.8	30.1	16.5	7.2
	Rural	1,527	1.1220	2,018	67.8	30.1	0.0	0.0	67.8	30.1	16.5	7.2
											106.6	79.9

Dp Depletions in acre-feet.
Wd Withdrawal in acre-feet.

TABLE 8.5

1980 OUTPUT AND WATER USE COEFFICIENTS
SAN MIGUEL COUNTY
PECOS RIVER BASIN.

Secter Number	Sector Description	1980 Employment	1980 Pecos Employment	1980 Output ($1000)	1980 Pecos Output ($1000)	Total Pecos Wd	Total Pecos Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	AF Total Wd/$1000 Output	AF Total Dp/$1000 Output	AF Surface Wd/$1000 Output	AF Surface Dp/$1000 Output	AF Ground Wd/$1000 Output	AF Ground Dp/$1000 Output
1.0	Harvested crops			465.8	342.4	1,495.4	690.6	1055.4	440.6	440.0	250.0	4.36741	2.01694	3.08236	1.28680	1.28680	0.73014
2.0	Irrigated pasture & all hay	304	212	1,848.6	1,358.9	17,164.6	7,929.4	17,164.6	7,929.4	0.0	0.0	12.63125	5.83501	12.63125	5.83501	0.0	0.0
3.0	Livestock			17,521.4	8,690.0	683.0	681.0	510.0	510.0	173.0	171.0	0.07860	0.07837	0.05869	0.05869	0.01991	0.01968
5.4	Non-metallic mining & quarrying	*	2	244.7	244.7	23.0	5.0	0.0	0.0	23.0	5.0	0.09399	0.02043	0.0	0.0	0.09399	0.02043
6.0	Construction	256	229	26,821.4	23,992.6	220.7	112.9	163.7	80.2	57.0	32.7	0.00920	0.00471	0.00682	0.00334	0.00238	0.00136
7.1	Non-durable manufacturing	45	43	3,796.2	3,627.5	11.7	6.0	9.4	4.3	2.3	1.7	0.00323	0.00165	0.00259	0.00119	0.00063	0.00047
7.2	Durable manufacturing	44	38	4,085.7	3,528.6	11.5	5.9	9.3	4.2	2.2	1.7	0.00326	0.00167	0.00264	0.00119	0.00062	0.00048
8.0	Transporation, Comm.& utilities	180	166	12,086.3	11,144.1	168.7	86.3	136.2	61.3	32.5	25.0	0.01514	0.00774	0.01222	0.00550	0.00292	0.00224
9.1	Wholesale trade	122	110	19,134.5	17,252.4	45.0	23.0	36.3	16.3	8.7	6.7	0.00261	0.00133	0.00210	0.00094	0.00050	0.00039
9.2	Retail trade	842	792	58,760.0	55,270.7	143.9	73.6	116.2	52.3	27.7	21.3	0.00260	0.00133	0.00210	0.00095	0.00050	0.00039
10.0	Finance, insurance & real estate	185	167	2,375.8	2,144.6	10.9	5.6	8.8	4.0	2.1	1.6	0.00508	0.00261	0.00410	0.00187	0.00098	0.00075
11.0	Services	784	725	11,716.5	10,862.5	170.8	93.2	157.2	82.7	13.6	10.5	0.01572	0.00858	0.01447	0.00761	0.00125	0.00097
12.0	Government & public admin.	3,698	3,550			414.5	212.1	334.7	150.7	79.8	61.4	0.11676	0.05975	0.09428	0.04245	0.02248	0.01730
	Population	22,751	21,224			2,151.3	968.4	1,737.0	781.6	414.3	186.8	0.10136	0.04563	0.08184	0.03683	0.01952	0.00880
	Urban	14,322	14,322			1,764.7	794.1	1,737.0	781.6	27.7	12.5	0.12322	0.05545	0.12128	0.05457	0.00193	0.00087
	Rural	8,429	6,902			386.6	174.3	0.0	0.0	386.6	174.3	0.05601	0.02525	0.0	0.0	0.05601	0.02525

* Disclosure - employment included in services.
Dp Depletions in acre-feet.
Wd Withdrawal in acre-feet.

less than 4 percent. The economy of the county, and the Pecos River Basin portion of the county as well, has been historically dependent upon government employment--principally employment at the state psychiatric hospital, public schools, and New Mexico Highlands University. In 1980, more than 56 percent of total employment in the Pecos River Basin region of San Miguel County was provided by the government sector, with one out of every six residents of the region employed in government jobs. The other major employment sectors of the Pecos River Basin economy in San Miguel County are trade and services.

Total economic output for the Pecos River Basin region of San Miguel County is estimated to be $138.5 million in 1980, with more than 52 percent of this total output attributable to wholesales and retail trade activities. The urban nature of the region, as well as topographic constraints faced by agriculture in the Pecos River Basin, is reflected in the fact that less than 8 percent of total employment in the region is provided by agriculture, and that agricultural outputs comprise about 7.5 percent of total econmic output estimated for the region. Next to trade, construction activities provided the second highest level of output for the region, with the value of construction output in 1980 estimated to be nearly $24 million for the Pecos River Basin portion of San Miguel County. The previously mentioned fiberboard plant will help to diversify the county's economy, with the value of output from this operation adding to the output of the durable manufacturing sector. In 1980 the durable manufacturing sector contributed less than 3 percent to total county output.

Land and Water Use Profile

It is estiamted that 1,224,960 acres of San Miguel County are located within the Pecos River Basin, with this area comprising approximately 40 percent of the total land area (tables 8.2 and 8.3). The portion of the county in which the Pecos River Basin is located ranges from the mountainous terrain of the Sangre de Cristos in the northwestern corner and along the western border of the county, giving way to Glorieta Mesa in the southwestern corner and the Las Vegas plateau in the center of the county. Approximately 28 percent of the total land area included in the Pecos River Basin region of the county was held as National Forest in 1980, with the recreation opportunities provided by this area of significant importance of future economic development of the county. Private land ownership is also significant, with the 1975 County Profile reporting more than 64 percent of the Pecos River Basin area held in private ownership in San Miguel County.

Even though agricultural activities account for only a small portion of employment and output in the Pecos River Basin in San Miguel County, agricultural activities dominate the use of water supplies in the region. Water use data published by the SEO for 1980 shows that more than 85 percent of total water withdrawals and depletions were for irrigated agriculture, with nearly 90 percent of this water use occuring in the irrigated pasture and hay production. The only other major water use reported in table 8.5 for the Pecos River Basin region of San Miguel County was for satisfaction of water requirements of the population of the region.

The largest of the agricultural areas under irrigation in 1980 was the Storrie Project, where there was irrigation of 4,350 acres of the 7,620 irrigated acres reported for the Pecos River Basin area of San Miguel County. With the exception of 150 acres served by a groundwater source of supply, all the agricultural water use in the Pecos region of San Miguel was provided by surface water supplies. The SEO also reports that the Storrie Project users received only 50 percent of their crop's consumptive irrigation requirement (CIR) demands; thus, water use and water availability reported in table 8.5 is less than the "desired" or "normal" supplies of water for agricultural uses in the Pecos Basin region of San Miguel County during 1980--and crop yields may also be less than found under normal supply conditions.

The urban water demands of population and economic activities in Las Vegas are satisfied by both surface water and groundwater sources of supply. In the 1975 County Profile it is stated that as of 1970, Las Vegas had water rights sufficient to allow withdrawal of 2,600 acre-feet of surface water and 1,400 acre-feet of groundwater. In 1980, the SEO reported that urban withdrawals were 2,644 acre-feet of surface water and 7 acre-feet of groundwater, clearly allowing some room for growth in urban water demands (including economic uses served by the city water system) without need for acquisition of additional wate rights by Las Vegas.

Economic Development and Water Use Projections

The increasing diversification of the San Miguel County economy found in the Pecos River Basin region, as contrasted with the historic dependence on the government sector, provides for a more optimistic outlook reflected by reversal of declining trends in the regional economy. The introduction of new manufacturing into the economy, as well as increased utilization of the available recreation resources will fuel much of the anticipated growth. Trade and service sectors will correspondingly grow in association with these changes in the county's economic base. The observed historic trends in out-migration are expected to be reversed, and the nonagricultural employment growth observed during the 1970 through 1981 period is expected to continue. It is likely that the government sector will continue to dominate employment in the region, although there is anticipated less vigorous growth in this sector than anticipated for the other nonagricultural sectors. Population projections for the Pecos River Basin region of San Miguel County are based on a 1.1 percent annual growth rate, with employment projected to increase at a 1.6 percent annual rate.

The impact on water supplies associated with the projected growth in the population and the economy of the Pecos River Basin portion of San Miguel County is distributed broadly across several economic sectors of the region. The projected net change in total water withdrawals of 1,773.8 acre-feet per year, and 872.3 acre-feet depletions (table 8.6), suggest that the water supplies defined by 1980 water uses will be substantially insufficient to satisfy the

TABLE 8.6

WATER USE PROJECTIONS
SAN MIGUEL COUNTY
PECOS RIVER BASIN.

Sector Number	Sector Description	1980 Output ($1000)	Growth Rate	2005 Output ($1000)	Total Wd	Total Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Net Change (Total Wd)	Net Change (Total Dp)
1.0	Harvested crops	342.4	0.381%	376.6	1,538.8	707.9	1,102.8	460.4	436.1	247.5	43.4	17.3
2.0	Irrigated pasture & all hay	1,358.9	0.195	1,426.8	17,121.2	7,909.1	17,121.2	7,909.1	0.0	0.0	-43.4	-20.1
3.0	Livestock	8,690.0	0.195	9,124.5	717.2	715.1	535.5	535.5	181.7	179.6	34.2	34.1
5.4	Non-metallic mining & quarrying	244.7	0.195	256.9	24.1	5.2	0.0	0.0	24.1	5.2	1.1	0.2
6.0	Construction	23,992.6	3.527	57,076.7	525.1	268.2	389.3	190.6	135.8	77.6	304.4	155.3
7.1	Non-durable manufacturing	3,627.5	3.527	8,629.6	27.8	14.4	22.4	10.3	5.4	4.1	16.1	8.4
7.2	Durable manufacturing	3,528.6	3.527	8,394.3	27.4	14.0	22.2	10.0	5.2	4.0	15.9	8.1
8.0	Transporation, comm. & utilities	11,144.1	3.527	26,511.0	401.4	205.2	324.0	145.8	77.4	59.4	232.7	118.9
9.1	Wholesale trade	17,252.4	3.527	41,042.3	106.7	54.6	86.2	38.6	20.5	16.0	61.7	31.6
9.2	Retail trade	55,270.7	3.527	131,485.2	341.8	176.2	276.1	124.9	65.7	51.3	197.9	102.6
10.0	Finance, insurance & real estate	2,144.6	3.527	5,101.9	25.9	13.3	20.9	9.5	5.0	3.8	15.0	7.7
11.0	Services	10,862.5	3.527	25,841.1	406.2	221.8	373.9	196.7	32.3	25.1	235.4	128.6
12.0	Government & public admin.	3,550	1.614	5,297	618.5	286.7	499.4	195.1	119.1	91.6	204.0	74.6
	Population	21,224	1.122	28,052	2,606.7	1,173.4	2,059.6	926.7	547.1	246.7	455.4	205.0
	Urban	14,322	1.103	18,869	2,092.4	941.5	2,059.6	926.7	32.8	14.8	327.7	147.4
	Rural	6,902	1.142	9,183	514.3	231.9	0.0	0.0	514.3	231.9	127.7	57.6
											1,773.8	872.3

Dp Depletions in acre-feet.
Wd Withdrawal in acre-feet.

increased demand requirements. If the SEO characterization of Las Vegas water rights is accurate, and specifically if the city in 1980 withdrew 1,393 acre-feet less than its maximum groundwater right, then these dmenad increases can likely be met in large part by expansion of use to the city's full right. Still, some supply shortage would exist, and it must also be noted that these agricultural use projections are based on a 50 percent CIR supply to the Storrie Project. The largest increase in demands occurs in the satisfaction of the consumption requirements of the region's population, although projected growth in the construction sector also provides for a large increase in water demands. Other notably large increases are predicted in services, retail trade, TCU, and government. In short, the economic growth and water use projections suggest that water scarcity will be significant by the year 2005 in the Pecos River Basin portion of San Miguel County.

CHAPTER IX

GUADALUPE COUNTY

Guadalupe County is an entirely rural county with an agricultural base augmented with trade activities generated by travelers on Interstate 40 which crosses the northern third of the county from east to west. Irrigated acreage has remained relatively constant over several decades, and few other resources are available to the county for diversified economic development. The location of Santa Rosa approximately halfway between the eastern border of the state and Albuquerque provides a logical stopping point for many travelers, and is the primary nonagricultural stimulus to the county's economy.

In the following analysis of demography, economic activity, and water use in Guadalupe County there will be presented separately data for the portions of the county located in the two surface water basins which provide for the county's water supplies. The agricultural eocnomy of the northeastern corner of the county which is served by AWR Basin water supplies will be discussed apart from the larger and slightly more economically diverse remainder of Guadalupe County through which the Pecos River flows and where Santa Rosa is found. There will be some overlap between the separate descriptions of the two hydrologic regions, and the assumptions employed in the projections of water use and economic activities will be largely the same due to their derivation from county-wide data and trends. The first section of this discussion wil be devoted to the Pecos River Basin located in Guadalupe County, and is followed by the discussion of the much smaller AWR Basin portion of the county.

GUADALUPE COUNTY--PECOS RIVER BASIN

Economic and Demographic Profile

The population in the Pecos River Basin portion of Guadalupe County stood at 4,411 in 1980, with this representing more than 98 percent of the county's total population. More than 55 percent of the region's population was located in Santa Rosa, with the 2,469 population count for this town in 1980 being just less than the urban status definition (i.e., populations of 2,500 or more). Throughout the 1970s Guadalupe County experienced population declines as a result of out-migration, and even Santa Rosa lost population with the 1980 population count showing 16 less people than in 1970. The county ranked 28th in total population in 1980 as compared to the other counties in the state, and nonagricultural employment levels ranked the county similarly. Total employment in the Pecos River Basin portin of Guadalupe County was 1,568 in 1980, with this comprising more than 97 percent of the total jobs in the county (table 9.1).

Employment in the Pecos River Basin portion of Guadalupe County is dominated by three sectors: retail trade with approximately 25 percent of total basin employment, government and agriculture, with each of the latter providing nearly 23 percent of total basin employment. The services sector must also be mentioned as important to the basin economy providing more than 16 percent of the employment in the region. Guadalupe County has traditionally been one of the state's poorer counties, and this is reflected in part by the high unemployment rate in the county which averaged 11.2 percent, compared to the

TABLE 9.1

1980 OUTPUT AND WATER USE COEFFICIENTS
GUADALUPE COUNTY
PECOS RIVER BASIN.

Secter Number	Sector Description	1980 Employment	1980 Pecos Employment	1980 Output ($1000)	1980 Pecos Output ($1000)	Total Pecos Wd	Total Pecos Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	AF Total Wd/$1000 Ouput	AF Total Dp/$1000 Ouput	AF Surface Wd/$1000 Output	AF Surface Dp/$1000 Output	AF Ground Wd/$1000 Output	AF Ground Dp/$1000 Output
1.0	Harvested crops			448.3	448.3	1,791.4	893.4	1,652.1	813.3	139.3	80.1	3.99598	1.99286	3.68526	1.81419	0.31073	0.17867
2.0	Irrigated pasture & all hay	392	358	638.1	638.1	13,648.6	6,806.6	12,587.9	6,196.7	1,060.7	609.9	21.38944	10.66698	19.72716	9.71117	1.66228	0.95581
3.0	Livestock			18,235.0	14,937.0	1,276.0	1,274.0	972.0	972.0	304.0	302.0	0.08543	0.08529	0.06507	0.06507	0.02035	0.02022
6.0	Construction	48	47	8,883.1	8,698.0	90.4	45.4	0.0	0.0	90.4	45.4	0.01039	0.00522	0.0	0.0	0.01039	0.00522
7.0	Manufacturing	*	38	1,480.2	1,480.2	5.4	2.7	0.0	0.0	5.4	2.7	0.00365	0.00182	0.0	0.0	0.00365	0.00182
8.0	Transportation, comm. & utilities	61	56	2,362.6	2,168.9	37.0	18.6	0.0	0.0	37.0	18.6	0.01706	0.00858	0.0	0.0	0.01706	0.00858
9.1	Wholesale trade	408	8	6,652.1	6,652.1	19.5	9.8	0.0	0.0	19.5	9.8	0.00293	0.00147	0.0	0.0	0.00293	0.00147
9.2	Retail trade		395	32,130.1	31,728.5	93.0	46.8	0.0	0.0	93.0	46.8	0.00293	0.00148	0.0	0.0	0.00293	0.00148
10.0	Finance, insurance & real estate	52	52	67.5	67.5	0.4	0.2	0.0	0.0	0.4	0.2	0.00593	0.00296	0.0	0.0	0.00593	0.00296
11.0	Services	292	254	4,106.1	4,106.1	194.1	149.1	26.0	26.0	168.1	123.1	0.04727	0.03631	0.00633	0.00633	0.04094	0.02998
12.0	Government & public admin.	360	360			47.4	23.8	0.0	0.0	47.4	23.8	0.13167	0.06611	0.0	0.0	0.13167	0.06611
	Population	4,496	4,411			395.8	162.4	0.0	0.0	395.8	162.4	0.08973	0.03682	0.0	0.0	0.08973	0.03682
	Rural	4,496	4,411			395.8	162.4	0.0	0.0	395.8	162.4	0.08973	0.03682	0.0	0.0	0.08973	0.03682

* Disclosure-employment included in services.
Dp Depletions in acre-feet.
Wd Withdrawal in acre-feet.

statewide average of 7.75 percent, during the 12-year period between 1970 and 1981. Also reflecting this poorer status is the face that Guadalupe County ranked 4th among all counties in the percentage of government transfer payments to total personal income in 1980.

Total economic output for 1980 in the Pecos River Basin portion of Guadalupe County is estimated to be $70.9 million, with this providing more than 94.5 percent of the total estimated output for the county. The value of sales in retail trade clearly dominates economic output for the region, with nearly 45 percent of the total output of the Pecos River Basin portion of Guadalupe County provided by this sector. The more than $16 million of agricultural output provides for an additonal 22.6 percent of the regional output. The remaining sectors of the county's Pecos Basin economy are significantly smaller, but exhibit relatively balanced diversity in their contributions to the regional economic output.

Land and Water Use Profile

The total area of the Pecos River Basin portion of Guadalupe County is 1,638,400, which amounts to more than 85 percent of the total lands area of the county. More than 85 percent of the total land area in the Pecos River Basin portion of the county is held in private ownership with state and federal lands, most of which are public rangelands, accounting for the remainder of the land area in this region of the county. See tables 9.2 and 9.3 for details of Guadalupe County land ownership and use. The landscape of Guadalupe

TABLE 9.2

GUADALUPE COUNTY LAND USE.

	1977	1980	1982
Cropland			
Cropped	4,340	4,160	4,390
Idle	2,540	2,720	2,440
National Forests	0	0	0
Wilderness areas	0	0	0
National grasslands	0	0	0
Public Rangeland			
BLM	49,584	49,584	49,584
State	161,220	161,220	161,220
National Forest	0	0	0
Bureau of Rec.	320	320	320
Commercial Forest Area			
Public	0	0	0
Private	0	0	0
Parks			
State	0	0	0
Game & Fish	27	27	27
Federal	0	0	0
Defense	0	0	0
Urban & Built-Up	1,375	1,375	1,375
Airports	100	100	100
Highways & Roads	12,711	12,798	12,863[1]
Energy Transmission Corridors	1,251	1,254	1,271
Railroads	1,651	1,615[2]	1,658[2]
Population	4,900	4,496	4,500
Assessed Valuation of:			
Real Estate ($000s)	17,131	15,284	16,852
Percent Residential			15.0
Percent Nonresidential			85.0
Percent Oil/Gas			0.0

Note: Total Area: 1,919,360 Acres.
Water Area: 1,225 Acres.

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

1 Information not available regarding acreage change.

2 Best available data.

TABLE 9.3

GUADALUPE COUNTY LAND USE AND ADMINISTRATION.
(1966-1970 DATA)

	Guadalupe County (Acres)	Pecos River Basin (Acres)	Pecos Basin As a Percent Of County	AWR Basin (Acres)	AWR Basin As a Percent Of County
Land Use					
Total area	1,919,360	1,638,400	85.4%	180,960	14.6%
Inland waters	1,225	1,225	100.0	0	0.0
Urban & built-up	17,052	16,932	99.3	120	0.7
Roads	12,702	10,987	86.5	1,715	13.5
Cropland (total)	6,540	6,540	100.0	0	0.0
(Irrigated)	(3,830)	(3,830)	100.0	0	0.0
(Dry)	(2,710)	(2,710)	100.0	0	0.0
Parks, F & W.L.	2,667	2,667	100.0	0	0.0
Commercial timber	438	438	100.0	0	0.0
Grazing lands (total)	1,878,736	1,599,611	85.1	279,125	14.9
(Non-comm. timber)	(323,676)	(157,214)	48.6	(166,462)	51.4
(Range lands)	(1,555,060)	(1,442,397)	92.8	(112,663)	7.2
Land Ownership & Admin.					
Total area	1,919,360	1,638,400	85.4	280,960	14.6
Federal lands (total)	120,053	117,833	98.2	2,220	1.8
(BLM)	(117,488)	(115,268)	98.1	(2,220)	1.9
(Miscellaneous)	(2,565)	(2,565)	100.0	(0)	0.0
State lands	177,810	123,760	69.6	54,050	30.4
Private & other misc.	1,621,497	1,396,807	86.1	224,690	13.9

Source: Interstate Stream Commission and N.M. State Engineer Office, County Profile, Torrance County, New Mexico (1974), Tables 1 and 2.

County consists of large expanses of plains interrupted with numerous small hills and mesas. The area is drained by a of web arroyos that enter the Pecos River from both sides. The Pecos River traverses the county generally from northwest to southwest, and most of the vegetation in the county consists of native grassland. There are no national forests, and Santa Rosa Lake State Park is the only public recreation facility located in the county.

Most of the irrigated lands of the Pecos River Basin portion of Guadalupe County are located in the northwest corner of the county, with the majority of water supplies provided by surface water sources. There is no storage regulation of surface water used for irrigation in Guadalupe County, and many of the diversion ditches are part of community acequia systems. Total water withdrawals in the Pecos Basin region of the county in 1980 were 17,599 acre-feet (table 9.1) and total depletions in this area of Guadalupe County were 9,433. Approximately 95 percent of both withdrawals and depletions were for agricultural uses, with more than 75 percent of the agricultural depletions and nearly 82 percent of agricultural withdrawals the result of pasture and hay irrigation. There were two other major water uses in the Pecos Basin region of the county in 1980: use of water by the population of the region and water use in the services sector. The majority of service sector water use is the result of golf course irrigation in Santa Rosa, and between agriculture, services, and population requirements, more than 98 percent of the region's water use is accounted for.

Economic Development and Water Use Projections

The economy of the Pecos Basin portion of Guadalupe County appears to be relatively stable. Trade activities generated along Interstate 40 are likely to continue with some expansion, and agricultural lands have been stable for many years and are likely to remain so. Recently there has been some gas well exploration activity, although no significant mineral or petroleum resources are presently under development in the area. In short, there seems to be limited growth potential for the county as a whole, with most growth attributable to growth in travel and tourism statewide and increased efficiency in agricultural production practices. Population is anticipated to grow slightly in the future at a 1.0 percent annual rate, and total employment is projected to grow at an even slower 0.4 percent annual rate, in accordance with the projections of Temple and Wombold.

The effects of these population and employment growth rates in the 25-year projection of future demands are presented in table 9.4. In these projections harvest crop output is expected to increase a total of 10 percent over the projection period, output from irrigated pasture and hay is expected to increase 5 percent as is total value of livestock sales. Combined with some slight changes in the efficiency of water use, the net impact of these growth projections suggest that there will be an additional 400 acre-feet of water withdrawals demand, and a corresponding 239 acre-feet of water depletions required by 2005 to accommodate this limited growth. The majority of the increases in water demands occur in the agricultural sector and

TABLE 9.4

WATER USE PROJECTIONS
GUADALUPE COUNTY
PECOS RIVER BASIN.

Sector Number	Sector Description	1980 Output ($1000)	Growth Rate	2005 Output ($1000)	Total Wd	Total Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Net Change (Total Wd)	Net Change (Total Dp)
1.0	Harvested crops	448.3	0.381%	493.1	1,864.2	929.1	1,726.3	849.8	137.9	79.3	72.8	35.7
2.0	Irrigated pasture & all hay	638.1	0.195	670.0	13,614.3	6,789.6	12,556.3	6,181.2	1,058.0	608.4	-34.3	-17.0
3.0	Livestock	14,937.0	0.195	15,683.9	1,339.8	1,337.7	1,020.6	1,020.6	319.2	317.1	63.8	63.7
6.0	Construction	8,698.0	1.343	12,140.4	126.1	63.4	0.0	0.0	126.1	63.4	35.7	18.0
7.0	Manufacturing	1,480.2	1.343	2,066.0	7.5	3.8	0.0	0.0	7.5	3.8	2.1	1.1
8.0	Transportation, comm. & utilities	2,168.9	1.343	3,027.3	51.6	25.9	0.0	0.0	51.6	25.9	14.6	7.3
9.1	Wholesale trade	6,652.1	1.343	9,284.8	27.2	13.6	0.0	0.0	27.2	13.6	7.7	3.8
9.2	Retail trade	31,728.5	1.343	44,285.5	129.8	65.5	0.0	0.0	129.8	65.5	36.8	18.7
10.0	Finance insurance & real estate	67.5	1.343	94.2	0.6	0.3	0.0	0.0	0.6	0.3	0.2	0.1
11.0	Services	4,106.1	1.343	5,731.2	270.9	208.1	36.3	36.3	234.6	171.8	76.8	59.0
12.0	Government & public admin.	360.0	0.391	397	52.3	26.2	0.0	0.0	52.3	26.2	4.9	2.4
	Population	4,411	1.008	5,668	508.6	208.7	0.0	0.0	508.6	208.7	118.8	46.3
	Rural	4,411	1.008	5,668	508.6	208.7	0.0	0.0	508.6	208.7	118.8	46.3
											399.9	239.1

Dp Depletions in acre-feet.
Wd Withdrawals in acre-feet.

TABLE 9.5

1980 OUTPUT AND WATER USE COEFFICIENTS
GUADALUPE COUNTY
AWR RIVERS BASIN.

Secter Number	Sector Description	1980 Employment	1980 AWR Employment	1980 Output ($1000)	1980 AWR Output ($1000)	Total AWR Wd	Total AWR Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	AF Total Wd/$1000 Ouput	AF Total Dp/$1000 Ouput	AF Surface Wd/$1000 Output	AF Surface Dp/$1000 Output	AF Ground Wd/$1000 Output	AF Ground Dp/$1000 Output
3.0	Livestock	392	34	18,235.0	3,298.0	97.0	97.0	36.0	36.0	61.0	61.0	0.02941	0.02941	0.01092	0.01092	0.01850	0.01850
6.0	Construction	48	1	8,883.1	185.1	0.3	0.1	0.0	0.0	0.3	0.1	0.00162	0.00054	0.0	0.0	0.00162	0.00054
8.0	Transportation, comm. & utilities	61	5	2,362.6	193.7	0.7	0.3	0.0	0.0	0.7	0.3	0.00361	0.00155	0.0	0.0	0.00361	0.00155
9.2	Retail trade	400	5	32,130.1	401.6	0.2	0.1	0.0	0.0	0.2	0.1	0.00050	0.00025	0.0	0.0	0.00050	0.00025
	Population	4,496	85			3.8	1.5	0.0	0.0	3.8	1.5	0.04471	0.01765	0.0	0.0	0.04471	0.01765
	Rural	4,496	85			3.8	1.5	0.0	0.0	3.8	1.5	0.04471	0.01765	0.0	0.0	0.04471	0.01765

Dp Depletions in acre-feet.
Wd Withdrawals in acre-feet

in the consumption demands of the population in the Pecos River Basin region of Guadalupe County. These are not extremely large increases in water demands, but will serve to aggravate already scarce water supply conditions in the basin as a whole.

GUADALUPE COUNTY--AWR BASIN

Economic and Demographic Profile

The AWR Basin portion of Guadalupe County had a total population of 85 in 1980, and a total employment of 45. The area is of such small size that economic and demographic data reported in table 9.5 must be recognized as estimated based on county aggregates allocated in accord with enumeration district sectoral employment, and are thus only approximations of output in the nonagricultural sectors. The agricultural sector data is of much more direct derivation, with reliance on SEO reported acreage and cropping patterns for output estimates.

Livestock production dominates employment in the AWR Basin region of Guadalupe County, with 34 of the regions 45 employed persons working this sector during 1980. Retail trade and TCU lead nonagricultural employment, with some construction employment. Interstate 40 provides for much of the nonagricultural economic activity, with interchanges at the small town of Cuervo and Newkirk. Total estimated economic output for the small region of Guadalupe County is approximately $4.1 million, with more than 80 percent of this estimated output derived from livestock sales.

Land and Water Use Profile

The AWR Basin region of Guadalupe County is drained principally by the intermittent Cuervo Creek, and consists of plains, small hills, and arroyos. The total area of the region is 280,960 acres, representing less than 15 percent of the total area of Guadalupe County (tables 9.2 and 9.3). Nearly 80 percent of the total area is held in private ownership, with the remainder of the AWR Basin area of Guadalupe County held as BLM rangeland. The land use of the region is exclusively open range, with the dominant water use reflecting this circumstance. Total withdrawals in the region reported by the SEO in 1980 were 102 acre-feet, and total depletions were 99 acre-feet in the AWR Basin region of Guadalupe County. Of this total, only 5 acre-feet withdrawals and 2 acre-feet depletions were attributable to purposes other than livestock production. Stockpond evaporation and livestock water consumption requirements were the principal uses of water in the region.

Economic Development and Water Use Projections

The economy of the AWR Basin portion of Guadalupe County is totally dependent upon two circumstances: first, the conditions of livestock markets and available range grasses; and second, economic activity generated by the locational circumstances of Interstate 40. Stated succinctly, potential economic growth is highly constrained. The projections of output and water use in the AWR Basin region

of Guadalupe County are presented in table 9.6. Output from livestock production is expected to increase a total of 5 percent during the 25-year projection period, and population is projected to grow 1.0 percent per annum. Associated with these economic and demographic growth projections are increases in water demands totaling 6.5 acre-feet for withdrawals and 5.4 acre-feet in depletions, as shown in table 9.6. These changes in water use demand must be considered inconsequential relative to water supply and demand scarcity conditions in the AWR Basin as a whole.

TABLE 9.6

WATER USE PROJECTIONS
GUADALUPE COUNTY
AWR RIVER BASIN.

Sector Number	Sector Description	1980 Output ($1000)	Growth Rate	2005 Output ($1000)	Total Wd	Total Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Net Change (Total Wd)	Net Change (Total Dp)
3.0	Livestock	3,298.0	0.195%	3,462.9	101.9	101.9	37.8	37.8	64.1	64.1	4.9	4.9
6.0	Construction	185.1	1.343	258.4	0.4	0.1	0.0	0.0	0.4	0.1	0.1	0.0
8.0	Transportation, comm. & utilities	193.7	1.343	270.4	1.0	0.4	0.0	0.0	1.0	0.4	0.3	0.1
9.2	Retail trade	401.6	1.343	560.5	0.3	0.1	0.0	0.0	0.3	0.1	0.1	0.0
	Population	85	1.008	109	4.9	1.9	0.0	0.0	4.9	1.9	1.1	0.4
	Rural	85	1.008	109	4.9	1.9	0.0	0.0	4.9	1.9	1.1	0.4
											6.5	5.4

Dp Depletions in acre-feet.
Wd Withdrawals in acre-feet.

CHAPTER X

QUAY COUNTY

The economy of Quay County provides a diverse mix of both agricultural and nonagricultural activities. Although the economy of the county is not large with respect to a statewide importance, it is a highly significant component of the economy of the AWR Basin, and ranks second in the basin with respect to both population and employment behind Colfax County. The diversity of the agricultural and nonagricultural mix is clearly illustrated by the relationship between the county's only urban area, Tucumcari, and the agricultural area which physically surrounds the city as a result of the Bureau of Reclamation's Tucumcari Project. Arch Hurley Conservancy District, which is a principal beneficiary of the Tucumcari Project, is also the largest of the irrigation districts in the AWR Basin. Additionally, a portion of southwestern Quay County is served by Pecos River Basin water supplies, with the economy of this area entirely dependent upon agricultural activities.

In the following analysis of demography, economic activity, and water use in Quay County there will be presented separately data for the portions of the county located in the two surface water basins which provide for the county's water supplies. The diverse economic and demographic conditions of the AWR Basin region of Quay County will be presented apart from the far more rural Pecos River Basin region of the county, with comparisions of each region to county aggregates provided when appropriate. There will be some overlap between the separate descriptions of the two hydrologic regions, and

the assumptions employed in the projections of water use and economic activities will be largely the same due to their derivation from county-wide data and trends. The first section of this discussion will be devoted to the AWR Basin located in Quay County, followed by the discussion of the Pecos River Basin in the county.

QUAY COUNTY--AWR BASIN

Economic and Demographic Profile

Of the total 10,577 people living in Quay County in 1980, more than 98 percent lived in the AWR Basin, with a total population in 1980 of 10,374 residing in this portion of the county. The urban population of Tucumcari accounts for 6,765 persons, or more than 65 percent of the total basin population. In-migration added nearly 400 persons between 1970 and 1971, with out-migration characterizing the population change in Quay County since 1971. In total, there was a 3 percent decline in the population of Quay County between 1970 and 1980, although differences in population trends between the AWR Basin and the county as a whole cannot be specifically identified due to changed census enumeration district boundary definitions.

Total employment in 1980 for the AWR Basin portion of Quay County was 4,105, with agricultural employment accounting for more than 22 percent of the total (table 10.1). The wholesale and retail trade sectors provided the largest employment in 1980, with their combined employment of 936 comprising nearly 23 percent of total employment in the basin. All government employment in Quay

TABLE 10.1

1980 OUTPUT AND WATER USE COEFFICIENTS
QUAY COUNTY
AWR RIVERS BASIN.

Secter Number	Sector Description	1980 Employment	1980 AWR Employment	1980 Output ($1000)	1980 AWR Output ($1000)	Total AWR Wd	Total AWR Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	AF Total Wd/$1000 Output	AF Total Dp/$1000 Output	AF Surface Wd/$1000 Output	AF Surface Dp/$1000 Output	AF Ground Wd/$1000 Output	AF Ground Dp/$1000 Output
1.0	Harvested crops			4,604.8	4,263.9	41,277.5	17,047.8	29,597.5	9,687.8	11,680.0	7,360.0	9.68069	3.99817	6.94142	2.27205	2.73928	1.72612
2.0	Irrigated pasture & all hay	978	924	4,418.1	3,732.6	43,152.5	17,822.2	43,152.5	17,822.2	0.0	0.0	11.56098	4.77474	11.56098	4.77474	0.0	0.0
3.0	Livestock			30,995.0	26,324.0	4,537.0	4,535.0	4,250.0	4,250.0	287.0	285.0	0.17235	0.17228	0.16145	0.16145	0.01090	0.01083
6.0	Construction	364	364	28,608.2	28,608.2	278.7	156.3	0.0	0.0	278.7	156.3	0.00974	0.00546	0.0	0.0	0.00974	0.00546
7.0	Manufacturing	125	125	13,072.5	13,072.5	45.1	25.3	0.0	0.0	45.1	25.3	0.00345	0.00194	0.0	0.0	0.00345	0.00194
8.0	Transporation, comm & utilities	228	228	7,844.1	7,844.1	125.6	70.6	0.0	0.0	125.6	70.6	0.01601	0.00900	0.0	0.0	0.01601	0.00900
9.1	Wholesale trade	63	63	43,225.4	43,225.4	119.3	66.9	0.0	0.0	119.3	66.9	0.00276	0.00155	0.0	0.0	0.00276	0.00155
9.2	Retail trade	873	873	58,997.3	58,997.3	162.9	91.3	0.0	0.0	162.9	91.3	0.00276	0.00155	0.0	0.0	0.00276	0.00155
10.0	Finance, insurance & real estate	118	118	349.0	349.0	2.0	1.1	0.0	0.0	2.0	1.1	0.00573	0.00315	0.0	0.0	0.00573	0.00315
11.0	Services	645	632	11,245.9	11,019.2	150.9	111.6	0.0	0.0	150.9	111.6	0.01369	0.01013	0.0	0.0	0.01369	0.01013
12.0	Government & public admin.	778	778			96.3	54.0	0.0	0.0	96.3	54.0	0.12378	0.06941	0.0	0.0	0.12378	0.06941
	Population	10,577	10,374			1,111.2	513.9	0.0	0.0	1,111.2	413.9	0.10711	0.03990	0.0	0.0	0.10711	0.03990
	Urban	6,765	6,765			833.6	375.1	0.0	0.0	833.6	375.1	0.13061	0.05545	0.0	0.0	0.13061	0.05545
	Rural	3,812	3,609			277.6	138.8	0.0	0.0	277.6	138.8	0.07692	0.03846	0.0	0.0	0.07692	0.03846

Dp Depletions in acre-feet.
Wd Withdrawal in acre-feet.

County was found in the AWR Basin, with this sector providing nearly 19 percent of all jobs in the AWR Basin area of Quay County. Services, construction, and TCU sectors also provided significantly to employment in the AWR Basin region of the county in 1980, and it is noteworthy that no mining activity was reported for 1980.

Total estimated economic output for the AWR Basin region of Quay County in 1980 was approximately $198.1 million, with nearly 52 percent of this output derived from wholesale and retail trade activities within the region. Certainly a significant portion of this retail trade activity can be associated with tourism activity, particularly as a result of the growing recreation use of Ute Reservoir and due to Tucumcari's location along Interstate 40. Agriculture in the AWR Basin region of Quay County accounted for more than 17 percent of the total economic output estimate for 1980, with the value of livestock production comprising nearly 77 percent of the total agricultural output. The value of harvested crops in the Quay County portion of the AWR Basin was greater in 1980 than the production of harvested crops in any of the other counties in the basin. Economic output of construction, manufacturing and services were also significant to the total value of output in the AWR Basin region of Quay County.

Land and Water Use Profile

Of the 1,845,120 acres that makeup Quay County, 1,585,920 are located in the AWR Basin, Privately owned lands account for more than 87 percent of this total area in the AWR Basin, with all other lands

TABLE 10.2

QUAY COUNTY LAND USE.

	1977	1980	1982
Cropland			
Cropped	178,750	168,510	185,200
Idle	61,650	73,380	34,080
National Forests	0	0	0
Wilderness areas	0	0	0
National grasslands	0	0	0
Public Rangeland			
BLM	819	819	819
State	218,610	218,610	218,610
National Forest	0	0	0
Bureau of Rec.	810	810	810
Commercial Forest Area			
Public	0	0	0
Private	0	0	0
Parks			
State[1]	5,385	5,385	5,385
Game & Fish	4,100	4,100	4,100
Federal	0	0	0
Defense	0	0	0
Urban & Built-Up	3,745	3,745[2]	3,825[2]
Airports	18,640	18,640	18,640
Highways & Roads	15,988	16,190	16,190[2]
Energy Transmission Corridors	2,909	2,933	2,952
Railroads	1,804	1,804	1,804
Population	11,200	10,577	10,400[2]
Assessed Valuation of:			
Real Estate ($000s)	$28,857	$32,195	$37,899
Percent Residential			23.9
Percent Nonresidential			76.1
Percent Oil/Gas			0.0

Note: Total Area: 1,845,120 Acres.
Water Area: 5,056 Acres.

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

1 Ute Lake State Park includes Games & Fish land in the figure of 5,385.

2 Best available data.

TABLE 10.3

QUAY COUNTY LAND USE AND ADMINISTRATION.
(1966-1970 DATA)

	Quay County (Acres)	AWR Basin (Acres)	AWR Basin As a Percent Of County	Pecos River Basin (Acres)	Pecos Basin As a Percent Of County
Land Use					
Total area	1,845,120	1,585,920	86.0%	259,200	14.0%
Inland waters	4,675	4,675	100.0	0	0.0
Urban & built-up	16,934	16,634	98.2	300	1.8
Roads	15,683	14,474	92.3	1,209	7.7
Cropland (total)	348,200	243,837	70.0	104,363	30.0
(Irrigated)	(49,100)	(42,800)	87.2	(6,300)	12.8
(Dry)	(299,100)	(201,037)	67.2	(98,063)	32.8
Parks, F & W.L.	633	633	100.0	0	0.0
Grazing lands	1,458,995	1,305,667	89.5	153,328	10.5
(Non-comm. timber)	(22,548)	(22,548)	100.0	0	0.0
(Range lands)	(1,436,447)	(1,283,119)	89.3	(153,328)	10.7
Land Ownership & Admin.					
Total area	1,845,120	1,585,920	86.0	259,200	14.0
Federal lands (total)	14,535	14,535	100.0	0	0.0
(BLM)	(7,600)	(7,600)	100.0	(0)	0.0
(Miscellaneous)	(6,935)	(6,935)	100.0	(0)	0.0
State lands	237,714	191,544	80.6	46,170	19.4
Private & other misc.	1,592,871	1,379,841	86.6	213,030	13.4

Source: Interstate Stream Commission and N.M. State Engineer Office, County Profile, Torrance County, New Mexico, (1974), Tables 1 and 2.

in the AWR Basin portion of Quay county held in either state or federal ownership. Details of land ownership and use in Quay County are provided in tables 10.2 and 10.3. Although the Red River drainage in the southern part of Quay county is included as part of the AWR surface drainage basin in the reporting of this land use data, the northern boundary of this small drainage delineates the edge of the Southern High Plains in New Mexico. Thus, even though land use data are reported as part of the AWR Basin here, water use in this region is attributed by the SEO to the Southern High Plains, with all water use in this region from groundwater sources.

The landscape in the AWR Basin portion of Quay County consists of mesas, canyons, arroyos, rolling plains, and pinon-juniper breaks on the edges of the caprock and deeper canyons. The highest elevation is 5,290 feet (MSL) and the lowest, where the Canadian River leaves the state, is 3,500 feet. The maximum surface area of Ute Reservoir, as reported in the 1975 County Profile, is 4,130 acres; but with the recently completed spillway improvements this area has increased substantially. There are no significant mineral resources found in Quay County and no commercial timber areas. The rural areas of Quay County in the AWR Basin can thus be characterized as entirely dependent upon agricultural activities and other economic activities associated with the recreational use of Ute Reservoir.

Water use activities in the AWR Basin portion of Quay County are dominated by agriculture, with nearly 98 percent of all withdrawals and more than 97 percent of all depletions reported in table 10.1 occuring in the agricultural sectors. It must be noted that SEO water

use data for 1980 is based on an assumed shortage of supply to Arch Hurley Conservancy District (AHCD), with the water use data reflecting a 50 percent of full CIR demand available to irrigated crops in 1980. Agricultural water use is rather closely divided among use in harvested crop production and irrigated pasture and hay, with only limited use of water in livestock production. The largest nonagricultural use is in satisfaction of human consumption needs of the region's population, with the largest economic sector water use in construction activities.

In 1980 irrigated acreage in the AWR Basin portion of Quay county was reported by the SEO as 38,060 acres, with more than 86 percent of this total irrigated acreage within AHCD. Of the 41,397 irrigable acres in AHCD, 32,870 acres were irrigated in 1980. The AHCD water is supplied by the Bureau of Reclamation's Tucumari Project, including a 39.3 mile delivery canal from Conchas Lake in San Miguel County that provides the surface water supplies of the District. Nearly 28 percent of the total irrigated acreage in the AWR Basin of Quay County was planted in harvested sorghum grains, with this single crop providing for more than 29 percent of the total value of production from harvested crops, irrigated pasture, and all hays.

Economic Development and Water Use Projections

Expansion of the economy in the AWR Basin portion of Quay County is anticipated largely due to a reversal in the out-migration

population change trend, a result of developing recreation activities and some expansion of the agricultural base. The diverse economic base of the region is anticipated to exhibit a slow general expansion, with population expected to grow at a 1.3 percent annual rate and employment anticipated to increase at a slower 0.7 percent annual rate. The Eastern New Mexico Water Supply Project, which has been proposed by the Bureau of Reclamation for more than a decade, appears to have limited support at this time. As originally conceived, the project would deliver water from Ute Reservoir to municipal purposes in nine communities in Quay, Curry, Roosevelt, and Lea counties. Most of the originally named communities have chosen not to participate in the project, with most citing anticipated costs of water delivered and uncertainty as reasons for their dwindling interest in the project.

Water supply conditions as they effect the Quay County portion of the AWR Basin appears somewhat mixed. The Tucumcari Underground Water Basin was declared by the state engineer on September 27, 1982, and is treated as a basin where a groundwater mining situation exists (see declared underground basin map in appendix B). That is, groundwater recharge is less than groundwater depletions annually. In September 1983, the SEO estimated that approximately 400,000 acre-feet of water remained available for appropriation from that underground basin. One a more positive note, the recent expansion of Ute Reservoir capacity has made available approximately 27,000 acre-feet of diversion rights annually for 25 years and 16,000 acre-feet of diversion rights annually for 50 years. The reduction in the

available supply with time is the result of reservoir sedimentation, and at this time Tucumcari has an option contract for delivery of 3,400 acre-feet of this total. The New Mexico Interstate Stream Commission controls the use of the reservoir and contracts for delivery from the reservoir. At this time Tucumcari is the only contract user, but the city has not exercised its delivery option. Finally, the SEO has estimated that there exists approximately 20,000 acre-feet per annum available of unappropriated surface water downstream of Ute Dam which is unreliable and intermittent flow, and which cannot be impounded under provisions of the Canadian River Compact. Any or all of these additional water supplies may be made available to satisfy future uses in the Quay County portion of the AWR Basin.

The projections of population and economic growth for the Quay County portion of the AWR Basin suggests a substantial portion of these available water resources will be utilized, with the results of these projections presented in table 10.4. The projections suggest that 14,653 acre-feet of additional water withdrawals will be required annually in the year 2005, with a corresponding increase in depletion of 6,666 acre-feet per annum. The majority of these increases occur in the agricultural sector, and particularly in the irrigated pasture and hay sector. In total, increased agricultural demands account for more than 90 percent of the total increased demands anticpated by 2005. It is important to note in light of this that AHCD water use requirements were calculated based on a 50 percent of full CIR supply; thus, increased future water requirements stated here may substantially understate the total demand increases in this region of Quay County.

TABLE 10.4

WATER USE PROJECTIONS
QUAY COUNTY
AWR RIVERS BASIN.

Sector Number	Sector Description	1980 Output ($1000)	Growth Rate	2005 Output ($1000)	Total Wd	Total Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Net Change (Total Wd)	Net Change (Total Dp)
1.0	Harvest crops	4,604.8	0.381%	5,065.3	45,890.2	18,802.2	33,402.4	10,933.2	12,487.8	7,869.0	4,612.7	1,754.4
2.0	Irrigated pasture & all hay	4,418.1	0.195	4,639.0	50,949.8	21,042.5	50,949.8	21,042.5	0.0	0.0	7,797.3	3,220.3
3.0	Livestock	30,995.0	0.195	32,544.8	5,609.1	5,606.9	5,254.4	5,254.4	354.7	352.5	1,072.1	1,071.9
6.0	Construction	28,608.2	2.596	54,293.9	528.8	296.4	0.0	0.0	528.8	296.4	250.7	140.1
7.1	Non-durable manufacturing	13,072.5	2.596	24,809.6	85.6	48.1	0.0	0.0	85.6	48.1	40.5	22.8
8.0	Transporation, comm. & utilities	7,844.1	2.596	14,886.9	238.3	134.0	0.0	0.0	238.3	134.0	112.7	63.4
9.1	Wholesale trade	43,225.4	2.596	82,035.1	226.4	127.2	0.0	0.0	226.4	127.2	107.1	60.3
9.2	Retail trade	58,997.3	2.596	111,967.7	309.0	173.5	0.0	0.0	309.0	173.5	146.1	82.2
10.0	Finance, insurance & real estate	349.0	2.596	662.3	3.8	2.1	0.0	0.0	3.8	2.1	1.8	1.0
11.0	Services	11,245.9	2.596	21,343.0	292.2	216.2	0.0	0.0	292.2	216.2	141.3	104.6
12.0	Government & public admin.	778	0.724	932	115.4	64.7	0.0	0.0	115.4	64.7	19.1	10.7
	Population	10,374	1.291	14,296	1,461.6	647.7	0.0	0.0	1,461.6	647.7	350.4	133.8
	Urban	6,765	1.306	9,376	1,102.1	467.9	0.0	0.0	1,102.1	467.9	268.5	92.8
	Rural	3,609	1.240	4,920	359.5	179.8	0.0	0.0	359.5	179.8	81.9	41.0
											14,651.8	6,665.5

Dp Depletions in acre-feet.
Wd Withdrawal in acre-feet.

QUAY COUNTY--PECOS RIVER BASIN

Economic and Demographic Profile

The total population of the Pecos River Basin region of Quay County was 203 people in 1980. The economy of this rural area is almost entirely dependent upon agriculture, with the only other economic sector reported in table 10.5 being services. Total 1980 economic output for this small region of Quay County was $5.9 million, with nearly 79 percent of this total derived from livestock sales. Total employment for the region in 1980 was 67, with more than 80 percent employed in agriculture.

Land and Water Use Profile

The total area of the Pecos River Basin portion of Quay County is 259,200 acres, comprising approximately 14 percent of the total area of the county. More than 82 percent of these lands are held in private ownership, with the remainder of the lands controlled by the state as public rangeland. The surface flows and the landscape is generally flat with a few small hills and scattered playa lakes. Total water withdrawals in 1980 were 13,939 acre-feet and total depletions were 9,314 acre-feet. Stockponds were the only surface water use in the region, and more than 99.9 percent of the total water use was in agriculture.

TABLE 10.5

1980 OUTPUT AND WATER USE COEFFICIENTS
QUAY COUNTY
PECOS RIVER BASIN.

Secter Number	Sector Description	1980 Employment	1980 Pecos Employment	1980 Output ($1000)	1980 Pecos Output ($1000)	Total Pecos Wd	Total Pecos Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	AF Total Wd/$1000 Output	AF Total Dp/$1000 Output	AF Surface Wd/$1000 Output	AF Surface Dp/$1000 Output	AF Ground Wd/$1000 Output	AF Ground Dp/$1000 Output
1.0	Harvested crops	978	54	4,604.8	340.9	4,936.0	3,113.1	0.0	0.0	4,936.0	3,113.1	14.47932	9.13200	0.0	0.0	14.47932	9.13200
2.0	Irrigated pasture & all hay			4,418.1	685.5	7,574.0	4,776.9	0.0	0.0	7,574.0	4,776.9	11.04887	6.95 49	0.0	0.0	11.04887	6.96849
3.0	Livestock			30,995.0	4,671.0	1,418.0	1,418.0	1,368.0	1,368.0	50.0	50.0	0.30358	0.30358	0.29287	0.29287	0.01070	0.01070
11.0	Services	645	13	11,245.9	226.7	0.8	0.4	0.0	0.0	0.8	0.4	0.00353	0.00176	0.0	0.0	0.00353	0.00176
	Population	10,577	203			10.2	5.6	0.0	0.0	10.2	5.6	0.05025	0.02759	0.0	0.0	0.05025	0.02759
	Urban	6,765	0			0.0	0.0	0.0	0.0	0.0	0.0						
	Rural	3,912	203			10.2	5.6	0.0	0.0	10.2	5.6	0.05025	0.02759	0.0	0.0	0.05025	0.02759

Dp Depletions in acre-feet.
Wd Withdrawal in acre-feet.

Economic Development and Water Use Projections

The economy of this region must be characterized as entirely dependent upon agricultural markets and climatic conditions. The small service sector is dependent upon transient demand for lodging and food services. In accord with the county as a whole, population increases are projected at a 1.3 percent annual growth rate, and employment is projected to increase at a 0.7 percent annual rate. Output from the harvested crops sector is projected to increase a total of 15 percent during the 25-year projection period, output from irrigated pasture and all hays is anticipated to increase a total of 10 percent over the projection period, and the value of livestock sales are anticipated to increase 5 percent over the period of projection. There is assumed a 10 percent increase in the efficiency of water use in the harvested crops sector and a 5 percent increase in the efficiency of water use in the irrigated pasture and all hays sector.

The projections, as shown in table 10.6, reflect an improvement in water availability as a result of increased use efficiency by the irrigated pasture and hay sector. Water demands for all other sectors increase, but these increases are more than offset by the net decrease in water use in the irrigated pasture sector. This forecast calls for a total net reduction in withdrawals by 2005 of 58.5 acre-feet, with a reduction in total depletions of 11.1 acre-feet. Clearly these are nominal changes in total water demands and largely insignificant to overall water supply and demand conditions in the Pecos River Basin.

TABLE 10.6

WATER USE PROJECTIONS
QUAY COUNTY
PECOS RIVER BASIN.

Sector Number	Sector Description	1980 Output ($1000)	Growth Rate	2005 Output ($1000)	Total Wd	Total Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Net Change (Total Wd)	Net Change (Total Dp)
1.0	Harvest crops	340.9	0.559%	392.0	5,108.3	3,221.8	0.0	0.0	5,108.3	3,221.8	172.3	108.7
2.0	Irrigated pasture & all hay	685.5	0.040	692.4	7,267.7	4,583.7	0.0	0.0	7,267.7	4,583.7	-306.3	-193.2
3.0	Livestock	4,671.0	0.195	4,904.6	1,488.9	1,488.9	1,436.4	1,436.4	52.5	52.5	70.9	70.9
11.0	Services	226.7	2.596	430.2	1.5	0.8	0.0	0.0	1.5	0.8	0.7	0.4
	Population	203	1.291	280	14.1	7.7	0.0	0.0	14.1	7.7	3.9	2.1
	Rural	203	1.291	280	14.1	7.7	0.0	0.0	14.1	7.7	3.9	2.1
											-58.5	-11.1

Dp Depletions in acre-feet.
Wd Withdrawal in acre-feet.

CHAPTER XI

TORRANCE COUNTY

The portion of Torrance County located in the Pecos River Basin is a small rural area dependent upon agriculture as its primary economic activity. The geographic area can be generally described as consisting of the northeastern and southeastern corners of the county, with the remainder of the county lying within the hydrologically isolated Estancia Basin. This is an extremely small portion of the county and thus economic value estimates have limited accuracy in nonagricultural sectors, although the agricultural values can be described as more accurate due to their derivation from actual irrigated acreage data and cropping patterns reported by the SEO.

Economic and Demographic Profile

Total population in the Pecos River Basin portion of Torrance County was 184 in 1980, with total employment in the region of 60 according to data provided by the census (table 11.1). Of the 60 employed in 1980, 53 were employed in livestock production activities. The only other significant economic activities found in the Pecos Basin portion of Torrance County in 1980 was due to travel along Interstate 40 and business activities principally in Clines Corners. Total economic output in 1980 for the Pecos Basin region is estimated to be less than $4.4 million, with nearly 87 percent of this output estimate derived from livestock sales. The other two sectors shown in table 11.1 present in the Pecos Basin region of

TABLE 11.1

1980 OUTPUT AND WATER USE COEFFICIENTS
TORRANCE COUNTY
PECOS RIVER BASIN.

Secter Number	Sector Description	1980 Employment	1980 Pecos Employment	1980 Output ($1000)	1980 Pecos Output ($1000)	Total Pecos Wd	Total Pecos Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	AF Total Wd/$1000 Ouput	AF Total Dp/$1000 Ouput	AF Surface Wd/$1000 Output	AF Surface Dp/$1000 Output	AF Ground Wd/$1000 Output	AF Grour Dp/$100(Output
3.0	Livestock	564[1]	53	na	3,789.0	640.0	640.0	588.0	588.0	52.0	52.0	0.16891	0.16891	0.15519	0.15519	0.01372	0.0137
9.2	Retail trade	336	4	34,526.9	443.6	3.1	1.4	0.0	0.0	3.1	1.4	0.00699	0.00316	0.0	0.0	0.00699	0.0031
11.0	Services	70	3	2,878.1	123.3	2.1	1.0	0.0	0.0	2.1	1.0	0.01703	0.00811	0.0	0.0	0.01703	0.0081
	Population	7,491	184			20.6	9.5	0.0	0.0	20.6	9.5	0.11196	0.05163	0.0	0.0	0.11196	0.0516
	Rural	7,491	184			20.6	9.5	0.0	0.0	20.6	9.5	0.11196	0.05163	0.0	0.0	0.11196	0.0516

Dp Depletions in acre-feet.
na Not available.
Wd Withdrawals in acre-feet.
1 Total agricultural employment for Torrance County, including harvested crops and irrigated pasture and all hay.

Torrance County were retail trade and service sectors, with combined total output estimated to be less than $600,000 in 1980. This region is clearly a limited economy dependent upon livestock markets and interstate highway travel.

Land and Water Use Profile

The total geographic area of the Pecos River Basin portion of Torrance County is 770,560 acres, which is less than 36 percent of the total area of the county. The land forms of the region consist principally of grassland plains, broken mesas and ridges, with surface drainage consisting of intermittent streams and arroyos. Nearly 99 percent of this area is described as grazing lands in the 1975 County Profile, with approximately 82 percent of the basin area held in private ownership (table 11.2). There are no irrigation or conservancy districts in Torrance County, and no significant mineral resource deposits within the Pecos River Basin portion of the county. There has been some oil and gas exploration activity in the past, but no production is currently reported.

Total withdrawals within the Pecos Basin portion of the county were 666 acre-feet in 1980, with depletions of 652 acre-feet. Of the total, 640 acre-feet of withdrawals and depletions were attributable to livestock water demands and stockpond evaporation. The remainder of water use was in the satisfaction of human consumption needs of the regional population and some minor use in the retail and service sectors, as reported in table 11.1.

TABLE 11.2

TORRANCE COUNTY LAND USE AND ADMINISTRATION.
(1966-1970 DATA)

	Torrance County (Acres)	Pecos River Basin (Acres)	Pecos Basin As a Percent Of County
Land Use			
Total area	2,147,200	770,560	35.9%
Urban & built-up	16,444	200	1.2
Roads	16,627	5,967	35.9
Dry Cropland	51,010	3,754	7.4
Grazing lands	1,920,200	760,639	39.6
Land Ownership & Admin.			
Total area	2,147,200	770,560	35.9%
Federal lands	207,787	33,157	16.0
(Forest service)	(151,283)	(18,477)	12.2
(BLM)	(56,017)	(14,440)	25.8
(Miscellaneous)	(385)	(240)	62.3
State lands	299,805	105,950	35.3
Private & other misc.	1,623,308	631,453	38.9

Source: Interstate Stream Commission and N.M. State Engineer Office, County Profile, Torrance County, New Mexico (1974), Tables 1 and 2.

Economic Development and Water Use Projections

The potential of significant economic development is highly constrained in the Pecos River Basin region of Torrance County, with the majority of development potential provided by improved livestock production techniques and increases in nonagricultural activities associated with travel along Interstate 40. In accord with county-wide trends of population and employment growth provided by Temple and Wombold, population in the Pecos River Basin portion of Torrance County was projected to grow at a 1.8 percent rate, and employment was projected to grow at a 2.5 percent rate during the 25-year period of projection used in this analysis.

The results of these projections are presented in table 11.3, with the caveat that the growth rate projections are extremely high compared to potential growth in similar areas throughout the rest of the state. The strong growth projections for Torrance County as a whole are based, in part, on the proximity of the western portion of the county to Albuquerque. The Pecos Basin portion of the county does not share this proximity and is not likely to develop in a like manner with the rest of the county. The Pecos Basin region, on the other hand, is of such small economic size in 1980 that even these strong growth projections do not substantially impact on the aggregate water supply and demand conditions of the Pecos River Basin as a whole, and are thus left equivalent to county-wide trends with this acknowledged difficulty. Total increases in water demands for the region include a 51.3 acre-feet increase in withdrawals and 40.9 acre-feet increase in depletions per annum. Likestock production

TABLE 11.3

WATER USE PROJECTIONS
TORRANCE COUNTY
PECOS RIVER BASIN.

Sector Number	Sector Description	1980 Output ($1000)	Growth Rate	2005 Output ($1000)	Total Wd	Total Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Net Change (Total Wd)	Net Change (Total Dp)
3.0	Livestock	3,789.0	0.1954%	3,978.4	672.0	672.0	617.4	617.4	54.6	54.6	32.0	32.0
9.2	Retail trade	443.6	4.1978	1,240.1	8.7	3.9	0.0	0.0	8.7	3.9	5.6	2.5
11.0	Services	123.3	4.1978	344.7	5.9	2.8	0.0	0.0	5.9	2.8	3.8	1.8
	Population	184	1.7930	287	30.5	14.1	0.0	0.0	30.5	14.1	9.9	4.6
	Rural	184	1.7930	287	30.5	14.1	0.0	0.0	30.5	14.1	9.9	4.6
											51.3	40.9

Dp Depletions in acre-feet.
Wd Withdrawals in acre-feet.

accounts for 32 acre-feet of these water demand increases. Increases of less than 20 acre-feet of withdrawals and less than 9 acre-feet depletions are required to satisfy all increases in nonagricultural water demands in the Pecos Basin portion of Torrance County by 2005.

CHAPTER XII

DE BACA COUNTY

De Baca County is entirely dependent upon water supplies from the Pecos River Basin, and is a county experiencing economic difficulties due to its reliance upon an agricultural economic base. The vast majority of the county land area is suitable only for rangeland, although there is significant agricultural activities in the Pecos River valley and the valleys of several tributaries. Water use reflects this dominance of agriculture, and Fort Sumner serves as the only significant nonagricultural economic center in the county. Some recreation activities are found at Sumner Lake (formerly Alamogordo Reservoir), near where the Pecos River enters the county from the north, but these recreation opportunities are limited due to reservoir level fluctuation associated with irrigation deliveries to the Carlsbad Irrigation District downstream.

Economic and Demographic Profile

In 1980 De Baca County was the second least populous county in the state, with a total population of 2,454. This represents a decline of nearly 100 residents since the 1970 census, with nearly 58 percent of this rural population found in Fort Sumner. The population of Fort Sumner, which stood at 1,421 in 1980, has declined by more than 200 since the 1970 census, and thus, the population of the remainder of the county has grown slightly in the decade between censuses. Total employment for the county in 1980 was 842, with more

than 36 percent of the total county employment attributable to agriculture directly (table 12.1). Total economic output for De Baca County in 1980 is estimated to be more than $36.6 million, with more than 47 percent of this total output provided by the agricultural sector. In short, the economy of De Baca County is agriculturally based with nonagricultural activities strongly associated with the health of agricultural markets.

Government is the largest nonagricultural employer in De Baca County. The only other relatively large employment sector is retail trade. Output from both retail and wholesale trade activities in the county combined accounted for more than 36 percent of the county's total estimated output; and, combined with agricultural output, these three sectors provide for nearly 84 percent of total output in the county. Agricultural outputs are predominantly livestock production, with more than 82 percent of the value of agricultural production provided by livestock sales. TCU, services and construction also provide contributions to the 1980 output estimates, yet all nonagricultural outputs must be recognized as either directly or indirectly tied to agricultural market conditions.

Land and Water Use Profile

The total land area of De Baca County is 1,514,240 acres, with nearly 78 percent of this area held in private ownership. Approximately 97.5 percent of this area was described as grazing land by the 1975 County Profile, and more than 21 percent of the county land area

TABLE 12.1

1980 OUTPUT AND WATER USE COEFFICIENTS
DE BACA COUNTY
PECOS RIVER BASIN.

Sector Number	Sector Description	1980 Employment	1980 Output ($1000)	Total Wd	Total Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	AF Total Wd/$1000 Ouput	AF Total Dp/$1000 Ouput	AF Surface Wd/$1000 Output	AF Surface Dp/$1000 Output	AF Ground Wd/$1000 Output	AF Ground Dp/$1000 Output
1.0	Harvested crops	304	618.1	9,811.1	4,020.3	7,456.4	2,535.8	2,354.7	1,484.5	15.87300	6.50429	12.06342	4.10257	3.80958	2.40171
2.0	Irrigated pasture & all hay		2,493.6	45,438.9	18,619.7	34,533.6	11,744.2	10,905.3	6,875.5	18.22221	7.46700	13.84889	4.70974	4.37332	2.75726
3.0	Livestock		14,276.0	1,019.0	1,017.0	758.0	758.0	261.0	259.0	0.07138	0.07124	0.05310	0.05310	0.01891	0.01849
5.4	Non-metallic mining & quarrying	8	510.8	12.0	2.0	0.0	0.0	12.0	2.0	0.02349	0.00392	0.0	0.0	0.23490	0.00392
6.0	Construction	46	1,615.6	19.5	9.8	0.0	0.0	19.5	9.8	0.01207	0.00607	0.0	0.0	0.01207	0.00607
7.0	Manufacturing	15	80.8	0.4	0.2	0.0	0.0	0.4	0.2	0.00495	0.00248	0.0	0.0	0.00495	0.00248
8.0	Transportation, comm. & utilities	61	1,888.0	3.8	1.9	0.0	0.0	3.8	1.9	0.00201	0.00101	0.0	0.0	0.00201	0.00101
9.1	Wholesale trade	14	4,956.4	17.0	8.5	0.0	0.0	17.0	8.5	0.00343	0.00171	0.0	0.0	0.00343	0.00171
9.2	Retail trade	108	8,390.4	28.5	14.3	0.0	0.0	28.5	14.3	0.00340	0.00170	0.0	0.0	0.00340	0.00170
10.0	Finance, insurance & real estate	11	76.0	0.6	0.3	0.0	0.0	0.6	0.3	0.00789	0.00395	0.0	0.0	0.00789	0.00395
11.0	Services	75	1,743.6	14.8	7.4	0.0	0.0	14.8	7.4	0.00849	0.00424	0.0	0.0	0.00849	0.00424
12.0	Government & public admin.	200		30.5	15.3	0.0	0.0	30.5	15.3	0.15250	0.07650	0.0	0.0	0.15250	0.07650
	Population	2,454		219.9	110.3	0.0	0.0	219.9	110.3	0.08961	0.04495	0.0	0.0	0.08961	0.04495
	Rural	2,454		219.9	110.3	0.0	0.0	219.9	110.3	0.08961	0.04495	0.0	0.0	0.08961	0.04495

Dp Depletions in acre-feet.
Wd Withdrawals in acre-feet.

TABLE 12.2

DE BACA COUNTY LAND USE.

	1977	1980	1982
Cropland			
Cropped	13,230	10,790	14,210
Idle	1,250	3,830	790
National Forests	0	0	0
Wilderness areas	0	0	0
Public Rangeland			
BLM	35,377	35,377	35,377
State	283,325	283,325	283,325
National Forest	0	0	0
Bureau of Rec.	4,991	4,991	4,991
Commercial Forest Area			
Public	0	0	0
Private	0	0	0
Parks			
State	11,227	11,227	11,227
Game & Fish	2,000	2,000	2,000
Federal	0	0	0
Defense	0	0	0
Urban & Built-Up	2,100	2,100	2,100
Airports	960	960	960
Highways & Roads	9,932	9,996	9,996
Energy Transmission Corridors	1,200	1,212	1,219
Railroads	800	800	800
Population	2,600	2,454	2,400
Assessed Valuations of:			
Real Estate ($000s)	9,940	11,299	12,480
Percent Residential			11.22
Percent Non-residential			77.89
Percent Oil/Gas			0

Note: Total Area: 1,514,240 Acres.
Water Area: 3,760 Acres.

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

is publicy owned rangeland (table 12.2). In 1980 10,970 acres were irrigated in De Baca County with more than 73 percent of this area irrigated hay or pasture. Sumner Lake State Park, associated with Sumner Lake, is the only significant recreation facility in the county. The landscape of De Baca County consists of rolling plains and mesas that are bisected by the Pecos River in the eastern part of the county. Intermittent arroyos enter the river on both sides as it travels southward. The only notable surface water tributaries, which are perennial in some reaches, are Conejo, La Mora and Yeso Creeks. Vegetation throughout the majority of the county is native grassland. There is some sand and gravel production in the county, and some recent oil and gas exploration activity has occurred, but no significant mineral resource deposits (except sand and gravel) are found in De Baca County.

Water use in De Baca County is from both surface and groundwater sources. All surface water use is for agriculture, and there is also some significant groundwater use by the agricultural sector as well. Surface water irrigation in the Fort Sumner region has been continuous for more than 100 years, with all irrigated lands within the county included in the Fort Sumner Underground Water Basin, which was first declared by the state engineer in 1964. Surface water irrigation in the county is within the Fort Sumner Irrigation District and in the Pecos River valley south of the district to the county line, with groundwater irrigation principally in the irrigated areas northeast of Fort Sumner along Truchas Creek. Water levels have remained fairly stable in the aquifers supplying groundwater to the several

hundred wells in all parts of the county. In a 1970 report by Mourant and Shomaker for the State Bureau of Mines, it was reported that the chemical quality of groundwater is variable, with two-thirds of the water samples containing sulfate levels greater than those recommended for domestic supplies but suitable for irrigation and stock use. Most groundwater wells are relatively shallow (less than 200 feet). Mourant and Shomaker concluded with respect to new groundwater supply development that "(t)he only foreseeable development of irrigation supplies is expansion of the existing irrigation areas (which are) subject to the regulation of the State Engineer."[1]

Total water use for 1980 is shown in table 12.1, with more than 99 percent of both withdrawals and depletions attributable to agricultural uses. Irrigated pasture and hay production provides for approximately 80 percent of all water use (both withdrawals and depletions) in the county, with the only major water use identified in table 12.1 being for satisifcation of human consumption requirements.

Economic Development and Water Use Projections

Potential economic development of De Baca County must be considered highly limited in light of observed population, employment, and agricultural market trends. For the projections of economic development and water use provided in table 12.3 there was reliance on the Temple and Wombold projections which reflect a long-term population growth rate of 0.9 percent and a employment growth rate of 1.2 percent. The projections of changes in harvested crop output

TABLE 12.3

WATER USE PROJECTIONS
DE BACA COUNTY
PECOS RIVER BASIN.

Sector Number	Sector Description	1980 Output ($1000)	Growth Rate	2005 Output ($1000)	Total Wd	Total Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Net Change (Total Wd)	Net Change (Total Dp)
1.0	Harvested crops	618.1	0.381%	679.9	10,122.9	4,119.5	7,791.8	2,649.9	2,331.1	1,469.6	311.8	99.2
2.0	Irrigated pasture & all hay	2,493.6	0.195	2,618.3	45,325.6	18,573.3	34,447.5	11,714.9	10,878.1	6,858.4	-113.3	-46.4
3.0	Livestock	14,276.0	0.195	14,989.8	1,079.5	1,073.2	796.0	796.0	283.5	277.2	60.5	56.2
5.4	Non-metallic mining & quarrying	510.8	0.195	536.3	12.6	2.1	0.0	0.0	12.6	2.1	0.6	0.1
6.0	Construction	1,615.6	2.758	3,189.8	38.5	19.4	0.0	0.0	38.5	19.4	19.0	9.6
7.0	Manufacturing	80.8	2.758	159.5	0.8	0.4	0.0	0.0	0.8	0.4	0.4	0.2
8.0	Transportation, comm. & utilities	1,888.0	2.758	3,727.7	7.5	3.8	0.0	0.0	7.5	3.8	3.7	1.9
9.1	Wholesale trade	4,956.4	2.758	9,785.9	33.6	16.7	0.0	0.0	33.6	16.7	16.6	8.2
9.2	Retail trade	8,390.4	2.758	16,565.9	56.3	28.2	0.0	0.0	56.3	28.2	27.8	13.9
10.0	Finance, insurance & real estate	76.0	2.758	150.1	1.2	0.6	0.0	0.0	1.2	0.6	0.6	0.3
11.0	Services	1,743.6	2.758	3,442.5	29.2	14.6	0.0	0.0	29.2	14.6	14.4	7.2
12.0	Government & public admin.	200	1.178	268	40.9	20.5	0.0	0.0	40.9	20.5	10.4	5.2
	Population	2,454	0.916	3,082	262.4	131.6	0.0	0.0	262.4	131.6	42.5	21.3
	Rural	2,454	0.916	3,082	262.4	131.6	0.0	0.0	262.4	131.6	42.5	21.3
											395.0	176.9

Dp Depletions in acre-feet.
Wd Withdrawals in acre-feet.

were based on the assumption that a 10 percent increase in output would occur during the 25-year projection period, with a corresponding 5 percent total increase in output from the irrigated pasture and hay sector. Total value of livestock production is assumed to increase 5 percent during the projection period. There is also assumed a 10 percent increase in the efficiency of groundwater use by the harvested crop sector, and a 5 percent increase in the efficiency of all other agricultural crop water uses.

The largest projected water demand increase in De Baca County in the 25-year growth projection is in the harvested crop sector, with a 312 acre-feet increase in withdrawal demand and 99 acre-feet increase in per annum depletion demands. Increases in livestock water demands are more than offset by declines in the total demands of irrigated pasture and hay production. In total, water withdrawals are projected to increase 395 acre-feet per annum in the year 2005, with a corresponding 177 acre-feet increase in depletion demands. Again, the majority of these increases are found in the harvested crop sector, with nominal increases in all other sectors of the De Baca County economy.

CHAPTER XII
ENDNOTES

1 W.A. Mourant and J.W. Shomaker, Reconnaissance of Water Resources of De Baca County, New Mexico, Ground Water Report 10, State Bureau of Mines and Mineral Resources, Socorro, New Mexico: New Mexico Institute of Mining and Technology, 1970, p. 26.

CHAPTER XIII

ROOSEVELT COUNTY

The portion of Roosevelt County that is located in the Pecos River Basin is described generally as the western "panhandle" region of the county (map 3.2). The definition of enumeration district boundaries provided by the 1980 census does not correspond at all closely with the hydrologic boundary definition. Thus, nonagricultural economic activities could not be assessed for use in the water demand projections. The small towns of Kenna, Tolar, and Krider are a part of this region, but are not large enough to be assigned "place" status by the census and are therefore not specifically described herein. The population data for the area is based on the SEO 1980 Water Use by Categories report, which is also the source for all water use data presented here.

Economic and Demographic Profile

The total population of the Pecos River Basin portion of Roosevelt County was estimated to be 376 in 1980, comprising less than 2.4 percent of the total population of the county (table 13.1). Although there is likely some small level of nonagricultural economic activity in the Pecos Basin portion of the county, this activity could be specifically identified and therefore must be ignored in the following anlaysis. No information could be relied upon to estimate agricultural employment in the region, but the value of sales associated with agricultural production activities in the Pecos River

TABLE 13.1

1980 OUTPUT AND WATER USE COEFFICIENTS
ROOSEVELT COUNTY
PECOS RIVER BASIN.

Sector Number	Sector Description	1980 Employment	1980 Output ($1000)	Total Pecos Wd	Total Pecos Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	AF Total Wd/$1000 Ouput	AF Total Dp/$1000 Ouput	AF Surface Wd/$1000 Output	AF Surface Dp/$1000 Output	AF Ground Wd/$1000 Output	AF Ground Dp/$1000 Output
1.0	Harvested crops	na	239.0	1,345.8	1,045.1	0.0	0.0	1,345.8	1,045.1	5.63096	4.37280	0.0	0.0	5.63096	4.37280
2.0	Irrigated pasture & all hay	na	52.0	534.2	414.9	0.0	0.0	534.2	414.9	10.27308	7.97885	0.0	0.0	10.27308	7.97885
3.0	Livestock	na	838.0	129.0	129.0	119.0	119.0	10.0	10.0	0.15394	0.15394	0.14200	0.14200	0.01193	0.01193
	Population	376	0.0	23.0	12.0	0.0	0.0	23.0	12.0	0.06117	0.03191	0.0	0.0	0.06117	0.03191
	Rural	376	0.0	23.0	12.0	0.0	0.0	23.0	12.0	0.06117	0.03191	0.0	0.0	0.06117	0.03191

Dp Depletions in acre-feet.
na Not available.
Wd Withdrawals in acre-feet.

Basin portion of Roosevelt County, based on cropping patterns and 1980 value of sales in Roosevelt County, was slightly greater than $1.1 million. The largest contribution to this agricultural output came from peanut production, with nearly twice the value of production of the next largest harvested crop produced (sorghum for grain). More than 74 percent of the total value of agricultural production in the region was derived from livestock sales, allowing a characterization of the region as an economy based largely on livestock production activities.

Land and Water Use Profile

The total area of the Pecos River Basin portion of Roosevelt County encompasses 231,680 acres, which is approximately 14.7 percent of the total land area of the county. More than 80 percent of this total area was classified by the 1975 County Profile to be grazing lands, with nearly 59 percent of the Pecos Basin region held in private ownership (table 13.2). State lands account for more than 28 percent of the area, and there must also be noted a significant acreage considered to be dry cropland reported in the 1975 SEO report.

A total of 1,180 acres were irrigated in 1980, with total withdrawals reported to be 2,009 acre-feet and total depletions of 1,589 acre-feet by the agricultural sectors (table 13.1). The only surface water depletions in the region were provided by stockpond evaporation. Total demands for the population of the region amounted to 23 acre-feet withdrawal and 12 acre-feet depletion in 1980.

TABLE 13.2

ROOSEVELT COUNTY LAND USE AND ADMINISTRATION.
(1966-1970 DATA)

	Roosevelt County (Acres)	Pecos River Basin (Acres)	Pecos Basin As A Percent Of County
Land Use			
Total area	1,572,480	231,680	14.7%
Urban & built-up	18,000	50	0.3
Roads	15,460	2,275	14.7
Cropland	461,700	18,802	4.1
(Irrigated)	(103,700)	(2,080)	2.0
(Dry)	(358,000)	(16,722)	4.7
Defense	22,120	22,120	100.0
Parks, F.& W.L.	19,571	1,760	9.0
Grazing lands	1,032,386	186,673	18.1
Land Ownership & Admin.			
Total area	1,572,480	231,680	14.7%
Federal lands	38,577	30,530	1.9
(BLM)	(16,397)	(8,410)	51.3
(Defense)	(22,120)	(22,120)	100.0
State lands	211,140	65,327	30.9
Private & other misc.	1,322,823	135,823	10.3

Source: Interstate Stream Commission and N.M. State Engineer Office, County Profile, Roosvelet County, New Mexico (1974), Table 1 and 2.

Economic Development and Water Use Projections

The potential development of the Pecos River Basin region of Roosevelt County is entirely dependent upon the agricultural market conditions. Because all water use is from groundwater sources, crops of low value relative to water use demands are not likely to flourish, and there will be much concern regarding the efficiency of water use in agricultural production--a concern this region shares with the remainder of Roosevelt County. It is assumed in the projections presented in table 13.3 that there will be a total 15 percent increase in the value of harvested crop production during the 25-year projection period, a total 10 percent increase in the value of output from irrigated pasture and hay production, and a 5 percent increase in the value of livestock sales during the 25-year period of projection. The slightly stronger growth of agricultural output in this county as compared to other counties in this analysis reflects the predominant use of groundwater and the corresponding (increasing) pumping costs associated with this groundwater's use, which are assumed to provide strong motivation for implementation of improved farm management techniques when possible. Likewise, there is an assumed 10 percent increase in the efficiency of groundwater use associated with this increased harvested crop production, and a 5 percent increase in the efficiency of water use in the irrigated pasture and hay production sector. Population growth in the region, corresponding to population growth throughout the county, is anticipated to occur at a 0.8 percent annual rate.

TABLE 13.3

WATER USE PROJECTIONS
ROOSEVELT COUNTY
PECOS RIVER BASIN.

Sector Number	Sector Description	1980 Output ($1000)	Growth Rate	2005 Output ($1000)	Total Wd	Total Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Net Change (Total Wd)	Net Change (Total Dp)
1.0	Harvested Crops	239.0	0.5606%	274.8	1,392.6	1,081.5	0.0	0.0	1,392.6	1,081.5	46.8	36.4
2.0	Irrigated pasture & all hay	52.0	0.3820	57.2	558.2	433.6	0.0	0.0	558.2	433.6	24.0	18.7
3.0	Livestock	838.0	0.1954	879.9	135.5	135.5	124.9	124.9	10.5	10.5	6.5	6.5
	Population	376	1.2180	510	31.2	16.3	0.0	0.0	31.2	16.3	8.2	4.3
	Rural	376	1.2180	510	31.2	16.3	0.0	0.0	31.2	16.3	8.2	4.3
											85.5	65.9

Dp Depletions in acre-feet.
Wd Withdrawals in acre-feet.

Total increases in water demands associated with these growth projections amount to 85.5 acre-feet of withdrawals and 65.9 acre-feet of depletions. Approximately 55 percent of these increased water demands are associated with increases in harvested crop production, with total annual increases in water demands of the region's populous being 8.2 acre-feet of withdrawal and 4.3 acre-feet of depletion by the year 2005. It would seem that these are largely nominal increases in water demand conditions when considered a part of the Pecos River Basin as a whole.

CHAPTER XIV

LINCOLN COUNTY

Lincoln County is one of the most diverse counties included in this anlaysis both geographically and economically. The recreation opportunities provided by the alpine environments of its central and western regions contrast dramatically with the agricultural based economy of its eastern region. Water supply and demand issues are currently a substantial topic of litigation and discussion, with economic development potentials, in part, having been limited for years as a result of water resource scarcity. Part of Lincoln County, particularly the western and west-central portions of the county, are located in the Tularosa Basin and are not served by Pecos Basin water resources. This is only partially true. Because Alamogordo and several smaller communities in the Tularosa Basin are served by water delivered from a pipeline originating at Lake Bonito in the Pecos River Basin drainage. Adjustments will be made when necessary to reflect the interbasin use of water, and, where otherwise not specifically identified, all water use and economic activities reflect only circumstances of the Pecos River Basin area of Lincoln County.

Economic and Demographic Profile

The total population of Lincoln County in the Pecos River Basin was 9,367, consisting of nearly 56 percent urban residents and representing more than 85 percent of the total Lincoln County population in 1980. The combined populations of Ruidoso and Ruidoso Downs

provide the county with its only urban area (i.e., population greater than 2,500), with these communities serving as the center for nonagricultural economic growth, which has been strong throughout the last 15 years. Between the 1970 and 1980 censuses, the population of the county grew at a very strong 4.5 percent annual rate. The nonagricultural base of the economy is clear in that more than 86 percent of total employment was in nonagricultural sectors. Service was the leading employment sector in 1980, providing 810 jobs or nearly 23 percent of the total employment in the Pecos Basin portion of Lincoln County. Retail trade, government, and construction sectors also provided significantly to employment in the region, with agricultural employment accounting for slightly more than 13 percent of total Pecos Basin employment in Lincoln County during 1980 (table 14.1). It should be noted that employment growth in the trade and services sectors has been very strong, with growth in the trade sectors at an average annual rate of 7.6 and growth in the service sector at a 8.5 percent average annual rate between 1970 and 1981.

Total economic output for all sectors of the Pecos River Basin economy in Lincoln County is estimated to be nearly $161.8 million in 1980, with more than 37 percent of this output provided by retail sales. Retail trade is clearly the most important sector to the regional economy both in terms of employment and estimated output, with construction, the second largest sector the Pecos Basin region of Lincoln County, providing an output contribution to the regional economy less than half as large as provided by the retail trade sector. Other nonagricultural sectors of importance include wholesale

TABLE 14.1

1980 OUTPUT AND WATER USE COEFFICIENTS
LINCOLN COUNTY
PECOS RIVER BASIN.

Sector Number	Sector Description	1980 Employment	1980 Output ($1000)	Total Pecos Wd	Total Pecos Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	AF Total Wd/$1000 Ouput	AF Total Dp/$1000 Ouput	AF Surface Wd/$1000 Output	AF Surface Dp/$1000 Output	AF Ground Wd/$1000 Output	AF Grour Dp/$100(Output
1.0	Harvested crops		682.2	3,529.0	1,526.7	2,600.6	1,033.6	928.4	493.1	5.17297	2.23791	3.81208	1.51510	1.36089	0.722
2.0	Irrigated pasture & all hay	475	578.1	16,581.0	7,173.3	12,219.4	4,856.4	4,361.6	2,316.9	28.68189	12.40841	21.13717	8.40062	7.54472	4.007
3.0	Livestock		14,653.0	1,551.0	1,549.0	1,271.0	1,271.0	280.0	278.0	0.10585	0.10571	0.08674	0.01911	0.01911	0.018
5.1	Metal mining[1]	8	675.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5.4	Non-metallic mining & quarrying[1]	17	187.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6.0	Construction	371	24,307.4	546.3	247.8	79.9	36.1	466.4	211.7	0.02247	0.01019	0.00329	0.00149	0.01919	0.008
7.1	Non-durable manufacturing	30	2,046.8	16.3	7.4	2.4	1.1	13.9	6.3	0.00796	0.00362	0.00117	0.00054	0.00679	0.003
7.2	Durable manufacturing	49	1,534.0	12.1	5.5	1.8	0.8	10.3	4.7	0.00789	0.00359	0.00117	0.00052	0.00671	0.003
8.0	Transportation, comm. & utilities	132	11,591.6	428.8	194.5	62.7	28.2	366.1	166.2	0.03699	0.01678	0.00541	0.00243	0.03158	0.014
9.1	Wholesale trade	38	23,339.1	148.6	67.4	21.7	9.9	126.9	57.5	0.00637	0.00289	0.00093	0.00042	0.00544	0.002
9.2	Retail trade	748	59,997.1	381.9	173.2	55.9	25.1	326.0	148.0	0.00637	0.00289	0.00093	0.00042	0.00544	0.002
10.0	Finance, insurance & real estate	276	4,543.1	56.9	25.8	8.3	3.8	48.6	22.0	0.01252	0.00568	0.00183	0.00084	0.01070	0.004
11.0	Services	810	17,661.8	741.1	313.5	41.1	18.6	700.0	294.9	0.04196	0.01775	0.00233	0.00105	0.03963	0.016
12.0	Government & public admin.	602		172.0	78.0	25.2	11.4	146.8	66.6	0.12857	0.12957	0.04186	0.01894	0.24385	0.110
	Population	9,367		816.4	367.0	119.5	53.4	696.9	313.6	0.08716	0.03918	0.01276	0.00570	0.07440	0.033
	Urban	5,209		583.5	262.6	85.4	38.2	498.1	224.4	0.11202	0.05041	0.01639	0.00733	0.09562	0.043
	Rural	4,158		232.9	104.4	34.1	15.2	198.8	89.2	0.05601	0.02511	0.00820	0.00366	0.04781	0.021

Dp Depletions in acre-feet.
Wd Withdrawals in acre-feet.
1 Although 1980 Census data reflects both metal and nonmetallic mining employment in the enumeration districts most closely corresponding to the Pecos River Basin hydrologic boundary, the 1980 SEO water use data provide no corresponding water use. No effort to reconcile this discrepancy was made in the data presented here.

trade, services and TCU. The agricultural economy of the Pecos River Basin portion of Lincoln County provided approximately $15.9 million to the output of the region, but this contribution amounted to less than 10 percent of the total output of the regional economy.

The large retail trade and service sectors provide significant evidence of the importance of the recreational resources to the economy of the Pecos River Basin region in Lincoln County. Although there is some concern with respect to the seasonal nature of this recreational activity, efforts are being made to make fuller use of the recreational facilities on a year round basis. The limited agricultural base of the region is not likely to decline rapidly, as the acequias have in some cases continued to provide water deliveries to irrigated lands for more than a century.

Land and Water Use Profile

The Pecos River Basin portion of Lincoln County is topographically defined by series of mountains, starting at the northern boundary of the county with Gallinas Peak and extending south in the Jicarilla, Capitan, and Sacramento Mountains. East of these mountains the Pecos River drainage consists in its northern parts of rolling hills, mesas, and arroyos, and moving south in the county the land forms become increasingly mountainous in the Rio Hondo drainage. The total area of the Pecos River Basin drainage in Lincoln county is 2,291,200 acres, comprising nearly 74 percent of the total area of the county.

TABLE 14.2

LINCOLN COUNTY LAND USE AND ADMINISTRATION.
(1966-1970 DATA)

	Lincoln County (Acres)	Pecos River Basin (Acres)	Pecos Basin As A Percent Of County
Land Use			
Total area	3,109,760	2,291,200	73.7%
Inland waters	173	100	57.8
Urban & built-up	20,837	19,837	95.2
Roads	15,265	11,247	73.7
Cropland	5,240	4,490	85.7
(Irrigated)	(4,940)	(4,490)	100.0
Commercial timber	304,375	303,080	99.6
Grazing lands	2,569,921	1,952,446	76.0
(Non-comm. timber)	(425,360)	(388,968)	91.4
(Range lands)	(2,144,561)	(1,563,478)	72.9
Land Ownership & Admin.			
Total area	3,109,760	2,291,200	73.7%
Federal lands	1,103,482	760,171	68.9
(Forest service)	(400,414)	(300,077)	74.9
(BLM)	(563,368)	(458,494)	81.4
(Miscellaneous)	(1,600)	(1,600)	100.0
State lands	300,841	167,011	55.5
Private & other misc.	1,705,437	1,364,018	80.0

Source: Interstate Stream Commission and N.M State Engineer Office, County Profile, Lincoln County, New Mexico (1974), Tables 1 and 2.

TABLE 14.3

LINCOLN COUNTY LAND USE.

	1977	1980	1982
Cropland			
Cropped	5,750	5,430	4,620
Idle	860	1,180	1,990
National Forests	398,738	398,775	398,720
Wilderness areas	38,813	38,813	38,813
National grasslands	0	0	0
Public Rangeland			
BLM	518,774	517,259	517,259
State	276,012	276,012	276,012
National Forest	215,621	215,621	215,621
Bureau of Rec.	0	0	0
Commercial Forest Area			
Public			
Private			
Parks			
State	463	463	465
Game & Fish	0	0	0
Federal	0	0	0
Defense	193,486	141,330	175,592
Urban & Built-Up	17,565	17,565	20,787
Airports	359	359	359
Highways & Roads	15,266	15,360	15,389
Energy Transmission Corridors	2,744	2,812	2,858
Railroads	2,121	2,121	2,121
Population	10,400	10,997	12,200
Assessed Valuation of:			
Real Estate ($000s)	65,218	81,554	102,756
Percent Residential			30.4
Percent Nonresidential			69.6
Percent Oil/Gas			0

Note: Total Area: 3,109,760 Acres.
Water Area: 173 Acres.

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

Private land ownership accounts for approximately 60 percent of the Pecos Basin area, and more than 85 percent of the Pecos River drainage in Lincoln County is described as committed to grazing use (tables 14.2 and 14.3).

The recreational resources provided by the mountainous areas of Lincoln County are also the source of much economic activity for the county. Portions of Cibola and Lincoln National Forests are within the Pecos River drainage of Lincoln County, with more than 13 percent of the total area of the basin held as National Forest. It is notable that more than 95 percent of the urban and built-up areas of Lincoln County are within the Pecos River drainage, as can be seen in table 14.2.

Most of the irrigated lands in Lincoln County are found in the narrow valleys of the Rio Ruidoso, Rio Bonito, and the Rio Hondo. Ownership is generally in small tracts, most of which are under 50 acres in size. There are no organized irrigation districts in Lincoln County, although several community acequias act as informal irrigation organizations. All of the area irrigated along the Rio Hondo and its tributaries in Lincoln County are included in the Hondo Underground Water Basin declared by the state engineer in 1953. The largest percentage of irrigated acres in the Pecos Basin portion of Lincoln County are served by a combination of surface and groundwater sources, with numerous irrigation wells located in the alluvial aquifer of the Rio Hondo and its tributaries. In 1980, 4,870 acres were irrigated within combined surface and groundwater sources of supply in the Rio Hondo and its tributaries. Nearly 62 percent of

the irrigated acres were planted pasture, and more than 650 acres in apple (and other) orchards. Total withdrawals from all sources of water supply in the Pecos Basin portion of Lincoln County during 1980 were 24,981 acre-feet. Depletions in 1980 were 11,729 acre-feet, with approximately 87 percent of all withdrawals and depletions applied to agricultural uses. As can be seen in table 14.1, the agricultural uses were dominated by irrigated pasture and hay. Other significant water using sectors include services, construction, and TCU, with the largest nonagricultural use of water in 1980 for the consumption needs of the population in the Pecos River Basin portion of Lincoln County.

Economic Development and Water Use Projections

The growth and development of the Pecos River Basin region of Lincoln County is likely to continue to be dependent upon recreation activities. The skiing, horse racing, and mountainous environs will serve as the basis for general expansion of all sectors with continued domination of the trade and service sectors. Population growth in the Pecos Basin portion of Lincoln County is projected to grow at a relatively slow 0.8 percent per annum over the 25-year projection period, and employment growth is anticipated to be at a much stronger 2.3 percent annually during the projection period. During the projection period there is also anticipated completion of the adjudication of water rights on the Rio Hondo and its tributaries, including the

TABLE 14.4

WATER USE PROJECTIONS
LINCOLN COUNTY
PECOS RIVER BASIN.

Sector Number	Sector Description	1980 Output ($1000)	Growth Rate	2005 Output ($1000)	Total Wd	Total Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Net Change (Total Wd)	Net Change (Total Dp)
1.0	Harvested crops	682.2	0.381%	750.4	3,636.7	1,568.3	2,717.6	1,080.1	919.1	488.2	107.7	41.6
2.0	Irrigated pasture & all hay	578.1	0.195	607.0	16,539.4	7,155.3	12,188.7	4,844.2	4,350.7	2,311.1	-18.0	-30.7
3.0	Livestock	14,653.6	0.195	15,385.7	1,628.6	1,626.5	1,334.6	1,334.6	294.0	291.9	77.6	77.5
5.1	Metal mining[1]	675.6	1.906	1,083.1								
5.4	Non-metallic mining &[1] quarrying	187.6	0.195	197.0								
6.0	Construction	24,307.4	4.378	70,947.7	1,594.9	723.7	233.4	105.7	1,361.5	618.0	1,048.6	475.9
7.1	Non-durable manufacturing	2,046.8	4.378	5,974.1	47.6	21.6	7.0	3.2	40.6	18.4	31.3	14.2
7.2	Durable manufacturing	1,534.0	4.378	4,477.4	35.2	16.0	5.2	2.3	30.0	13.7	23.1	10.5
8.0	Transportation, comm.& utilities	11,591.6	4.378	33,833.2	1,251.5	567.4	183.0	82.2	1,068.5	485.2	822.7	372.9
9.1	Wholesale trade	23,339.1	4.378	68,121.4	434.0	196.2	63.4	28.6	370.6	167.6	285.4	128.8
9.2	Retail trade	59,997.1	4.378	175,117.6	1,115.5	504.3	162.9	73.5	952.6	430.8	733.6	331.1
10.0	Finance, insurance & real estate	4,543.1	4.378	13,260.3	166.2	75.3	24.3	11.1	141.9	64.2	109.3	49.5
11.0	Services	17,661.8	4.378	51,550.7	2,162.1	915.0	120.1	54.1	2,043.0	860.9	1,421.0	601.5
12.0	Government & public admin.	602	2.280	1,057	301.9	136.9	44.2	20.0	257.7	116.9	129.9	58.9
	Population	9,367	0.800	11,432	935.3	420.4	136.9	61.1	798.4	359.3	118.9	53.4
	Urban	5,209	0.937	6,584	663.7	298.7	97.1	43.4	566.6	255.3	80.2	36.1
	Rural	4,158	0.614	4,848	271.6	121.7	39.8	17.7	231.8	104.0	38.7	17.3
											4,891.1	2,185.1

Dp Depletions in acre-feet.
Wd Withdrawals in acre-feet.

1 Although 1980 Census data reflects both metal and nonmetallic mining employment in the enumeration districts most closely corresponding to the Pecos River Basin hydrologic boundary, the 1980 SEO water use data provide no corresponding water use. No effort to reconcile this discrepancy was made in the data presented here.

rights of the Mescalaro Apache Indians whose reservation is located in the Rio Hondo drainage of Otero County adjacent to the southern boundary of Lincoln County.

Total projected increased water demands by the year 2005 in the Pecos River Basin region of Lincoln County are substantial. Total withdrawal demand is anticipated to increase more than 4,891 acre-feet, with corresponding increases in depletion demands of 2,185 acre-feet (table 14.4). Approximately 50 percent of these increased water demands come from expanded economic activity in the services and construction sectors. Other significant increaes in water demands occur as a result of increased trade and TCU activities, and it must also be noted that increases in agricultural water use demands are relatively minor compared to the increased demands associated with nonagricultural growth in the Lincoln County economy. Total water use demand in 2005 will still be dominated by agriculture, but the majority of increases in demands in the Pecos River Basin portion of Lincoln County will be the result of growth in the nonagricultural economy.

CHAPTER XV

CHAVES COUNTY

Chaves County is the most urban and economically diverse county in the Pecos River Basin. At the same time, water use in Chaves County is greater than total water use in any other county of the Pecos Basin, with the great majority of use in agriculture. Indeed, in many senses Roswell is the urban center for most economic activities in southeastern New Mexico, with the other major urban areas of the region dependent upon single industries or industry groups for their economic bases. The water supply problems of the Roswell Basin--a declared underground water basin which was first regulated by the state engineer in 1937--are also among the most severe found in the Pecos Basin. Litigation has become commonplace in this region with respect to nearly all changes in place or purpose of use of the exiting water rights, and the boundaries of the underground basin have been extended nine times. Priority calls by senior right holders have become more than a legal theory in this portion of the Pecos River Basin, and it can be anticipated that water availability circumstances, which have resulted in priority calls by downstream senior right holders, can only become an increasingly severe problem over the next 25 years.

Economic and Deomographic Profile

The total population of Chaves County was 51,103 in 1980, with an urban population in Roswell of 39,676--or nearly 78 percent urban

population. The population of the county as a whole grew at a 1.7 percent average annual rate between the 1970 and 1980 censuses, with somewhat more rapid growth observed during the last several years of the decade. Table 15.1 provides details of population and employment in Chaves County for 1980. Total employment in 1980 was 18,725, with less than 11 percent of total Chaves County employment provided by agriculture. Clearly, nonagricultural jobs dominate employment in the county, and nonagricultural employment has experienced healthy growth at a 3.6 percent average annual rate between 1970 and 1981.

The combined (wholesale and retail) trade sectors provided the most jobs in Chaves County, with 1980 employment in the trade sectors providing nearly 23 percent of total employment. Other large employment sectors were government, services and manufacturing, with the sum of the four largest employment sectors accounting for more than 72 percent of the total county employment in 1980. As can be seen in table 15.1, employment is broadly distributed among many economic sectors.

Total value of econmic output in 1980 for Chaves County is estimated to be approximately $1.1 billion. Durable manufacturing and retail trade dominate this output estimate, with these two sectors combined providing more than 45 percent of the total value of output in the county. Agriculture accounted for nearly $160 million in output, but this contribution amounted to only slightly more than 14 percent of the total output estimate for Chaves County in 1980. Crude petroleum and natural gas extraction provided an additional $91 million to output estimate. It must be noted that the combined

TABLE 15.1

1980 OUTPUT AND WATER USE COEFFICIENTS
CHAVES COUNTY
PECOS RIVER BASIN.

Sector Number	Sector Description	1980 Employment	1980 Output ($1000)	Total Pecos Wd	Total Pecos Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	AF Total Wd/$1000 Ouput	AF Total Dp/$1000 Ouput	AF Surface Wd/$1000 Output	AF Surface Dp/$1000 Output	AF Ground Wd/$1000 Output	AF Ground Dp/$1000 Output
1.0	Harvested crops		17,171.4	77,717.6	55,984.4	8,899.8	5,534.1	68,817.8	50,450.3	4.52599	3.26033	0.51829	0.32294	4.00770	2.93804
2.0	Irrigated pasture & all hay	1,970	23,763.8	211,152.4	152,105.6	24,180.2	15,035.9	186,972.2	137,069.7	8.88546	6.40073	1.01752	0.63272	7.86794	5.76800
3.0	Livestock		118,773.0	4,695.0	4,657.0	3,515.0	3,515.0	1,180.0	1,142.0	0.03953	0.03921	0.02959	0.02959	0.00993	0.00961
5.3	Crude petroleum & natural gas extract	620	90,948.0	1,363.0	80.0	0.0	0.0	1,363.0	80.0	0.01499	0.00088	0.0	0.0	0.01499	0.00088
5.4	Non-metallic mining & quarrying	5	527.3	120.0	102.0	0.0	0.0	120.0	102.0	0.22757	0.19344	0.0	0.0	0.22757	0.19344
6.0	Construction	896	53,157.1	848.5	453.3	0.0	0.0	848.5	453.3	0.01596	0.00853	0.0	0.0	0.01596	0.00853
7.1	Non-durable manufacturing	1,611	33,948.4	190.6	95.4	0.0	0.0	190.6	95.4	0.00561	0.00281	0.0	0.0	0.00561	0.00281
7.2	Durable manufacturing	1,127	244,761.1	1,374.4	688.0	0.0	0.0	1,374.4	688.0	0.00562	0.00281	0.0	0.0	0.00562	0.00281
8.0	Transportation, comm. & utilities	881	61,168.6	1,597.2	799.5	0.0	0.0	1,597.2	799.5	0.02611	0.01307	0.0	0.0	0.02611	0.01307
9.1	Wholesale trade	862	140,116.4	629.5	315.1	0.0	0.0	629.5	315.1	0.00449	0.00225	0.0	0.0	0.00449	0.00225
9.2	Retail trade	3,432	255,353.5	1,147.1	574.2	0.0	0.0	1,147.1	574.2	0.00449	0.00225	0.0	0.0	0.00449	0.00225
10.0	Finance, insurance & real estate	851	7,158.9	63.3	31.7	0.0	0.0	63.3	31.7	0.08846	0.00443	0.0	0.0	0.08846	0.00443
11.0	Services	2,737	64,472.0	963.1	483.5	0.0	0.0	963.1	483.5	0.01494	0.00750	0.0	0.0	0.01494	0.00750
12.0	Government & public admin.	3,733		752.3	376.6	0.0	0.0	752.3	376.6	0.20153	0.10088	0.0	0.0	0.20153	0.10088
	Population	51,103		6,357.2	3,178.6	0.0	0.0	6,357.2	3,178.6	0.12440	0.06220	0.0	0.0	0.12440	0.06220
	Urban	39,676		5,333.2	2,666.6	0.0	0.0	5,333.2	2,666.6	0.13442	0.06721	0.0	0.0	0.13442	0.06721
	Rural	11,427		1,024.0	512.0	0.0	0.0	1,024.0	512.0	0.08961	0.04481	0.0	0.0	0.08961	0.04481

Dp Depletions in acre-feet.
Wd Withdrawals in acre-feet.

manufacturing and trade sectors provided for nearly 61 percent of the total output of the Chaves County economy. The diversity of the Chaves County economy must be acknowledged as highly sigificant to the stability of the community, and allows for more balanced economic growth in the future.

Land and Water Use Profile

The total area of Chaves County is 3,900,800 acres, with more than 95 percent of the total land area within the hydrologic boundaries of the Pecos River Basin. The southwestern corner of the county is located in the Rio Grande Basin, and a small sliver of the eastern boarder of Chaves County is part of the Southern High Plains as defined by the caprock which separates the two basins. The areas outside of the Pecos River Basin are described by the 1975 County Profile as nearly 99 percent grazing lands, and thus their economic value to the county as a whole is so small that their treatment as a portion of the Pecos River Basin is largely insignificant.

As can be seen in table 15.2, public rangeland accounts for nearly 48 percent of the total land area of Chaves County. Private lands described in the 1975 County Profile account for nearly 50 percent of the total land area of the county. Total irrigated acreage in 1980 amounted to 104,580 acres, or less than 3 percent of the land area of Chaves County. The landscape of Chaves County consists of grasslands interrupted with rollings hills and arroyos, and more than 40,000 acres of Lincoln National Forest is located in Chaves County. The

TABLE 15.2
CHAVES COUNTY LAND USE.

	1977	1980	1982
Cropland			
Cropped	91,030	92,580	96,470
Idle	8,540	6,990	4,830
National Forests	40,332	40,332	40,332
Wilderness areas	0	0	0
National grasslands			
Public Rangeland			
BLM	1,166,034	1,175,938	1,175,938
State	669,401	669,401	669,401
National Forest	20,729	20,729	20,729
Bureau of Rec.	0	0	0
Commercial Forest Area			
Public	0	0	0
Private	0	0	0
Parks			
State	1,647	1,647	1,647
Game & Fish	179	179	179
Federal	23,789	23,189	25,189
Defense	0	0	0
Urban & Built-Up	14,330	14,330	14,330
Airports	5,029	5,029	5,029
Highways & Roads	22.890	22,891	23,019
Energy Transmission Corridors	4,652	4,667	4,674
Railroads	2,376	2,376	1,407
Population	49,700	51,103	54,500
Assessed Valuation of:			
Real Estate ($000s)	114,331	172,860	222,836
Percent Residential			29.8
Percent Nonresidential			70.2
Percent Oil/Gas			52.3

Note: Total Area: 3,900,800 Acres.
Water Area: 1,128 Acres.
Source: Joel A. Diemer and Joy F. Morrison, New Mexico Land Use by County, 1977-1982, Research Report 532, Agricultural Experiment Station, Las Cruces, New Mexico: New Mexico State University, 1984.

Pecos River flows from north to south through the center of the county, with the larger tributaries, all joining the river from the west, being Arroyo del Macho, Rio Hondo, Rio Felix, and Walnut Creek. There are several recreation areas in the county, with the two largest areas being Bottomless Lake State Park and the combined Bitter Lake/Salt Creek Wilderness areas.

Most of the irrigated acreage of Chaves County is located in the Roswell Basin in the general vicinity of Roswell. Census of agriculture data indicates that about 60 percent of the irrigated farms are 200 or more acres, and SEO water use data shows that approximately 88 percent of all water use is from groundwater sources. The only surface water use is in agriculture, and there is no surface storage in Chaves County for regulation. There are portions of four underground water basins in Chaves County which have been declared by the state engineer encompassing all the irrigated acreage of the county, including Fort Sumner Underground Water Basin, Roswell Underground Water Basin, Penasco Underground Water Basin, and Lea County Underground Water Basin (appendix B). There are three organized conservancy and irrigation districts in Chaves County, including the Pecos Valley Artesian Conservancy District, the Upper Felix Artesian Conservnacy District, and Hagerman Irrigation Company.

Of the total, 104,580 irrigated acres in 1980, approximately 83 percent were planted in harvested crops, with the remainder in irrigated pasture and hay. Cotton accounted for nearly 47 percent of the total harvested acreage, and alfalfa provided for approximately 75 percent of the irrigated pasture and hay acreage. Livestock feed

lots in the Roswell area have become very significant over the last several decades, and livestock production provided nearly 75 percent of the total value of agricultural output in 1980. It must be recognized that, although agriculture provided for less than 15 percent of the total output in Chaves County during 1980, agriculture accounted for more than 95 percent of total water withdrawals and depletions in the year.

Economic Development and Water Use Projections

The diverse economic activities that are found in Chaves County also provide for a healthy climate in which economic growth may occur. Long-term population growth for the county is projected at a 1.2 percent average annual rate during the 25-year projection period, and employment growth is projected at a 2.6 percent average annual rate. It is assumed in these projections that water supplies will not constraint growth, although included in these growth projectons are some assumptions regarding the increased efficiency of water use associated with a general perception of water scarcity in the county.

The projections provide for a total increase in annual withdrawals by the year 2005 of 6,217 acre-feet, and a total increase in annual depletion demands of 579 acre-feet over their 1980 levels (table 15.3). These substantial increases may not be as dramatic as anticipated, and this is largely due to the substantially reduced water demands of the agricultural output and efficiency of water use. The projections assumed a total 15 percent increase in output

TABLE 15.3

WATER USE PROJECTIONS
CHAVES COUNTY
PECOS RIVER BASIN.

Sector Number	Sector Description	1980 Output ($1000)	Growth Rate	2005 Output ($1000)	Total Wd	Total Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Net Change (Total Wd)	Net Change (Total Dp)
1.0	Harvested crops	17,171.4	0.3820%	18,888.5	77,429.7	55,740.5	9,300.2	5,794.9	68,129.5	49,945.6	-287.9	-243.9
2.0	Irrigated pasture & all hay	23,763.8	0.1954	24,952.0	200,808.5	144,529.0	24,119.7	14,998.2	176,688.8	129,530.8	-10,343.9	-7,576.6
3.0	Livestock	118,773.0	0.1954	124,711.6	4,929.8	4,889.9	3,690.2	3,690.2	1,238.4	1,198.5	234.8	232.9
5.3	Crude petroleum & nat. gas extract	90,948.0	1.2110	122,886.0	1,842.1	108.1	0.0	0.0	1,842.1	108.1	479.1	28.1
5.4	Non-metallic mining & quarrying	527.3	0.1954	553.7	126.0	107.1	0.0	0.0	126.0	107.1	6.0	5.1
6.0	Construction	51,157.1	4.6008	157,500.5	2,513.7	1,343.5	0.0	0.0	2,513.7	1,343.5	1,665.2	890.2
7.1	Non-durable manufacturing	33,948.4	4.6008	104,519.0	586.4	293.7	0.0	0.0	586.4	293.7	395.8	198.3
7.2	Durable manufacturing	244,761.1	4.6008	753,560.9	4,235.0	2,117.5	0.0	0.0	4,235.0	2,117.5	2,860.6	1,429.5
8.0	Transportation, comm. & utilities	61,168.6	4.6008	188,323.5	4,917.1	2,461.4	0.0	0.0	4,917.1	2,461.4	3,319.9	1,661.9
9.1	Wholesale trade	140,116.4	4.6008	431,384.9	1,936.9	970.6	0.0	0.0	1,936.9	970.6	1,307.4	655.5
9.2	Retail trade	255,353.5	4.6008	786,172.3	3,529.9	1,768.9	0.0	0.0	3,529.9	1,768.9	2,382.8	1,194.7
10.0	Finance, insurance & real estate	7,158.9	4.6008	22,040.5	194.9	97.6	0.0	0.0	194.9	97.6	131.6	65.9
11.0	Services	64,472	4.6008	198,493.9	2,965.5	1,488.7	0.0	0.0	2,965.5	1,488.7	2,002.4	1,005.2
12.0	Government & public admin.	3,733	2.5830	7,062	1,423.2	712.4	0.0	0.0	1,423.2	712.4	670.9	335.8
	Population	51,103	1.2220	69,234	7,749.7	3,875.0	0.0	0.0	7,749.7	3,875.0	1,392.5	696.4
	Urban	39,676	1.0699	51,769	6,262.9	3,131.5	0.0	0.0	6,262.9	3,131.5	929.7	464.9
	Rural	11,427	1.7113	17,465	1,486.8	743.5	0.0	0.0	1,486.8	743.5	462.8	231.5
											6,217.2	579.0

Dp Depletions in acre-feet.
Wd Withdrawals in acre-feet.

of harvested crops in 2005 and a 10 percent total increase in value of livestock production. Associated with these increased output estimates, the agricultural sectors of Chaves County are also anticipated to increase the efficiency of water use. Efficiency of groundwater use in harvested crop production is projected to increase a total of 10 percent in 25-years, and the efficiency of surface water use by this sector is projected to improve a total of 5 percent over the projection period. The efficiency of both surface and groundwater use in irrigated pasture and hay production is projected to increase a total of 5 percent during the projection period. These output and efficiency changes in the agricultural sectors are significant simply because they result in a more than 10,000 acre-feet reduction in withdrawal demands, and a more than 7,500 acre-feet reduction in depletion demands. These reduced agricultural water use demands in Chaves County reflect only general water scarcity conditions in the county, and are <u>not</u> direct retirements of irrigation rights in favor of nonagricultural uses. These output and efficiency changes in the agricultural sector are more properly characterized as improvements in agricultural technology, which as a by-product make available water for alternative uses.

Nonagricultural sectors of the Chaves County economy that have the largest increases in water demands include TCU, durable manufacturing, retail trade, and service sectors. Increased demands of the Chaves County population is not as significant as in several of the nonagricultural economic sectors. In conjunction with these increased water demands, an increased dependence on groundwater

resources of the county, must be acknowledged which is not reflected in the projection presented in table 15.3. The surface water priority call of the Carlsbad Irrigation District (CID), which is presently in litigation, will likely force increased reliance on groundwater resources due to their more assured supply in light of decreased surface flows available for appropriation in Chaves County (assuming CID is, at least in part, successful in their challenge of junior rights). The outcome of this litigation is not a subject of speculation here, and is only noted for informational purposes as it potentially affects water supply and demand conditions in Chaves County. To summarize, scarce water resources of Chaves County are likely to become significantly more scarce during the 25-year projection period herein discussed.

CHAPTER XVI

OTERO COUNTY

The economy of the Pecos River Basin portion of Otero County is substantially different from the economy of the remainder of the county. The Pecos Basin region is highly dependent on recreational resources and corresponding travel and tourism activities. A substantial portion of the Pecos River Basin in Otero County is Mescalero Apache Indian reservation, and the majority of the area is mountainous. Water demands are currently not large, but supplies are extremely limited and economic development in the Cloudcroft area resulting from increased recreational use of the region will make the resources which are available even more scarce relative to future demands.

Economic and Demographic Profile

The total population of the Pecos River Basin region in Otero County was 2,600 in 1980, representing less than 6 percent of the total population of the county (table 16.1). Cloudcroft is the largest community in the Pecos Basin area with a 1980 population of 521, or 20 percent of the total population of the region. Population growth in Otero County between the 1970 and 1980 censuses was very slow, averaging 0.8 percent per annum during the period. Although some agriculture is found in the region, recreation activities are more important to the future economic development of the Pecos River

TABLE 16.1

1980 OUTPUT AND WATER USE COEFFICIENTS
OTERO COUNTY
PECOS RIVER BASIN.

Sector Number	Sector Description	1980 Employment	1980 Output ($1000)	Total Pecos Wd	Total Pecos Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	AF Total Wd/$1000 Ouput	AF Total Dp/$1000 Ouput	AF Surface Wd/$1000 Output	AF Surface Dp/$1000 Output	AF Ground Wd/$1000 Output	AF Grour Dp/$100(Output
1.0	Harvested crops		330.7	2,172.9	944.0	1,042.9	354.0	1,130.0	590.0	6.57061	2.85455	3.15361	1.07046	3.41699	1.784
2.0	Irrigated pasture & all hay	102	338.9	4,157.1	1,806.0	4,157.1	1,806.0	0.0	0.0	12.26645	5.32901	12.26645	5.32901	0.0	0.0
3.0	Livestock		3,289.0	424.6	423.0	381.8	381.0	42.8	42.0	0.12910	0.12861	0.11608	0.11608	0.01277	0.012
4.0	Forestry & Fisheries	5	52.1	0.2	0.1	0.0	0.0	0.2	0.1	0.00384	0.00192	0.0	0.0	0.00384	0.001
5.4	Non-metallic mining & quarrying	*	69.3	17.0	8.5	0.0	0.0	17.0	8.5	0.00488	0.00244	0.0	0.0	0.00488	0.002
6.0	Construction	51	3,416.8												
7.0	Manufacturing	48	1,278.3	2.2	1.1	0.0	0.0	2.2	1.1	0.00172	0.00086	0.0	0.0	0.00172	0.000
8.0	Transportation, comm. & utilities	11	798.3	6.4	3.2	0.0	0.0	6.4	3.2	0.00802	0.00401	0.0	0.0	0.00802	0.004
9.2	Trade	48	2,700.8	3.8	1.9	0.0	0.0	3.8	1.9	0.00141	0.00070	0.0	0.0	0.00141	0.000
10.0	Finance, insurance & real estate	11	97.3	0.2	0.1	0.0	0.0	0.2	0.1	0.00206	0.00103	0.0	0.0	0.00206	0.001
11.0	Services	253	3,920.0	13.4	6.7	0.0	0.0	13.4	6.7	0.00342	0.00171	0.0	0.0	0.00342	0.001
12.0	Government & public admin.	592		36.3	18.2	0.0	0.0	36.3	18.2	0.06132	0.03074	0.0	0.0	0.06132	0.030
	Population	2,600		116.5	58.2	0.0	0.0	116.5	58.2						
	Rural	2,600		116.5	58.2	0.0	0.0	116.5	58.2	0.04481	0.02238	0.0	0.0	0.04481	0.022
										0.04481	0.02238	0.0	0.0	0.04481	0.022

* Disclosure-employment included in services.
Dp Depletions in acre-feet.
Wd Withdrawal in acre-feet.

Basin portion of Otero County. Total employment in the Pecos Basin region in 1980 was 1,122, with slightly more than 9 percent of total employment provided agricultural activities.

Government employment in the Pecos River Basin region of Otero County, standing at 592 jobs in 1980, was more than twice as large as the next largest employment sector (services), with nearly 53 percent of all employment in the region provided by the government sector. Services and agriculture were also significant employment sectors in the Pecos Basin region of Otero County, as can be seen in table 16.1. Employment in the construction, manufacturing and trade sectors was approximately equal in 1980, with nonagricultural jobs providing for more than 90 percent of the employment in the region in 1980.

The estimated value of total economic output from the region in 1980 is $16.3 million, with more than 24 percent of this output from the service sector. Although agriculture is not large in an employment sense, the value of output from agriculture activities was greater in 1980 than output from any other sector of the Pecos River Basin economy in Otero County, with the value of agricultural products standing at nearly $4 million in 1980. Livestock sales in 1980 provided for more than 83 percent of the total agricultural output for the Pecos Basin portion of Otero County. Output from the agricultural and service sectors, combined with the slightly lesser outputs of the construction and trade sectors, account for nearly 86 percent of total output estimated for the Pecos River Basin region of Otero County in 1980.

Land and Water Use Profile

The total area of the Pecos River Basin portion of Otero County is 838,400 acres, comprising approximately 19.7 percent of the total county land area. Most of the area of the Pecos River drainage is high mountainous country, with the headwaters of the Rio Penasco and its tributaries rising out of the east and southeast flanks of the Sacramento Mountains. As can be seen in table 16.2, approximately 38 percent of the total Pecos Basin drainage area is part of the Mescalero Apache Indian reservation, with the combined federal and Indian lands accounting for more than 83 percent of the total land area of the Pecos River Basin in Otero County. Nearly 50 percent of all lands included within the Pecos drainage of Otero County are considered suited to grazing, and private lands amount to only slightly more than 16 percent of the total basin area in the county.

With 356,025 acres of the Pecos River Basin area in Otero County part of the Lincoln National Forest, recreation opportunities are abundant. Some nonmetallic mineral resources (sand and gravel) are produced in the Pecos Basin portion of Otero County, and there are also limited commercial timber operations. Vegetation in the Pecos drainage consists principally of ponderosa pine, spruce, and fir in the higher elevations, and woodlands (pinon, juniper) and grasslands in the lower elevations.

Of the 1,700 acres irrigated in 1980, nearly 57 percent was in irrigated pasture and hay. Most irrigated lands are served by either groundwater or combined surface and groundwater sources of supply.

TABLE 16.2

OTERO COUNTY LAND USE AND ADMINISTRATION.
(1966-1970 DATA)

	Otero County (Acres)	Pecos River Basin (Acres)	Pecos Basin As A Percent Of County
Land Use			
Total area	4,248,320	838,400	19.7%
Urban & built-up	33,623	3,635	10.8
Roads	15,230	3,006	19.7
Cropland	16,000	2,800[1]	8.4
(Irrigated)	(14,900)	(1,700)[1]	11.4
(Dry)	(1,100)	(1,100)	100.0
Grazing lands	2,223,875	474,100	21.3
(noncomm. timber)	(360,067)	(61,176)	17.0
(Range lands	(1,863,808)	(412,924)	22.2
Commercial timer	493,305	356,309	72.2
Land Ownership & Admin.			
Total area	4,248,320	838,400	19.7%
Indian lands	460,255	319,338	69.4
Federal lands	2,886,626	378,065	13.1
(Forest service)	(543,922)	(365,025)	67.1
(BLM)	(941,526)	(22,040)	2.3
State lands	449,908	4,280	1.0
Private & other misc.	451,531	135,717	30.3

1 Reflects irrigated acreage reported elsewhere in County Profile by SEO due to assumed error in Table 1 of report.

Source: Interstate Stream Commission and N.M. State Engineer Office, County Profile, Otero County, New Mexico (1974), Table 1 and 2.

There are no organized irrigation districts in the Pecos Basin drainage of Otero County, and all irrigated lands are included with the Penasco Underground Water Basin (appendix B). The major irrigated crops, in descending order of acreage magnitude, include alfalfa, small grains and orchards. Total water withdrawals in 1980 were 6,951 acre-feet (table 16.1), with total depletion in the Pecos River drainage of Otero County 3,271 acre-feet. More than 97 percent of the total water use in the region was for irrigated agriculture, with the next largest use in the satisfaction of human consumption needs of the regional population.

Economic Development and Water Use Projections

The population of the Pecos River Basin portion of Otero County is anticipated to grow at a long-term average rate of 1.4 percent per annum, with corresponding employment increases in the region of 2.3 percent per annum. The continued development of the recreational facilities is likely to provide the primary source of this growth and economic development. The active role adopted by the Mescalero Apache Indians in the development of the recreational resources of their reservation will be the principal source of this recreational development in the Pecos River Basin region of Otero County.

The total value of harvest crop production from the irrigated lands of the Pecos drainage in Otero County is projected to increase a total of 15 percent, while total output of irrigated pasture and hay production is expected to increase a total of 5 percent during

the 25-year projection period. Even with increased use efficiencies in the agricultural sectors, the water demands of agriculture are projected to increase by 2005. Total increased withdrawals demands in the Pecos River Basin portion of Otero County are projected to be 477 acre-feet, with corresponding increased depletion demands of 222 acre-feet by 2005. The majority of these increased demands come from the agricultural sector, as can be seen in table 16.3. The location of irrigated lands in the Penasco Underground Water Basin, the water right claims of the Indians which remain unresolved at this time, and the substantial dependence upon groundwater resources all serve as significant constraints on the potential development of additional water resources for satisfaction of these increased water demands. No attempt is here made to reconcile the increased demands with the limited availability of water, although it should be noted that the magnitude of these increases are not substantial in relation to other demand increases projected for the Pecos River Basin by 2005.

TABLE 16.3

WATER USE PROJECTIONS
OTERO COUNTY
PECOS RIVER BASIN.

Sector Number	Sector Description	1980 Output ($1000)	Growth Rate	2005 Output ($1000)	Total Wd	Total Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Net Change (Total Wd)	Net Change (Total Dp)
1.0	Harvested crops	330.7	0.5606%	380.3	2,308.9	997.3	1,139.4	386.7	1,169.5	610.6	136.0	53.3
2.0	Irrigated pasture & all hay	338.9	0.3820	372.8	4,344.3	1,887.3	4,344.3	1,887.3	0.0	0.0	187.2	81.3
3.0	Livestock	3,289.0	0.1954	3,453.4	445.8	444.1	400.9	400.9	44.1	44.1	21.2	21.1
4.0	Forestry & fisheries	52.1	0.3820	57.3	0.2	0.1	0.0	0.0	0.2	0.1	0.0	0.0
5.4	Non-metallic mining & quarrying	3,486.1	3.8337	8,928.9	43.6	21.8	0.0	0.0	43.6	21.8	26.6	13.3
6.0	Construction											
7.0	Manufacturing	1,278.3	3.8337	3,273.3	5.6	2.8	0.0	0.0	5.6	2.8	3.4	1.7
8.0	Transportation, comm. & utilities	798.3	3.8337	2,044.2	16.4	8.2	0.0	0.0	16.4	8.2	10.0	5.0
9.0	Trade	2,700.8	3.8337	6,915.9	9.8	4.8	0.0	0.0	9.8	4.8	6.0	2.9
10.0	Finance, insurance & real estate	97.3	3.8337	249.2	0.5	0.3	0.0	0.0	0.5	0.3	0.3	0.2
11.0	Services	3,920.0	3.8337	10,037.8	34.3	17.2	0.0	0.0	34.5	17.2	20.9	10.5
12.0	Government & public admin.	592	2.2680	1,037	63.6	31.9	0.0	0.0	63.6	31.9	27.3	13.7
	Population	2,600	1.3529	3,637	154.8	77.3	0.0	0.0	154.8	77.3	38.3	19.1
	Rural	2,600	1.3529	3,637	154.8	77.3	0.0	0.0	154.8	77.3	38.3	19.1
											477.2	222.1

Dp Depletions in acre-feet.
Wd Withdrawals in acre-feet.

CHAPTER XVII

EDDY COUNTY

Eddy County provides for the largest economic output and the second largest number of jobs of all the counties comprising the Pecos River Basin in New Mexico. Mineral extraction dominates economic activity, although Eddy County also possess substantial agricultural and recreational resources which provide some diversity to the economy of the county. Water resource supplies are substantial but highly constrained by declared underground basin restrictions, and by significant litigation of water right attributes. The county has two urban areas, Artesia and Carlsbad, and most economic activities revolve around these urban centers in Eddy County. Economic development conditions must be considered fragile due to the dependence on extractive industry and agricultural market conditions.

Economic and Demographic Profile

The total population of Eddy County in 1980 was 47,855. The county includes two urban areas: Artesia with a population of 10,385, and Carlsbad with a population of 25,496. The urban population was 75 percent of the total population of Eddy County in 1980, and at the same time both urban areas serve as the hub for the agricultural regions of the county. The population of Eddy County has vacillated between growth and decline over the past 15 years, although census data for 1970 and 1980 indicate that the population of the county experienced an annual average growth rate of 1.5 percent

during the decade of the 1970s. The population growth trend fluctuations reflect the dynamic conditions of extractive resource markets during the 10-year period, and also suggests concern with respect to future growth conditions in Eddy County.

Total employment in Eddy County during 1980 was 17,660, with less than 6 percent of total employment provided by agriculture, and nearly 25 percent of all employment provided by the extractive (and refining) industries of Eddy County (table 17.1). The mineral resources of Eddy County consist of potash and other soluable salt minerals, petroleum and natural gas, industrial stone, sand, gravel, and other scattered metallic and nonmetallic minerals. Eddy County has consistently ranked second in the state (behind Lea County) in oil production, and in 1982 ranked third (behind San Juan and Lea counties) in gas production. Other large employment sectors in Eddy County in 1980 included services, retail trade, and government.

Total value of economic outputs in Eddy County for 1980 is estimated to be just short of $2 billion, with more than 57 percent of this estimated output derived from activities in crude petroleum and natural gas extraction, nonmetallic mining and quarrying, and petroleum refining. The total value of agricultural production in Eddy County in 1980 amounted to more than $69.5 million, yet this agricultural output contributed only 3.5 percent of the total economic output estimated for the county. The largest nonagricultural nonminerals economic activity in 1980 was provided by retail trade, with the value of retail sales in 1980 being more than $209 million. The combined sales of wholesale and retail trade for 1980 in Eddy County

TABLE 17.1

1980 OUTPUT AND WATER USE COEFFICIENTS
EDDY COUNTY
PECOS RIVER BASIN.

Sector Number	Sector Description	1980 Employment	1980 Output ($1000)	Total Pecos Wd	Total Pecos Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	AF Total Wd/$1000 Output	AF Total Dp/$1000 Output	AF Surface Wd/$1000 Output	AF Surface Dp/$1000 Output	AF Ground Wd/$1000 Output	AF Ground Dp/$1000 Output
1.0	Harvested crops		9,334.6	52,211.6	34,294.3	22,291.3	12,882.5	29,920.3	21,411.9	5.59334	3.67389	2.38803	1.38008	3.20531	2.29382
2.0	Irrigated pasture & all hay	1,002	16,519.4	172,198.4	113,105.7	73,518.7	42,487.5	98,679.7	70,618.1	10.42401	6.84684	4.45045	2.57198	5.97356	4.27486
3.0	Livestock		43,663.0	1,456.0	1,451.0	963.0	963.0	493.0	488.0	0.03335	0.03323	0.02206	0.02206	0.01129	0.01118
5.3	Crude petroleum & nat. gas extract	1,360	805,104.2	10,575.0	65.0	0.0	0.0	10,575.0	65.0	0.01313	0.00008	0.0	0.0	0.01313	0.00008
5.4	Non-metallic mining & quarrying	2,751	230,349.7	5,777.0	7,802.0	0.0	0.0	5,777.0	7,802.0	0.02508	0.03387	0.0	0.0	0.02508	0.03387
5.5	Petroleum refining & related ind.	266	95,594.8	199.0	195.0	0.0	0.0	199.0	195.0	0.00208	0.00204	0.0	0.0	0.00208	0.00204
6.0	Construction	1,291	89,074.0	761.4	414.6	0.0	0.0	761.4	414.6	0.00855	0.00465	0.0	0.0	0.00855	0.00465
7.1	Non-durable manufacturing	378	94,057.9	284.8	155.0	0.0	0.0	284.8	155.0	0.00303	0.00165	0.0	0.0	0.00303	0.00165
7.2	Durable manufacturing	403	27,502.8	83.2	45.3	0.0	0.0	83.2	45.3	0.00303	0.00165	0.0	0.0	0.00303	0.00165
8.0	Transporation, comm. & utilities	1,166	105,394.2	1,484.3	807.7	380.0	380.0	1,104.3	427.7	0.01408	0.00766	0.00361	0.00361	0.01048	0.00406
9.1	Wholesale trade	633	168,502.3	408.3	222.2	0.0	0.0	408.3	222.2	0.00242	0.00132	0.0	0.0	0.00242	0.00132
9.2	Retail trade	2,708	209,003.2	506.5	275.6	0.0	0.0	506.5	275.6	0.00242	0.00132	0.0	0.0	0.00242	0.00132
10.0	Finance, insurance & real estate	570	2,959.3	14.2	7.7	0.0	0.0	14.2	7.7	0.00480	0.00260	0.0	0.0	0.00480	0.00260
11.0	Services	2,836	86,452.4	523.6	284.9	0.0	0.0	523.6	284.9	0.00606	0.00330	0.0	0.0	0.00606	0.00330
12.0	Government & public admin.	2,297		249.7	135.9	0.0	0.0	249.7	135.9	0.10871	0.05916	0.0	0.0	0.10871	0.05916
	Population	47,855		9,917.5	4,958.1	0.0	0.0	9,917.5	4,958.1	0.20724	0.10361	0.0	0.0	0.20724	0.10361
	Urban	35,881		8,037.8	4,019.2	0.0	0.0	8,037.8	4,019.2	0.22401	0.11201	0.0	0.0	0.22401	0.11201
	Rural	11,974		1,879.7	938.9	0.0	0.0	1,879.7	938.9	0.15698	0.07841	0.0	0.0	0.15698	0.07841

Dp Depletions in acre-feet.
Wd Withdrawal in acre-feet.

provided for more than 19 percent of the total economic output estimate for the county. Outputs from manufacturing, TCU, construction and services are significant, but of much lesser magnitude when compared with the aforementioned sectors.

Land and Water Use Profile

The total area of Eddy County is 2,675,200 acres with nearly 99.5 percent of this total aea located within the Pecos River drainage basin (table 17.2). A very small portion of the southwestern corner of Eddy County is part of the Rio Grande Basin, with more than 99 percent of this small area considered grazing lands. The insignificance of this area relative to the county as a whole, as well as lack of enumeration district boundaries which closely correspond to the Rio Grande Basin boundary, suggested treatment of the county economic and land use data as wholly encompassed within the Pecos River Basin. The foothills of the Sacramento Mountains extend into the northwestern part of Eddy County, with the landscape in this region consisting of arroyos, mesas, and high plains. The landscape of the northeastern portion of Eddy County is generally grasslands which gradually slope up to the Caprock which defines the Southern High Plains. In the southern portion of Eddy County east of the Pecos River there are a series of ridges which extend to the Texas border, and west of the river are found the foothills and eastern slopes of the Guadalupe Mountains.

TABLE 17.2

EDDY COUNTY LAND USE.

	1977	1980	1982
Cropland			
Cropped	62,320	61,130	59,690
Idle	13,120	15,310	14,040
National Forests	135,019	135,019	135,019
Wilderness areas	0	0	0
National grasslands			
Public Rangeland			
BLM	1,411,180	1,411,180	1,411,180
State	539,250	539,250	539,250
National Forest	93,457	93,457	93,457
Bureau of Rec.	31,381	31,381	31,381
Commercial Forest Area			
Public	0	0	0
Private	0	0	0
Parks			
State	1,120	1,120	1,120
Game & Fish	640	640	640
Federal	46,755	46,755	46,755
Defense	725	725	725
Urban & Built-Up	19,535	19,535	20,985
Airports	3,500	3,500	3,500
Highways & Roads	19,079	19,155	19,174
Energy Transmission Corridors	6,541	6,541	6,541
Railroads	2,309	2,309	3,370
Population	45,000	47,855	50,400
Assessed Valuation of:	405,930	674,269	813,417
Real Estate ($000s)	405,930	674,269	813,417
Percent Residential			10.3
Percent Nonresidential			89.7
Percent Oil/Gas			67.1

Note: Total Area: 2,675,200 Acres.
Water Area: 7,494 Acres.

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

Irrigated lands are scattered from north to south along the Pecos River Valley, and in some of the tributary areas. Salt cedar has established itself throughout the river floodplain and is especially dense in the McMillian and Avalon Reservoir areas. Irrigated lands accounted for 16,130 acres in 1980, or nearly 2.3 percent of the total Eddy County land area. Approximately 85 percent of all irrigated lands in Eddy County receive all or part of their water from groundwater sources, and all irrigated lands within Eddy County are included within declared underground water basins. Two organized irrigation and conservancy districts are found in Eddy County: the Carlsbad Irrigation District (CID), which is located entirely within Eddy County, and the Pecos Valley Artesian Conservancy District which includes irrigated areas of both Chaves and Eddy counties. The state engineer delcared basins found in Eddy County include the Roswell Artesian Underground Water Basin, the Lea County Underground Water Basin, the Capitan Underground Water Basin, and the Carlsbad Underground Water Basin (appendix B).

Surface water is furnished to all lands included within the CID, with some additional surface water use on the agricultural lands along Black River and lands in the vicinity of Hope. McMillian and Avalon Reservoirs regulate surface water flows to the CID, although this surface water regulation has become less dependable through the years as a result of siltation in these two reservoirs. Brantley Dam and Reservoir, which is currently anticipated to begin construction during fiscal year 1986 subject to appropriation approval, is designed to replace McMillian Reservoir and serve flood control and surface

flow regulation needs of CID and downstream areas. Completion of Brantley Dam and Reservoir will not appreciably increase total available water supplies, but is intended to improve the dependability of surface water deliveries.

Total water withdrawals in 1980 for Eddy County amounted to 256,650 acre-feet (table 17.1), with depletions of 164,220 acre-feet. More than 88 percent of withdrawals, and more then 90 percent of depletions, in 1980 were attributable to irrigated agriculture in Eddy County. Irrigated pasture and hay production account for approximately 76 percent of the agricultural water use in Eddy County. Withdrawals for crude petroleum and natural gas extraction (including secondary recovery) is the second largest water use sector in 1980, although it is notable that depletions in this sector are essentially nominal. Depletions in nonmetallic mining and quarrying are greater than withdrawals due to diversion of water from the Southern High Plains (Lea County) for use in Eddy County potash production. Water use for satisfaction of consumption requirements by the population of Eddy County was also significant in 1980.

Economic Development and Water Use Projections

Population growth and economic development projections for Eddy County must be acknowledged to be highly dependent upon generally favorable conditions in potash, oil and gas markets. With this caveat recognized, population growth in Eddy County was projected to increase at a average annual rate of 1.5 percent over the 25-year

projection period, and employment is projected to increase at a 2.8 percent annual rate over the same projection period.

The total change in withdrawal requirements amount to 27,723 acre-feet, with corresponding increases in depletion demands of 14,320 acre-feet (table 17.3). The increased demands on the water resouces of Eddy County are substantial, with a very broad distribution of these impacts over essentially all sectors of the county's economy. Agricultural demand increases account for 40 percent of the increased withdrawals demands, and nearly 50 percent of increased depletions demands. The growth in agricultural output is projected based on a 15 percent total increase in harvested crop output, a total 10 percent increase in output from irrigated pasture and hay, and a 5 percent increase in livestock production values. Correspondings to the increased agricultural output are increased in agricultural water use efficiency, including a 10 percent total increase in the efficiency of groundwater use, a 5 percent total increase in the efficiency of surface water use by the harvested crops sector, and a 5 percent increase in the efficiency of both surface and groundwater use in irrigated pasture and hay production.

The magnitude of the increases in water demands is very important, and it is clear that the increased scarcity of water in the Pecos River Basin is most severe in Eddy County. Evidence of this increasing scarcity is already apparent in Eddy County. One clear manifestation of this scarcity is the litigation characterized as State of New Mexico ex rel. Reynolds v. Pecos Valley Artesian Conservancy District (99 N.M. 699, 663 P.2d (1983)). The litigation

TABLE 17.3

WATER USE PROJECTIONS
EDDY COUNTY
PECOS RIVER BASIN.

Sector Number	Sector Description	1980 Output ($1000)	Growth Rate	2005 Output ($1000)	Total Wd	Total Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Net Change (Total Wd)	Net Change (Total Dp)
1.0	Harvested crops	9,334.6	0.5606*	10,734.8	55,320.8	36,235.4	24,353.3	14,074.1	30,967.5	22,161.3	3,109.2	1,941.1
2.0	Irrigated pasture & all hay	16,519.4	0.3820	18,171.3	179,946.9	118,195.2	76,826.9	44,399.4	103,120.0	73,795.8	7,748.5	5,089.5
3.0	Livestock	43,663.0	0.1954	45,846.2	1,529.0	1,524.0	1,011.4	1,011.4	517.6	512.6	73.0	73.0
5.3	Crude petroleum & natural gas extract	805,104.2	1.2110	1,087,789.8	14,282.7	87.0	0.0	0.0	14,282.7	87.0	3,707.7	22.0
5.4	Non-metallic mining & quarrying	230,349.7	0.1954	241,867.2	6,066.0	8,192.0	0.0	0.0	6,066.0	8,192.0	289.0	390.0
5.5	Petroleum refining & related ind.	95,594.8	1.2110	129,159.7	268.7	263.5	0.0	0.0	268.7	263.5	69.7	68.5
6.0	Construction	89,074.0	4.4835	266,648.6	2,279.8	1,239.9	0.0	0.0	2,279.8	1,239.9	1,518.4	825.3
7.1	Non-durable manufacturing	94,057.9	4.4835	281,568.2	853.2	464.6	0.0	0.0	853.2	464.6	568.4	309.6
7.2	Durable manufacturing	27,502.8	4.4835	82,331.4	249.5	135.8	0.0	0.0	249.5	135.8	166.3	90.5
8.0	Tranportation, comm.& utilities	105,394.2	4.4835	315,504.2	4,445.5	2,419.9	1,139.0	1,139.0	3,306.5	1,280.9	2,961.2	1,612.2
9.1	Wholesale trade	168,502.3	4.4835	504,422.2	1,220.7	665.8	0.0	0.0	1,220.7	665.8	812.4	443.6
9.2	Retail trade	209,003.2	4.4835	625,664.2	1,514.1	825.9	0.0	0.0	1,514.1	825.9	1,007.6	550.3
10.0	Finance, insurance & real estate	2,959.3	4.4835	8,858.9	42.5	23.0	0.0	0.0	42.5	23.0	28.3	15.3
11.0	Services	86,452.4	4.4835	258,800.7	1,568.3	854.0	0.0	0.0	1,568.3	854.0	1,044.7	569.1
12.0	Government & public admin.	2,297	2.8340	4,619	502.1	273.3	0.0	0.0	502.1	273.3	252.4	137.4
	Population	47,855	1.4700	68,924	12,898.7	6,448.2	0.0	0.0	12,898.7	6,448.2	2,961.2	1,490.1
	Urban	35,881	1.3302	49,927	10,065.7	5,033.1	0.0	0.0	10,065.7	5,033.1	2,027.9	1,013.9
	Rural	11,974	1.8633	18,997	2,833.0	1,415.1	0.0	0.0	2,833.0	1,415.1	953.3	476.2
											26,338.0	13,627.5

Dp Depletions in acre-feet.
Wd Withdrawal in acre-feet.

is in essense a suit brought by CID to accomplish a priority call on the Pecos River such that all junior users of the river are enjoined from use of water which is detrimental to the senior rights of CID. Although the case is not near resolution at this time, impacts will be felt throughout the Pecos River system regardless of whether the priority call relief which CID seeks is granted. A priority call of this magnitude has never been contemplated by the courts of this state prior to this suit. The perception of scarcity created by the filing of the suit should itself be sufficient to induce significant response, including further litigation of priority issues.

CHAPTER XVIII

LEA COUNTY

Although Lea County is one of the wealthiest counties in New Mexico, the economy of the county is extremely delicate. The economy of Lea County, and particularly the economy of the Pecos River Basin portion of the county, is highly dependent upon oil and gas production. Few other resources are available in Lea County which are able to support significant economic expansion. Specifically, agriculture has limited prospects for providing future growth stimulus in light of declining water tables in both the Pecos River and Southern High Plains regions of the county. Nearly all of Lea County is included in declared underground water basins, and one-third to one-half of all the county land area is located above known oil and gas production areas.

Economic and Demographic Profile

The total population of the Pecos River Basin portion of Lea County in 1980 was 7,410, comprising 13.2 percent of the county's total population (table 18.1). There are two urban areas found within the Pecos Basin portion of Lea County, including Eunice, with a 1980 population of 2,970, and Jal, with a 1980 population of 2,675. These two urban areas account for more than 76 percent of the population in the Pecos Basin portion of Lea County. Total employment in the Pecos Basin portion of Lea County during 1980 was 7,388, with more than 76 percent of these jobs associated with oil and gas

TABLE 18.1

1980 OUTPUT AND WATER USE COEFFICIENTS
LEA COUNTY
PECOS RIVER BASIN.

Sector Number	Sector Description	1980 Employment	1980 Output ($1000)	Total Pecos Wd	Total Pecos Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	AF Total Wd/$1000 Output	AF Total Dp/$1000 Output	AF Surface WD/$1000 Output	AF Surface Dp/$1000 Output	AF Ground Wd/$1000 Output	AF Ground Dp/$1000 Output
1.0	Harvested crops		128.2	1,044.3	773.3	0.0	0.0	1,044.3	773.3	8.14587	6.03198	0.0	0.0	8.14587	6.03198
2.0	Irrigated pasture & all hay	76	95.7	1,305.7	966.7	0.0	0.0	1,305.7	966.7	13.64368	10.10136	0.0	0.0	13.64368	10.10136
3.0	Livestock		17,490.0	546.0	546.0	358.0	358.0	188.0	188.0	0.03122	0.03122	0.02047	0.02047	0.01075	0.01075
5.3	Crude petroleum & nat. gas extract.	5,415	1,209,569.1	6,156.0	75.0	0.0	0.0	6,156.0	75.0	8.00509	0.00006	0.0	0.0	0.00509	0.00006
5.4	Nonmetallic mining & quarrying	158	20,213.7	10,631.0	741.0	0.0	0.0	10,631.0	741.0	0.52593	0.03666	0.0	0.0	0.52593	0.03666
5.5	Petroleum refining & related ind.	227	95,461.1	2,594.0	2,127.0	0.0	0.0	2,594.0	2,127.0	0.02717	0.02228	0.0	0.0	0.02717	0.02228
6.0	Construction	293	19,676.7	384.3	189.4	0.0	0.0	384.3	189.4	0.01953	0.00963	0.0	0.0	0.01953	0.00963
7.0	Manufacturing	53	15,414.8	106.5	52.5	0.0	0.0	106.5	52.5	0.00691	0.00341	0.0	0.0	0.00691	0.00341
8.0	Trans., Comm. & Utilities	287	38,164.7	1,226.1	604.2	0.0	0.0	1,226.1	604.2	0.03213	0.01583	0.0	0.0	0.03213	0.01583
9.1	Wholesale trade	66	9,989.8	55.2	27.2	0.0	0.0	55.2	27.2	0.00553	0.00272	0.0	0.0	0.00553	0.00272
9.2	Retail trade	366	30,339.4	167.6	82.6	0.0	0.0	167.6	82.6	0.00552	0.00272	0.0	0.0	0.00552	0.00272
10.0	Fin., Insur. & Real Est.	41	450.0	4.9	2.4	0.0	0.0	4.9	2.4	0.01089	0.00533	0.0	0.0	0.01089	0.00533
11.0	Services	306	17,360.7	239.9	118.2	0.0	0.0	239.9	118.2	0.01382	0.00681	0.0	0.0	0.01382	0.00681
12.0	Government & Public Admin.	100		24.8	12.2	0.0	0.0	24.8	12.2	0.24800	0.12200	0.0	0.0	0.24800	0.12200
	Population	7,410		761.7	353.3	0.0	0.0	761.7	353.3	0.10279	0.04768	0.0	0.0	0.10279	0.04768
	Urban	5,645		623.3	284.5	0.0	0.0	623.3	284.5	0.11042	0.05040	0.0	0.0	0.11042	0.05040
	Rural	1,765		138.4	68.8	0.0	0.0	138.4	68.8	0.07841	0.03898	0.0	0.0	0.07841	0.03898

Dp Depletions in acre-feet.
Wd Withdrawal in acre-feet.

production and refining. The extremely large percentage of employed residents in the Pecos Basin portion of Lea County is misleading, and reflects the allocation of all oil and gas production employment with residence in Hobbs, which is just outside the basin, to the Pecos Basin portion of Lea County. This is because most of the oil and gas production areas near Hobbs are included within the boundaries of the Pecos River Basin, and most oil field workers would communte to those jobs from a residence in Hobbs.

The dominance of oil and gas production in the employment data provided in table 18.1 is clear. The largest nonmining employment sectors include trade, services, construction and TCU. The small agricultural sector provides only 1 percent of the jobs in the Pecos Basin portion of Lea County. The total value of economic output from the Pecos River Basin portion of Lea County is estimated to be nearly $1.5 billion in 1980, with more than 88 percent of this total output value derived from oil and gas production and refining. The second largest output sector was TCU in 1980, but the value of output in this sector amounted to slightly more than 3 percent of the total value of oil and gas production in the Lea County portion of the Pecos River Basin. Agricultural output in the Pecos Basin portion of Lea County was slightly more than $17.7 million in 1980, with nearly 99 percent of this value provided by livestock sales. Other nonagricultural nonmining sectors of significance to the Pecos Basin economy in Lea County included retail trade, construction and services.

Land and Water Use Profile

The total area of the Pecos River Basin portion of Lea County is 1,312,640 acres, with this area comprising nearly 47 percent of the total area of the county (table 18.2). There is little surface water drainage in the Pecos Basin region which is directly tributary to the Pecos River and the area is esentially a closed sub-basin with surface drainage to a series of intermittent playa lakes. The area is included within the state engineer declared Lea County Underground Water Basin, Carlsbad Underground Water Basin, Jal Underground Water Basin, and Capitan Underground Water basin. All water use is from groundwater sources, with the exception of a small amount of livestock use.

Nearly 99 percent of the lands included within the Pecos Basin portion of Lea County are described in the 1975 County Profile as grazing lands, and land ownership is nearly evenly divided among private, state and federal control (table 18.2). Mescalero Ridge generally defines the boundary between the Southern High Plains and the Pecos River Basin, with the boundary excluding the county's major population centers, Hobbs and Lovington. The plains landscape is principally rolling grasslands, and there are a few small New Mexico Game and Fish lakes found within the region. In 1980, there were 1,000 irrigated acres in the Pecos Basin region of Lea County, with the largest acreages devoted to cotton and alfalfa.

Total water withdrawals in 1980 were 25,248 acre-feet, and total depletions were 6,671 acre-feet (table 18.1). Total withdrawals are much greater than depletions due to the transfer of water to Eddy

TABLE 18.2

LEA COUNTY LAND USE AND ADMINISTRATION.
(1966-1970 DATA)

	Lea County (Acres)	Pecos River Basin (Acres)	Pecos Basin As A Percent Of County
Land Use			
Total area	2,812,160	1,312,640	46.7%
Inland water	2,640	2,000	75.8
Urban & built-up	40,275	480	1.2
Roads	20,777	9,670	46.5
Crop land	122,810	2,900	2.4
(Irrigated)	(101,500)	(2,900)	2.9
Grazing lands	2,625,068	1,297,590	49.4
Land Ownership & Admin.			
Total area	2,812,160	1,312,640	46.7%
Federal lands	466,952	425,480	91.1
(BLM)	(455,952)	(425,480)	91.1
State lands	873,748	473,760	54.2
Private & other misc.	1,471,460	413,400	28.1

Source: Interstate Stream Commission and N.M. State Engineer Office, County Profile, Lea County, New Mexico (1974), Tables 1 and 2.

County for potash mining, with the withdrawals reported in Lea County and the depletions reported in Eddy County. Withdrawals associated with agriculture account for less than 12 percent of the total for the basin region, but the agricultural sector is responsible for more than 34 percent of the depletions within the Pecos Basin region of Lea County in 1980. The high levels of withdrawals for petroleum production, with limited corresponding depletions, are the result of secondary petroleum recovery activities which reinject water deep within the aquifer which is withdrawn from strata relatively close to the surface. The secondary recovery techniques thus do not deplete water from the aquifer in the accounting of water use by the SEO. Other substantial water users within the Pecos River Basin portion of Lea County in 1980 were the TCU and construction sectors, as well as the water use requirements of the region's populous.

Economic Development and Water Use Projections

Although there is some potential for development in the non-mining related sectors of the Pecos Basin economy in Lea county, the principal source of development and growth in the region is oil and gas production and to a lesser extent potash mining. The growth prospects for the oil and gas sector are not particularly strong, but there is also not likely precipitous declines in production during the period of projection. The region economic development associated with continued oil and gas production is substantial, and growth projections for the region are based on optimism with respect to

continued oil and gas production. The Temple and Wombold projections of population growth for Lea County reflect a very strong 3.6 average annual percentage population growth rate, and employment growth within the county is projected based on a similiar 3.7 percent average annual rate of growth. The water supplies of the Pecos Basin region of Lea County are limited to groundwater resources, with the state engineer estimating that there remains 4,760 acre-feet of water available in storage in the Jal Underground Water Basin in his September 1983 memo to the governor's Water Law Study Committee.

The projections of population growth and economic development in the Lea County portion of the Pecos River Basin show a very substantial increase in water demands, with total withdrawal demands increasing 12,257 acre-feet per year, and depletion demands by 2005 5,396 acre-feet greater than in 1980 (table 18.3). The largest increase comes in the TCU sector, although substantially increased demands are also seen in the mining sectors and for satisfaction of the population consumption demands. Clearly, the constraints imposed by water resource supplies will not allow for all this increased demand, yet there is no speculation here as to which of the present uses will be curtained in favor of an alternative use. The continued development of the region must be recognized to be fragile and subject to both domestic and international market circumstances. Thus, the projections of growth and economic change in the Lea County portion of the Pecos River Basin must be considered to be among the most tenuous included in this analysis.

TABLE 18.3

WATER USE PROJECTIONS
LEA COUNTY
PECOS RIVER BASIN.

Sector Number	Sector Description	1980 Output ($1000)	Growth Rate	2005 Output ($1000)	Total Wd	Total Dp	Surface Wd	Surface Dp	Ground Wd	Ground Dp	Net Change (Total Wd)	Net Change (Total Dp)
1.0	Harvested crops	128.2	0.5610%	147.4	1,080.6	800.2	0.0	0.0	1,080.6	800.2	36.3	26.9
2.0	Irrigated pasture & all hay	95.7	0.3820	105.3	1,364.8	1,010.5	0.0	0.0	1,364.8	1,010.5	59.1	43.8
3.0	Livestock	17,490.0	0.1950	18,364.5	770.7	770.7	573.3	573.3	197.4	197.4	224.7	224.7
5.3	Crude petroleum & natural gas extract	1,209,569.1	1.2110	1,634,269.1	8,318.4	98.1	0.0	0.0	8,318.4	98.1	2,162.4	23.1
5.4	Non-metallic mining & quarrying	20,213.7	0.1950	21,224.4	11,162.5	778.1	0.0	0.0	11,162.5	778.1	531.5	37.1
5.5	Petroleum refining & related ind.	95,461.1	1.9060	153,045.4	4,158.2	3,409.9	0.0	0.0	4,158.2	3,409.9	1,564.2	1,282.9
6.0	Construction	19,676.7	5.7240	79,114.2	1,545.1	761.9	0.0	0.0	1,545.1	761.9	1,160.8	572.5
7.0	Manufacturing	15,414.8	5.7240	61,978.4	428.3	211.3	0.0	0.0	428.3	211.3	321.8	158.8
8.0	Transportation, comm. & utilities	38,164.7	5.7240	153,449.0	4,930.3	2,429.1	0.0	0.0	4,930.3	2,429.1	3,704.2	1,824.9
9.1	Wholesale trade	9,989.8	5.7240	40,166.0	222.1	109.3	0.0	0.0	222.1	109.3	166.9	82.1
9.2	Retail trade	30,339.4	5.7240	121,985.8	673.4	331.8	0.0	0.0	673.4	331.8	505.8	249.2
10.0	Finance, insurance & real estate	450.0	5.7240	1,809.3	19.7	9.6	0.0	0.0	19.7	9.6	14.8	7.2
11.0	Services	17,360.7	5.7240	69,802.3	964.7	475.4	0.0	0.0	964.7	475.4	724.8	357.2
12.0	Government & public admin.	100	3.7330	250	62.0	30.5	0.0	0.0	62.0	30.5	37.2	18.3
	Population	7,410	3.5810	17,858	1,644.1	766.3	0.0	0.0	1,644.1	766.3	882.4	413.0
	Urban	5,645	3.2670	12,610	1,253.2	572.0	0.0	0.0	1,253.2	572.0	629.9	287.5
	Rural	1,765	4.4550	5,248	390.9	194.3	0.0	0.0	390.9	194.3	252.5	125.5
											12,096.9	5,321.7

Dp Depletions in acre-feet.
Wd Withdrawals in acre-feet.

CHAPTER XIX

SUMMARY ASSESSMENT OF FUTURE WATER SUPPLY AND DEMAND CONDITIONS IN THE AWR BASIN

Future water supply and demand conditions in the AWR Basin, as assessed by the 25-year projections of economic and demographic growth and associated water use requirements, can be summarized as a moderate increase in water scarcity conditions subject to uncertainty with respect to coal resource development in the basin. Table 19.1 provides projected basin-wide and county total water demand increases, as well as 1980 withdrawals and depletions for the AWR Basin. What is readily apparent from this summary of future water supply and demand conditions is the limited overall increased demands relative to the 1980 withdrawals and depletions.

It is important to understand the nature of the information presented in table 19.1 before further interpretation of the data is provided. The assumption in the presentation of 1980 water use data is that actual SEO reported appropriations in that year represent the existing water supplies in the AWR Basin (excluding the SEO categories for fish and wildlife and reservoir evaporation) except for those additional water supplies described as available for appropriation in the September 1983 memo from the state engineer to the governor's Water Law Study Committee. The application of 1980 water use data to define available water supplies is acknowledged to be crude from a legal water right assessment perspective, but accurate in the sense that the water supplies so defined are empirically based with reliance on observed use of available water supplies. The SEO memo must be clearly understood to be an estimate of waters available for

TABLE 19.1

SUMMARY WATER USE PROJECTIONS
1980-2005--BY COUNTY
AWR BASIN.

	1980 Total Wd	1980 Total Dp	1980-2005 Net Change Total Wd	1980-2005 Net Change Total Dp	Net Change Wd as a % of 1980 Wd	Net Change Dp as a % of 1980 Dp
Colfax County	57,244	36,731	1,870	1,136	3.27%	3.09%
Mora County	44,040	20,691	-64	-3	NA	NA
Harding County	3,727	3,299	217	158	5.82	4.79
San Miguel County	10,004	5,096	107	80	1.07	1.57
Guadalupe County	102	99	7	5	6.86	5.05
Quay County	91,058	40,496	14,652	6,666	16.09	16.46
Union County	106,418	67,092	3,356	1,974	3.15	2.94
AWR Basin TOTAL	312,593	173,504	20,145	10,016	6.44	5.77

Dp Depletions in acre-feet.
NA Not applicable.
Wd Withdrawals in acre-feet.

appropriation, and (quoting from the memo) "...every application to appropriate water is subjected to protest and hearing and presentation of evidence that could modify the estimates given."[1]

The basin-wide projections of increased water use demands are based on an assortment of assumptions with respect to economic and demographic growth by county, increased water us efficiency, and site-specific water availability. It must be clearly understood that the changes in the efficiency of use in the agricultural sector are induced by improved irrigation technology, partially as a result of the public investment in agricultural research, and as a result of increasing water delivery costs (i.e., increased pumping and ditch maintenance costs). Reduced agricultural water use demands make more water available to the system, but do not reflect changes in the number of irrigated acres. Likewise, increased use efficiency by the population of a basin is the result of consumer sensitivity to increasing water prices associated with increasing costs of distribution. The growth trends were derived directly from the projections of population and employment completed by Temple and Wombold. It was assumed that all increased water demands can be made available on a site-specific basis; thus, projections of demand increases reflect, in a quantitative fashion, the likely pressure for transfer of water rights from existing (i.e., 1980) uses to new uses when unappropriated water are unavailable.

Increases in water use demands by the year 2005 will amount to more than 20,000 acre-feet withdrawal requirement and more than 10,000 acre-feet depletion requirement in the AWR Basin. These quantities represent approximately 6 percent of the 1980 water use in the AWR Basin, and implies that annual water demands will increase only moderately during the 25-year projection period.

Data reflecting changes in water use demands by sector are presented in table 19.2 for the AWR Basin in New Mexico. The first observation with respect to sectoral changes in water use demands is that even though water use in many nonagricultural sectors more than doubles during the 25-year projection of economic growth, these increased demands are relatively minor as compared to the magnitude of demand changes in the agricultural sector. Growth in the agricultural sectors was limited to small output increases induced by change in agricultural production technology, and does not contemplate increases in agricultural acreages. The most significant nonagricultural water demand increase is for satisfaction of the population water demand requirements.

It is noteworthy that the largest quantitative increases are found in Quay, Union, and Colfax counties; but, more importantly, substantial increases in water use demands can be anticipated in Quay County relative to 1980 use levels. The availability of unappropriated waters in Ute Reservoir, subject to contract delivery by the Interstate Stream Commission, is adequate to cover the increased use demands in Quay County. The pressure of increasing water demands throughout the remainder of the basin suggests substantial potential for some moderate level of water right transfer activities within specific areas, particularly in Colfax County, but the quantitative increases are not so substantial as to suggest severe water scarcity for the AWR Basin as a whole by 2005. It must be noted that these water scarcity conditions are subject to an assumption of limited increases in coal production in the Raton Basin. There is a significant potential for development of these coal resources during the period of projection, with this assessment of water scarcity conditions in the AWR Basin suject to this substantial caveat.

TABLE 19.2

SUMMARY WATER USE PROJECTIONS
1980-2005--BY SECTOR
AWR BASIN.

Sector Number	Sector Description	1980 Total Wd	1980 Total Dp	1980-2005 Net Change Total Wd	1980-2005 Net Change Total Dp	Net Change Wd As a % Of 1980 Wd	Net Change Dp As a % Of 1980 Dp
1.0	Harvested	113,802.4	61,785.8	7,314.7	3,378.2	6.43%	5.47%
2.0	Irrigated pasture & all hay	177,657.6	93,814.2	7,376.6	2,960.2	4.15	3.16
3.0	Livestock	14,937.0	14,928.0	1,971.0	1,966.6	13.20	13.17
5.2	Coal mining	312.8	113.4	188.5	69.1	60.26	60.93
5.3	Crude petroleum & natural gas extract.	3.0	1.0	1.1	0.4	36.67	40.00
5.4	Non-metallic mining & quarrying	38.0	7.2	1.9	0.3	5.00	4.17
6.0	Construction	490.3	251.4	469.8	238.1	95.82	94.71
7.0	Manufacturing	101.6	50.6	104.0	51.2	102.36	101.19
8.0	Transportation, comm. & utilities	367.1	243.9	371.8	242.0	101.28	99.22
9.1	Wholesale trade	242.1	122.0	255.1	126.9	105.37	104.02
9.2	Retail trade	428.8	210.9	445.2	216.6	103.82	102.70
10.0	Finance, insurance & real estate	50.2	22.6	55.4	25.0	110.36	110.62
11.0	Services	447.4	233.2	467.0	240.7	104.38	103.22
12.0	Government & public admin.	286.4	165.1	113.5	65.6	39.63	39.73
	Population	3,427.5	1,554.5	1,025.5	436.7	29.92	28.20
	Urban	2,054.1	924.1	684.5	279.9	33.32	30.29
	Rural	1,373.4	630.4	341.0	156.8	24.83	24.87

Dp Depletions in acre-feet.
Wd Withdrawals in acre-feet.

CHAPTER XIX
ENDNOTES

1 S.E. Reynolds, memo to Mr. Charles T. DuMars, Chairman, Water Law Study Committee, September 1, 1983, p. 8 (memo reproduced in appendix).

CHAPTER XX

SUMMARY ASSESSMENT OF FUTURE WATER SUPPLY AND DEMAND CONDITIONS IN THE PECOS RIVER BASIN

Future water supply and demand conditions in the Pecos River Basin, as assessed by the 25-year projections of economic and demographic growth and associated water use requirements, can be summarized to describe moderate increases in demands subject to significant supply constraints. Water resources scarcity, in light of increasing demands and constrained supplies, can be anticipated to become a significant potential limitation on economic growth and development in the Pecos River Basin, with water scarcity conditions likely to induce substantial water right transfer activity and efficiency of use increases not contemplated by these projections.

Before proceeding further with the interpretation of the data presented in table 20.1, it is important to recognize the assumptions and limitations of this water supply and demand analysis as present in the last chapter. In short, reported 1980 water use defines available water supplies with additional supplies available for appropriation defined by the state engineer's memo of September 1983. Water demands are projected over a 25-year period based on a variety of assumptions with respect to economic and demographic growth, increased water use efficiency, and site specific water availability. Summary water supply and demand conditions provide information relative to pressures for transfer of water rights from existing 1980 uses, and incentives for significant water use efficiency improvements of a magnitude which are not included in the projections of demand requirements.

TABLE 20.1

SUMMARY WATER USE PROJECTIONS
1980-2005--BY COUNTY
PECOS RIVER BASIN.

	1980 Total Wd	1980 Total Dp	1980-2005 Net Change Total Wd	1980-2005 Net Change Total Dp	Net Change Wd as a % of 1980 Wd	Net Change Dp as a % of 1980 Dp
San Miguel County	22,715	10,893	1,774	872	7.81%	8.01%
Guadalupe County	17,599	9,433	400	239	2.27	2.53
Quay County	13,939	9,314	-59	-11	NA	NA
Torrance County	666	652	51	41	7.66	6.29
De Baca County	56,616	23,827	395	177	0.70	0.74
Roosevelt County	2,032	1,601	86	66	4.23	4.12
Lincoln County	24,981	11,729	4,891	2,185	19.58	18.63
Chaves County	308,971	219,925	6,217	579	2.01	0.26
Otero County	6,951	3,271	477	222	6.86	6.79
Eddy County	256,651	164,220	26,338	13,628	10.26	8.30
Lea County	25,248	6,671	12,097	5,322	47.91	79.78
Pecos River Basin TOTAL	736,369	461,536	52,667	23,320	7.15	5.05

Dp Depletions in acre-feet.
NA Not applicable.
Wd Withdrawals in acre-feet.

The total water supply, as here defined by 1980 uses, of the Pecos River Basin consists of 736,369 acre-feet withdrawals and 461,536 acre-feet depletions. Total annual increases in the demands for water in the Pecos River Basin by 2005 are projected to be 52,667 acre-feet of withdrawal requirements, and 23,320 acre-feet of depletion requirements. That these increases in withdrawals and depletion demands amount to approximately 7 and 5 percent, respectively, of total water supplies suggests that water scarcity could become significantly greater in some regions of the basin by 2005.

Data reflecting changes in water use demands by sector are presented in table 20.2 for the Pecos River Basin. It is evident from the summary of sector water demand increases that nonagricultural growth in the Pecos River Basin will account for the great majority of water demand increases. The largest projected increase is in the TCU sector, although other substantial increases can be observed in the water demands of the service, trade, construction and manufacturing sectors. The increased water demands of the Pecos Basin population are also projected to be significant, although essentially no net change in the total agricultural water demands are projected. The increased withdrawal demands of the petroleum extraction sector are projected to be substantial, but depletions associated with the secondary recovery activity in this sector are limited. It should be recognized that in many of the nonagricultural sectors, the projected economic growth results in a tripling of water use demands associated with these sectors, but that total water demands in the Pecos River Basin increase in the 5 to 7 percent range as compared to 1980 water supplies.

TABLE 20.2

SUMMARY WATER USE PROJECTIONS 1980-2005--BY SECTOR PECOS RIVER BASIN.

Sector Number	Sector Description	1980 Total Wd	1980 Total Dp	1980-2005 Net Change Total Wd	1980-2005 Net Change Total Dp	Net Change Wd As a % Of 1980 Wd	Net Change Dp As a % Of 1980 Dp
1.0	Harvested crops	156,055.1	103,285.2	3,748.4	2,116.3	2.40%	2.05%
2.0	Irrigated pasture & all hay	489,754.9	313,704.8	-2,840.4	-2,650.7	NA	NA
3.0	Livestock	13,837.6	13,785.0	889.2	892.6	6.50	6.48
4.0	Forestry & fisheries	0.2	0.1	0.0	0.0	0.00	0.00
5.3	Crude petroleum & natural gas extract.	18,094.0	220.0	6,349.2	73.2	35.09	33.27
5.4	Non-metallic mining & quarrying	16,563.0	8,652.0	828.2	432.5	5.00	5.00
5.5	Petroleum refining & related Inc.	2,793.0	2,322.0	1,633.9	1,351.4	58.50	58.20
6.0	Construction	2,888.1	1,481.7	5,778.7	2,960.1	200.09	199.78
7.0	Manufacturing	2,099.1	1,065.0	4,405.2	2,230.9	209.86	209.47
8.0	Transportation, comm. & utilities	4,952.3	2,515.9	11,069.0	5,605.0	223.51	222.78
9.1	Wholesale trade	1,323.1	673.2	2,658.1	1,353.6	200.90	201.07
9.2	Retail trade	2,475.4	1,243.6	4,903.9	2,465.9	198.11	198.29
10.0	Finance, insurance & real estate	151.4	73.8	300.1	146.2	198.22	198.10
11.0	Services	2,863.7	1,457.9	5,544.9	2,740.5	193.63	187.98
12.0	Government & public admin.	1,727.5	872.1	1,337.0	646.3	77.40	74.11
	Population	20,790.1	10,183.4	6,052.0	2,955.6	29.11	29.02
	Urban	16,342.5	8,027.0	3,995.4	1,949.8	24.45	24.29
	Rural	4,447.6	2,156.4	2,056.6	1,005.8	46.24	46.64

Dp Depletion in acre-feet.
Wd Withdrawals in acre-feet.
NA Not applicable.

The largest projected increases in water demands are found in Eddy, Lea, Chaves, and Lincoln counties--areas where water scarcity issues are already a topic of substantial public concern. Due to limited supply availability and strong nonagricultural growth, the projected water scarcity conditions of Lincoln County must be considered among the most severe. Also of significant concern are the demand increases found in Lea and Eddy counties which account for more than 73 percent of the increased withdrawal demands and more than 81 percent of the total increased depletion demands in the Pecos River Basin projections. In short, the areas of the Pecos River Basin which are presently the most constrained by water availability will become even more problematic with respect to satisfying increased water demands associated with growth and development of the region.

Further aggravating the future water scarcity conditions is the uncertainty imposed by the numerous water right litigations and adjudications which are currently pending in the Pecos River Basin. If Texas is successful in their challenge of New Mexico's deliveries under the Pecos River Compact, substantial reductions in the water supplies available could exist due to an obligation to increase deliveries to Texas. If the Carlsbad Irrigation District successfully imposes a priority call on upstream junior users, then reduction in the available supplies in these upstream regions can be anticipated. Finally, if the Mescalero Apache Indians are granted substantial reserved rights beyond their present appropriations, existing patterns of water use in the Rio Hondo Basin could be modified significantly.

The summary assessment of future water supply and demand conditions in the Pecos River Basin thus appears dependent not only on projected

increases in water demands, but also on significant potential changes in water supply conditions. Throughout nearly all regions of the Pecos River Basin in New Mexico there is anticipated some increasing scarcity with respect to water availability. The most dramatic of the increased demands is anticpated in the southern portion of the basin where water scarcity is currently a substantial concern. Changing water supply conditions, associated both with aquifer management and use as well as water right litigation, appears to be the determining factor with respect to future water scarcity conditions in the Pecos River Basin. Finally, it must also be noted that these projections of water supply and demand conditions in the Pecos River Basin assume relative stability in the mineral extractive sectors, and in particular the oil and gas industry. A precipitous decline in oil and gas production during the 25-year projection period would singificantly alter water scarcity conditions within the region.

BIBLIOGRAPHY

Arnold, E.C. and Hill, J.M. 1981. New Mexico Energy Resources 1980. Annual Report of Bureau of Geology in the Mining and Minerals Division of New Mexico Energy and Minerals Department, New Mexico Bureau of Mines and Minerals Resources, Circular 181, New Mexico Institute of Mining and Technology, Socorro, New Mexico.

Arnold, E.C. and Hill, J.M. 1981. New Mexico Energy Resources 1981. Annual Report of Bureau of Geology in the Mining and Minerals Division of New Mexico Energy and Minerals Department, Santa Fe, New Mexico.

Berkstresser, C.F., Jr. and Mourant, W.A. 1966. Ground-Water Resources and Geology of Quay County, New Mexico. State Bureau of Mines and Mineral Resources, New Mexico Institute of Mining and Technology, Ground-Water Report 9, Socorro, New Mexico.

Bravo Dome Study Committee. 1979. Carbon Dioxide Development in Northeastern New Mexico. Prepared in conjunction with The Eastern Plains Council of Governments and The El Llano Estacado RC & D Area Council, Tucumcari, New Mexico.

Bureau of Reclamation. 1976. New Mexico Water Resources Assessment for Planning Purposes. U.S. Department of Interior, Bureau of Reclamation, in cooperation with the State of New Mexico.

Bureau of Reclamation. 1982. Brantley Project, New Mexico Definite Plan Report. U.S. Department of Interior, Bureau of Reclamation, Southwest Regional Office, Amarillo, Texas.

Clevenger, T. and Carpenter, P. 1983. Irrigated Acreage in New Mexico and Estimated Crop Value By County, 1980. Agricultural Experiment Station, New Mexico State University, Research Report No. 498, Las Cruces, New Mexico.

Clevenger, T., Carpenter, P. and Southward, M. 1984. Analysis of Differences in Irrigated Crop Values for New Mexico, 1979 to 1980. Agricultural Experiment Station, New Mexico State University, Research Report 527, Las Cruces, New Mexico.

Cooper, J.B. and Davis, L.V. 1967. General Occurrence and Quality of Ground Water in Union County, New Mexico. State Bureau of Mines and Mineral Resources, New Mexico Institute of Mining and Technology, Ground-Water Report 8, Socorro, New Mexico.

d'Arge, R.C. 1970. Quantitative Water Resource Basin Planning: An Analysis of the Pecos River Basin, New Mexico. New Mexico Water Resources Research Institute, New Mexico State University, WRRI Report No. 8, Las Cruces, New Mexico.

Data Resources, Inc. 1983. U.S. Long-Term Review, Winter 1983 to 1984. McGraw-Hill, Inc., Lexington, Massachusetts.

Diemer, J.A. and Morrison, J.F. 1984. New Mexico Land Use, by County 1977 to 1982. Agricultural Experiment Station, New Mexico State University, Research Report 532, Las Cruces, New Mexico.

DuMars, C.T., ET AL. 1984. The Impact of Recent Court Decisions Concerning Water and Interstate Commerce on Water Resources of the State of New Mexico. Institute of Public Law, School of Law, Univeristy of New Mexico, Albuquerque, New Mexico.

Folk-Williams, J.A. and Cannon, J.S. 1983. Water for the Energy Market. Western Network, Santa Fe, New Mexico.

Hughes, W.C. 1970. Economic Feasibility of Increasing Pecos Basin Water Supplies Through Reduction of Evaporation and Evaportranspiration. New Mexico Water Resources Research Institute, WRRI Report No. 9, Las Cruces, New Mexico.

Lansford, R.R. ET AL. 1984. Sources of Irrigation Water and Irrigated and Dry Cropland Acreages in New Mexico, by County, 1977 to 1982. Agricultural Experiment Station, New Mexico State University, Research Report 514, Las Cruces, New Mexico.

Lingle, R.T. and Linford, D. 1961. The Pecos River Commission of New Mexico and Texas. Compiled under the direction of The Pecos River Commission, The Rybal Press, Santa Fe, New Mexico.

Mourant, W.A. 1963. Water Resources and Geology of the Rio Hondo Drainage Basin, Chaves, Lincoln, and Otero Counties, New Mexico. New Mexico State Engineer, in cooperation with The U.S. Geological Survey, Technical Report 28, Santa Fe, New Mexico.

Mourant, W.A. and Shomaker, J.W. 1970. Reconnaissance of Water Resources of De Baca County, New Mexico. State Bureau of Mines and Mineral Resources, New Mexico Institute of Mining and Technology, Ground-Water Report 10, Socorro, New Mexico.

New Mexico Energy and Minerals Department. 1983. 1983 Update, Annual Resources Report. State of New Mexico, Santa Fe, New Mexico.

New Mexico Interstate Stream Commission and New Mexico State Engineer Office. 1974 and 1975. County Profile (by County), Water Resources Assessment for Planning Purposes. New Mexico State Engineer, Santa Fe, New Mexico.

New Mexico State Engineer. 1966. Rules and Regulations Governing Drilling of Wells and Appropriations and Use of Ground Water in New Mexico. New Mexico State Engineer, Santa Fe, New Mexico.

Reynolds, S.E. 1983. Annual Report of the State Engineer of New Mexico, for the 70th Fiscal Year. New Mexico State Engineer, Santa Fe, New Mexico.

Reynolds, S.E. 1984. Annual Report of the State Engineer of New Mexico, for the 71st Fiscal Year. New Mexico State Engineer, Santa Fe, New Mexico.

Saleem, Z.A. and Jacob, C.E. 1971. Dynamic Programing Model and Quantitative Analysis, Roswell Basin, New Mexico. New Mexico Water Resources Research Institute in cooperation with New Mexico Institue of Mining and Technology, WRRI Report No. 10.

Sewell, W.R. and Bower, B.T., eds. 1968. Forecasting the Demands for Water. Policy and Planning Branch, Department of Energy, Mine and Resources, Ottawa, Ontario, Canada.

Snodgrass, M.M. and Wilmeth, S.I. 1984. An Economic Analysis of Enterprise Adjustment to Water Availability and Risk. Agricultural Experiment Station, New Mexico State University, Bulletin 707, Las Cruces, New Mexico.

Sorensen, E.F. 1982. 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.

Sorensen E.F., Stotelmeyer, R.B., and Baker, D.H., Jr. 1973. Mineral Resources and Water Requirements for New Mexico Mineral Industries. New Mexico Bureau of Mines and Mineral Resources, New Mexico Institute of Mining and Technology, Circular 138, Socorro, New Mexico.

Temple, J. and Wombold, L. 1983. Population, Employment and Income for Counties in New Mexico: Historical Data 1970 to 1980 and Projections 1980 to 2000. Bureau of Business and Economic Research, University of New Mexico, Albuquerque, New Mexico.

Tysseling, J.C. and McDonald, B. 1983. The Economic Impact of Alternative Resolutions of Pueblo Indian Water Rights in the Upper Rio Grande Basin. (Forthcoming). New Mexico Water Resources Research Institute, Las Cruces, New Mexico.

United States Department of Agriculture and New Mexico Crop and Livestock Reporting Service. 1978. New Mexico Agricultural Statistics 1977. New Mexico Department of Agriculture, New Mexico State Unviersity, Las Cruces, New Mexico.

Welder, G.E. 1983. Geohydrologic Framework of the Roswell Ground-Water Basin, Chaves and Eddy Counties, New Mexico. U.S. Geological Survey in cooperation with New Mexico State Engineer Office, Technical Report 42, Santa Fe, New Mexico.

Yguado and Associates. 1971. Utilities Feasibility Study-Water and Power Systems, Las Vegas, New Mexico. Albuquerque, New Mexico.

APPENDIX A

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/l total dissolved solids
[2/] 1,000 to 3,000 mg/l 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 ft^2/day	83,300	100 yr.	3.4
S = 0.05		300 yr.	7.1
Boundary @ 10 miles		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.

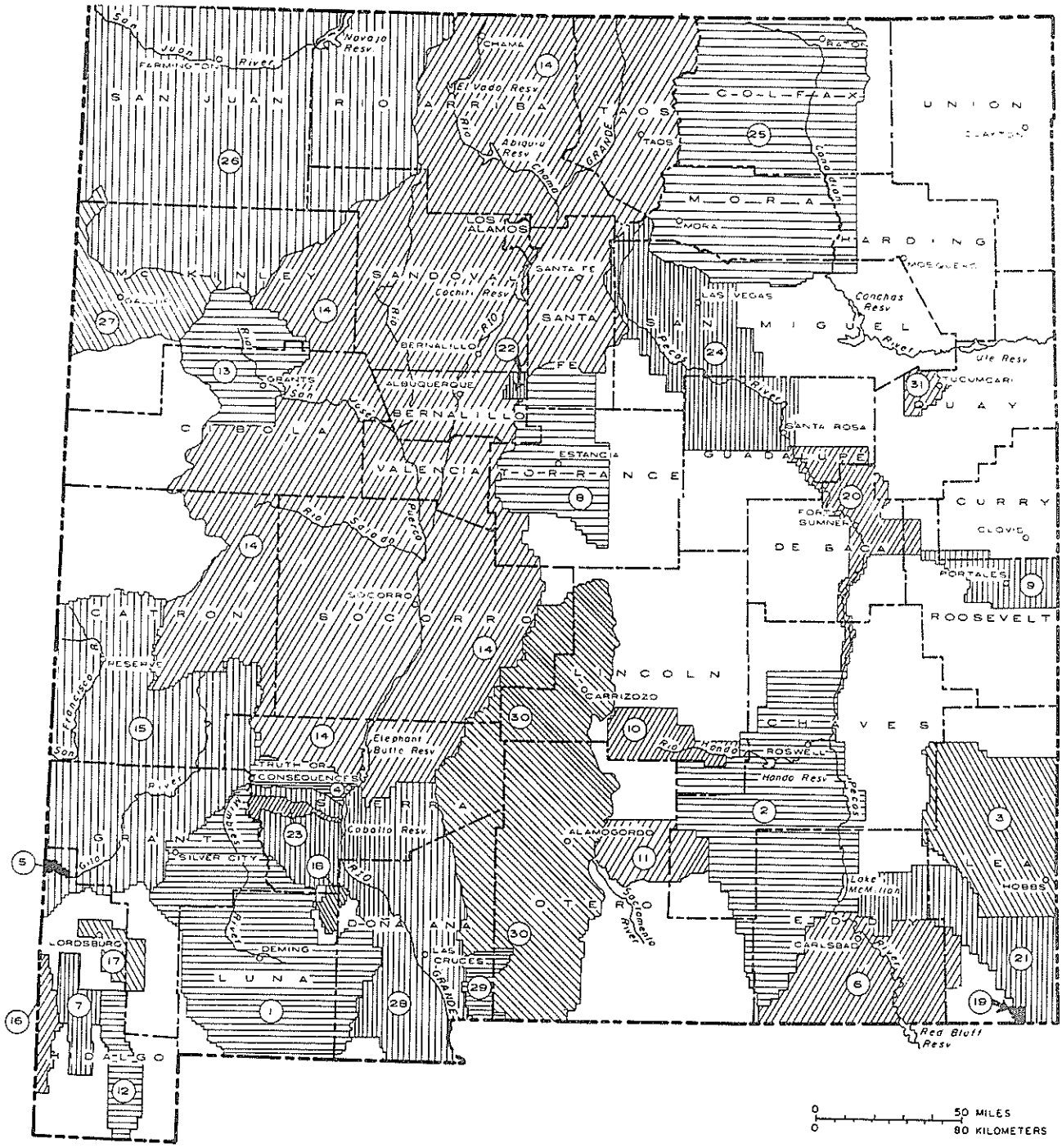
Sincerely,

S. E. Reynolds
State Engineer

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

APPENDIX B

STATE ENGINEER OFFICE MAPS



DECLARED UNDERGROUND WATER-BASINS IN NEW MEXICO

BASIN	AREA IN SQUARE MI.
1 MIMBRES VALLEY	4,279
2 ROSWELL	4,281
3 LEA COUNTY	2,180
4 HOT SPRINGS	284
5 VIRDEN VALLEY	19
6 CARLSBAD	1,965
7 ANIMAS	426
8 ESTANCIA	1,724
9 PORTALES	628
10 HONDO	611
11 PENASCO	723
12 PLAYAS VALLEY	515
13 BLUEWATER	1,318
14 RIO GRANDE	26,209
15 GILA—SAN FRANCISCO	5,659

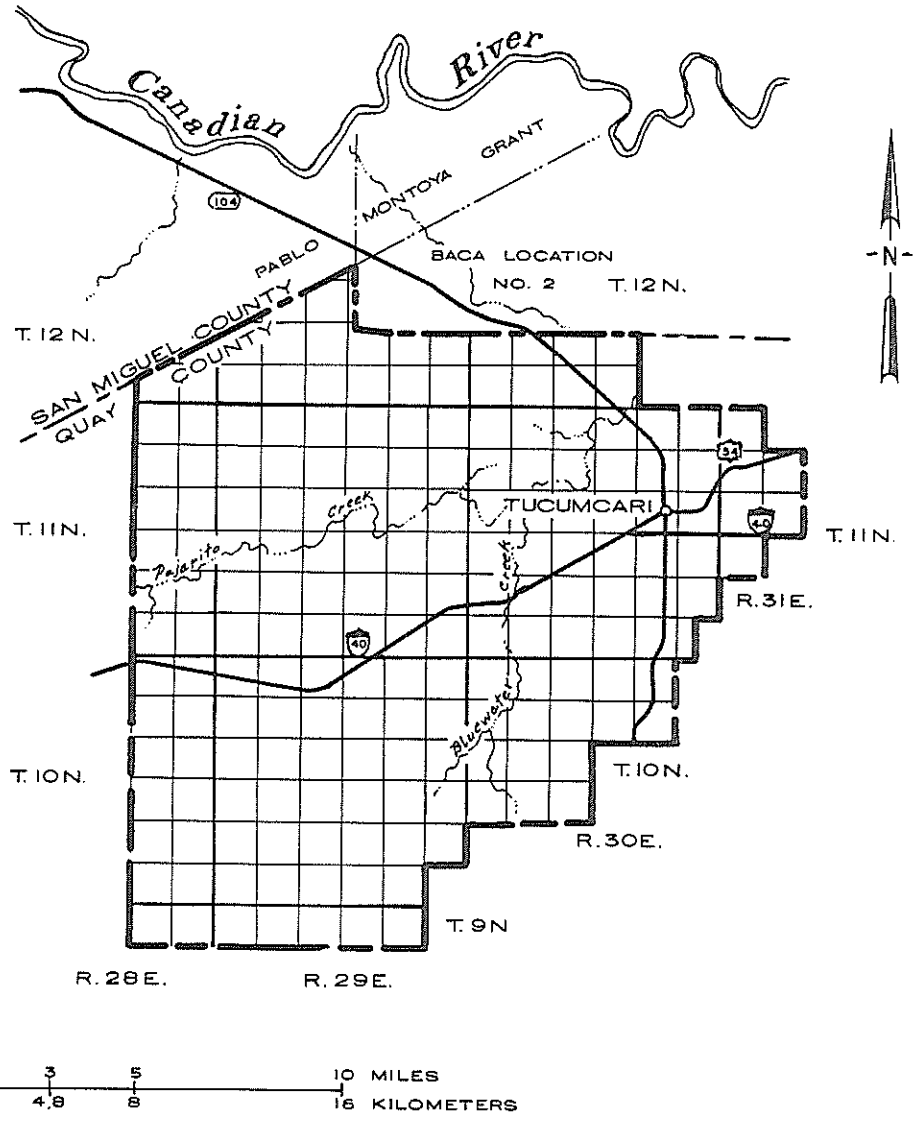
BASIN	AREA IN SQUARE MI.
16 SAN SIMON	263
17 LORDSBURG VALLEY	329
18 NUTT-HOCKETT	133
19 JAL	15
20 FORT SUMNER	1,059
21 CAPITAN	1,550
22 SANDIA	73
23 LAS ANIMAS CREEK	131
24 UPPER PECOS	2,708
25 CANADIAN RIVER	5,825
26 SAN JUAN	8,727
27 GALLUP	1,439
28 LOWER RIO GRANDE	3858
29 HUECO	255
30 TULAROSA	6,070
31 TUCUMCARI	177
	84,433

TUCUMCARI UNDERGROUND WATER BASIN

WITHIN QUAY COUNTY

STATE ENGINEER OFFICE

JULY 7, 1982

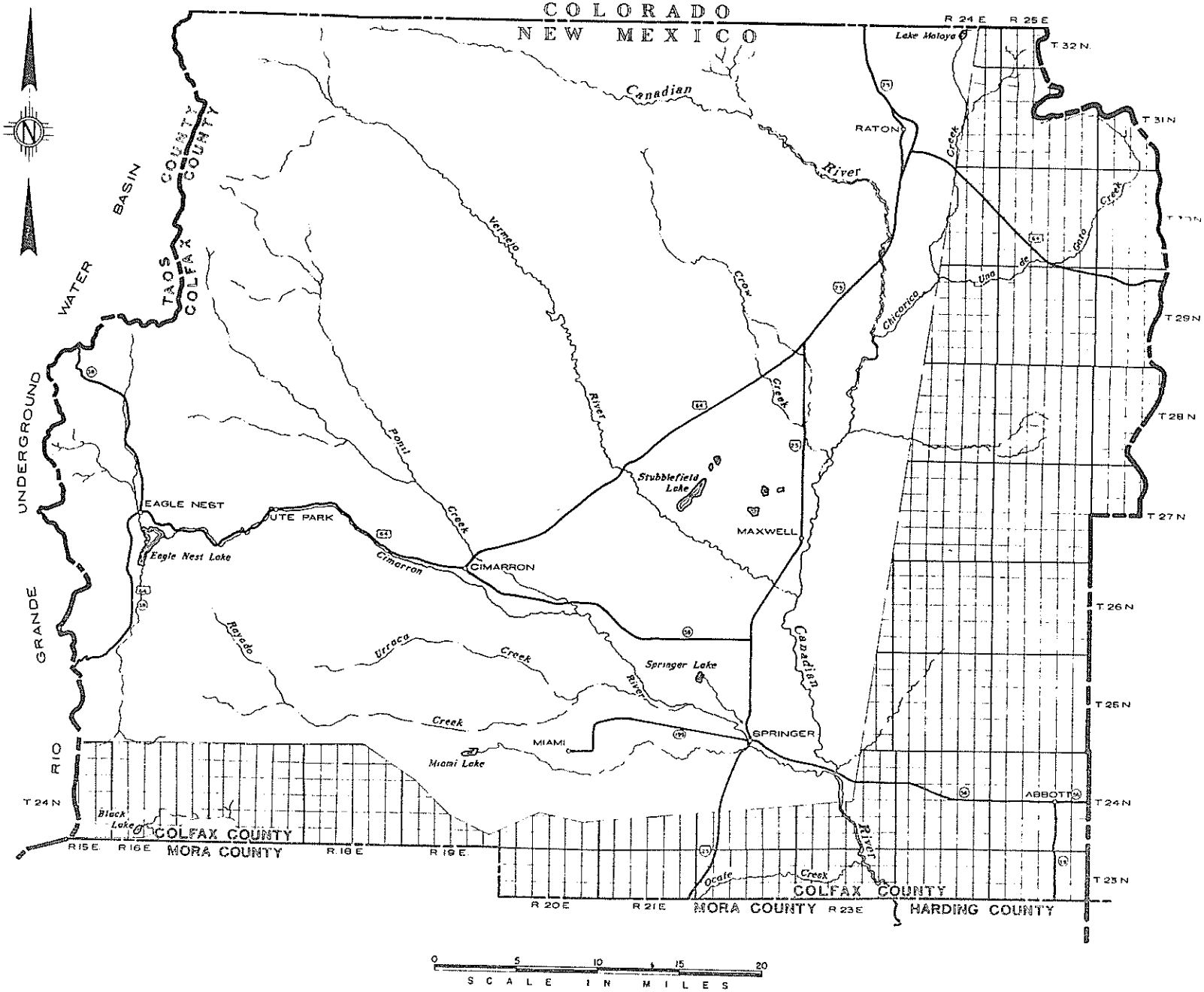


State Engineer of the State of New Mexico
Rule No. 2, Amendment No. 19

CANADIAN RIVER UNDERGROUND WATER BASIN

WITHIN COLFAX COUNTY

N. MEX. STATE ENGINEER
1973

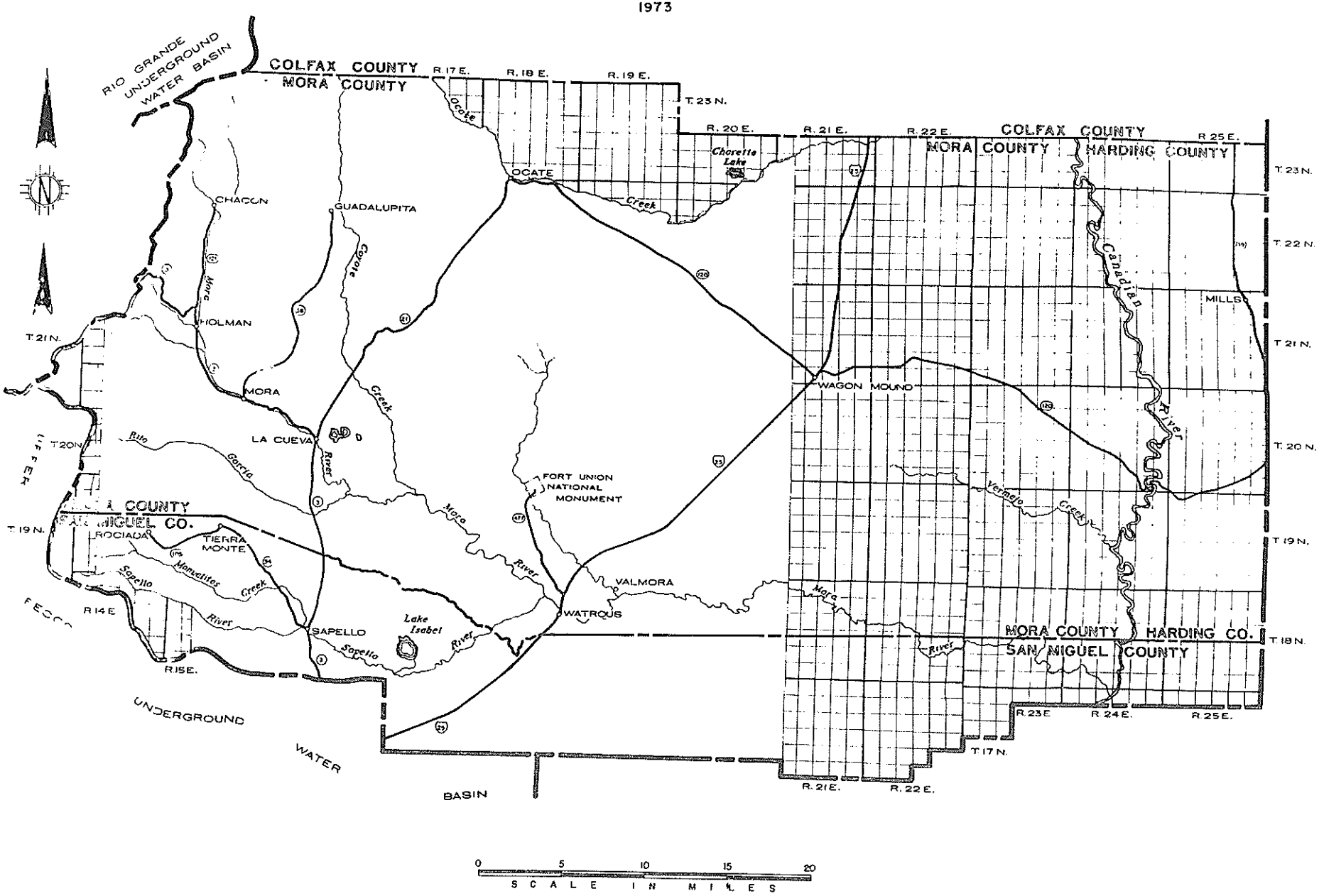


CANADIAN RIVER UNDERGROUND WATER BASIN

WITHIN MORA, HARDING AND SAN MIGUEL COUNTIES

N. MEX. STATE ENGINEER

1973

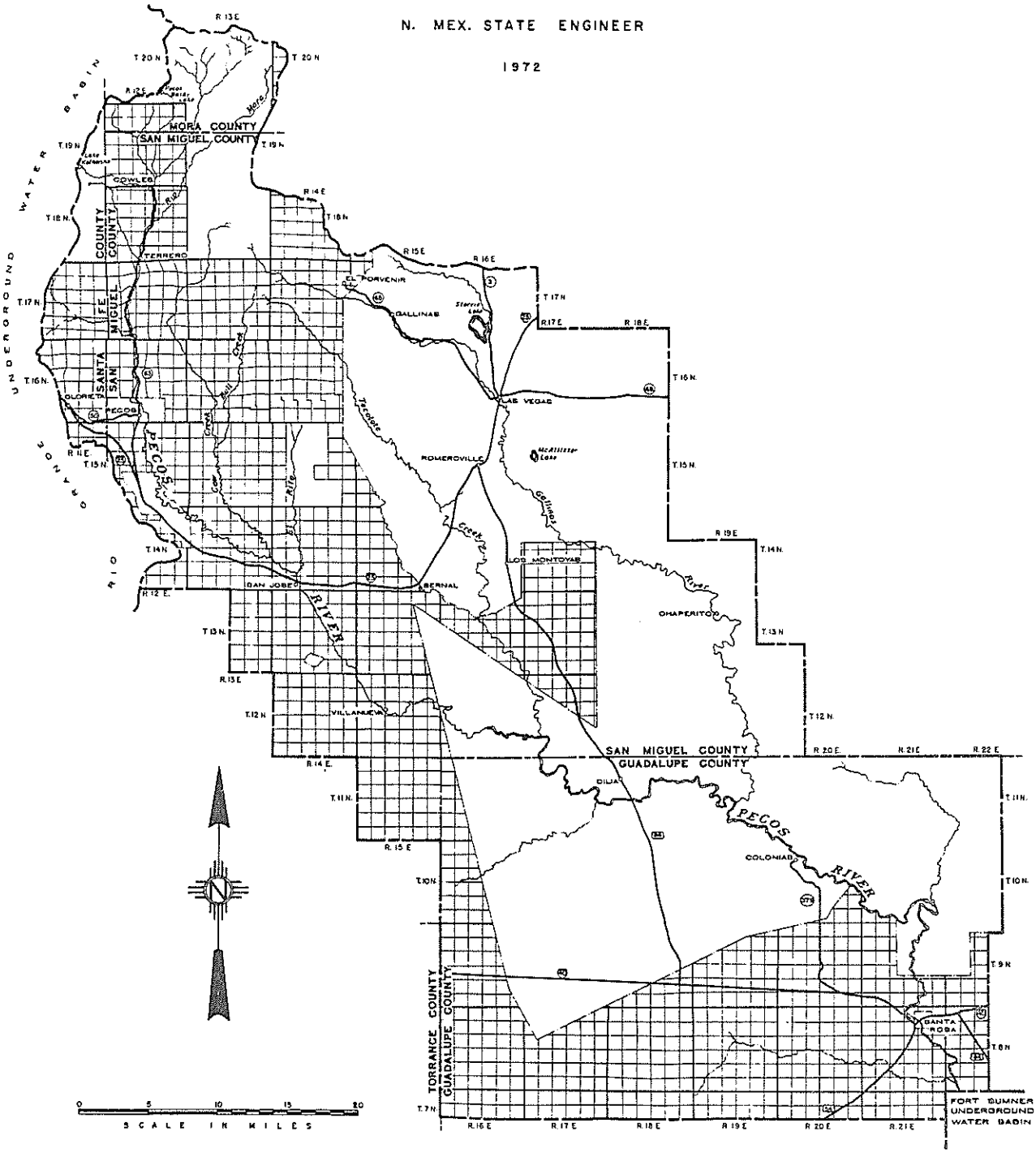


UPPER PECOS UNDERGROUND WATER BASIN

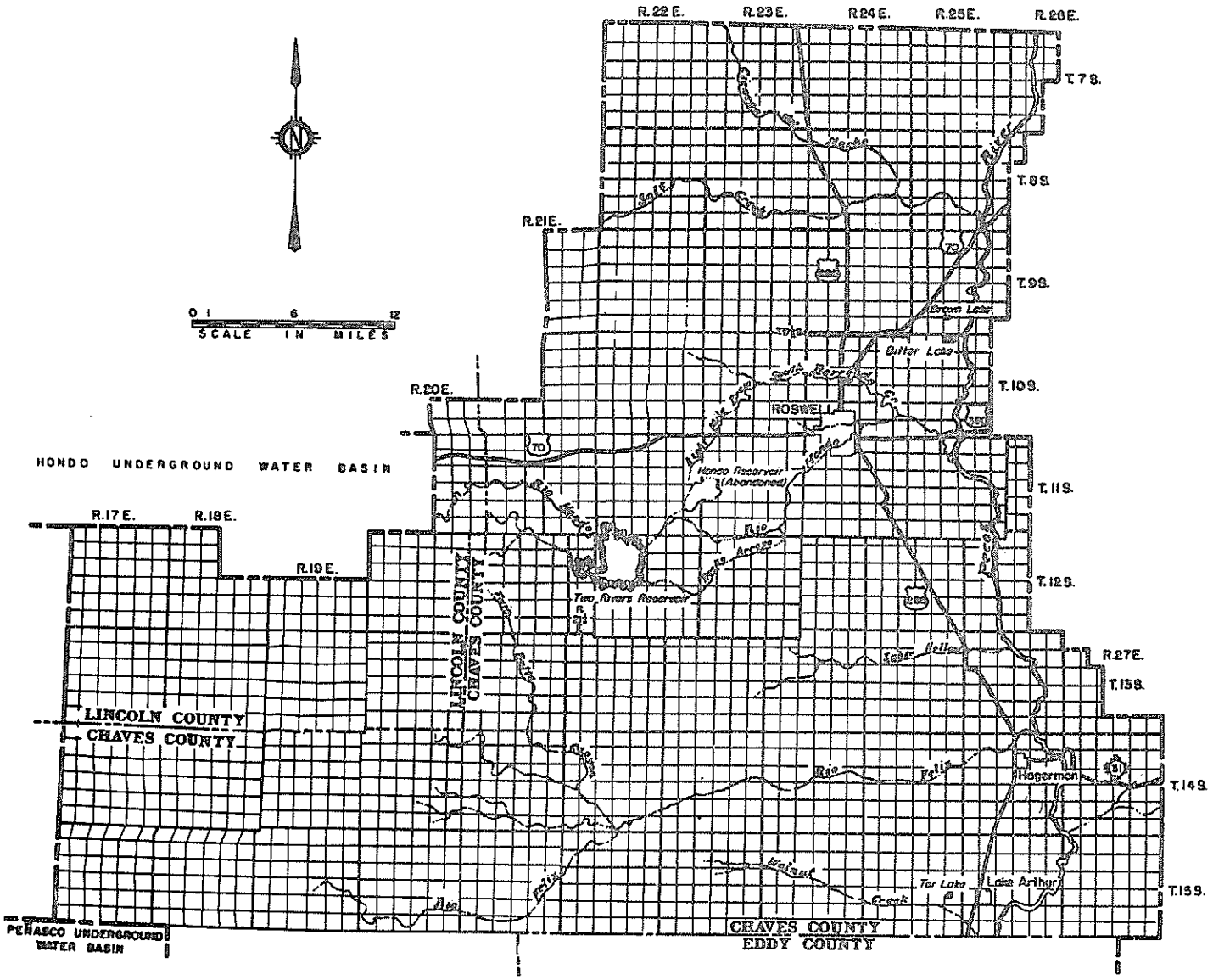
WITHIN GUADALUPE, MORA, SAN MIGUEL AND SANTA FE COUNTIES

N. MEX. STATE ENGINEER

1972



ROSWELL UNDERGROUND WATER BASIN
WITHIN CHAVES AND LINCOLN COUNTIES
N. MEX. STATE ENGINEER
AUGUST 1966

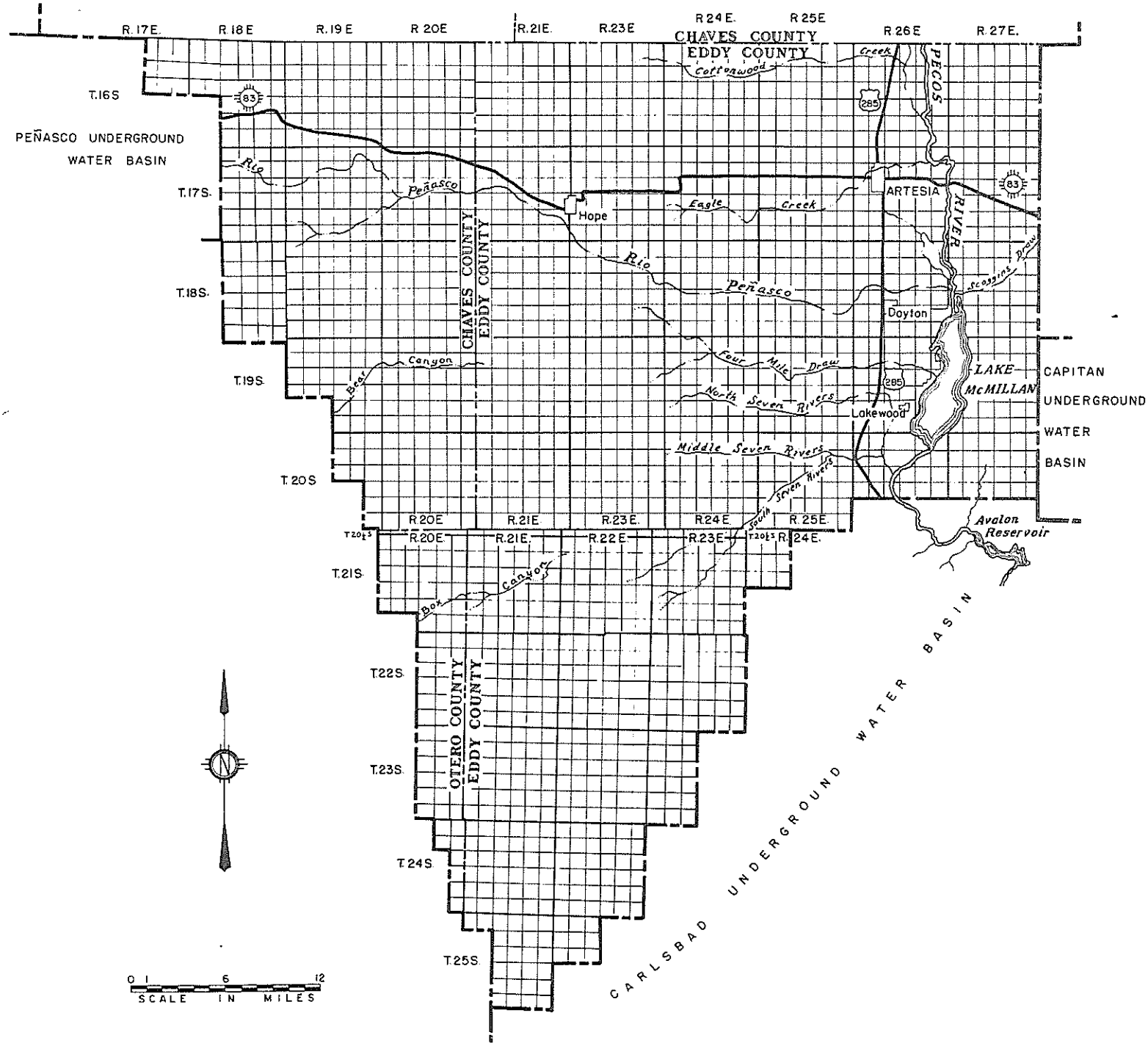


ROSWELL UNDERGROUND WATER BASIN

WITHIN CHAVES, EDDY AND OTERO COUNTIES

N. MEX. STATE ENGINEER

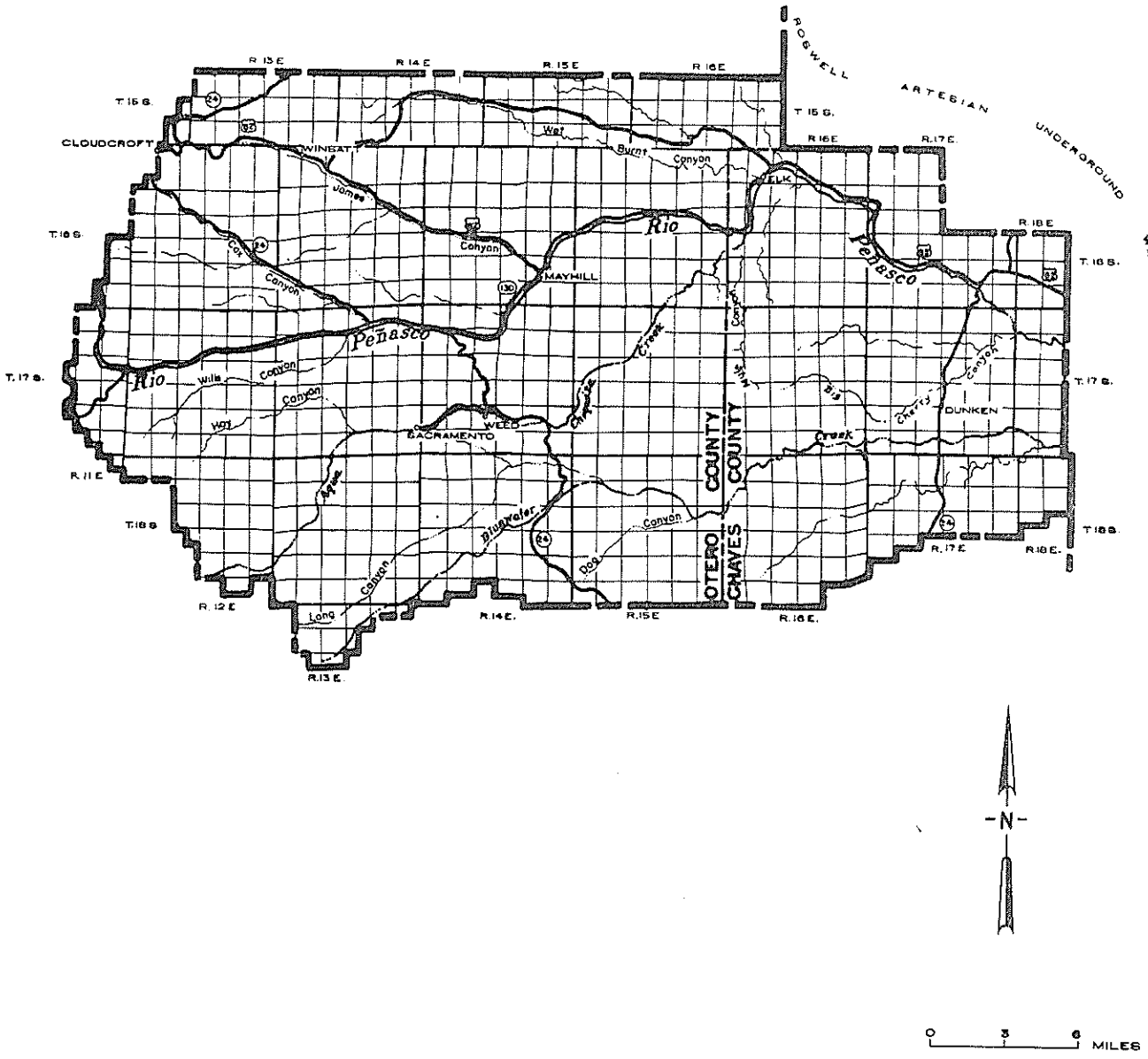
AUGUST 1966



PEÑASCO UNDERGROUND WATER BASIN

N. MEX. STATE ENGINEER

1974

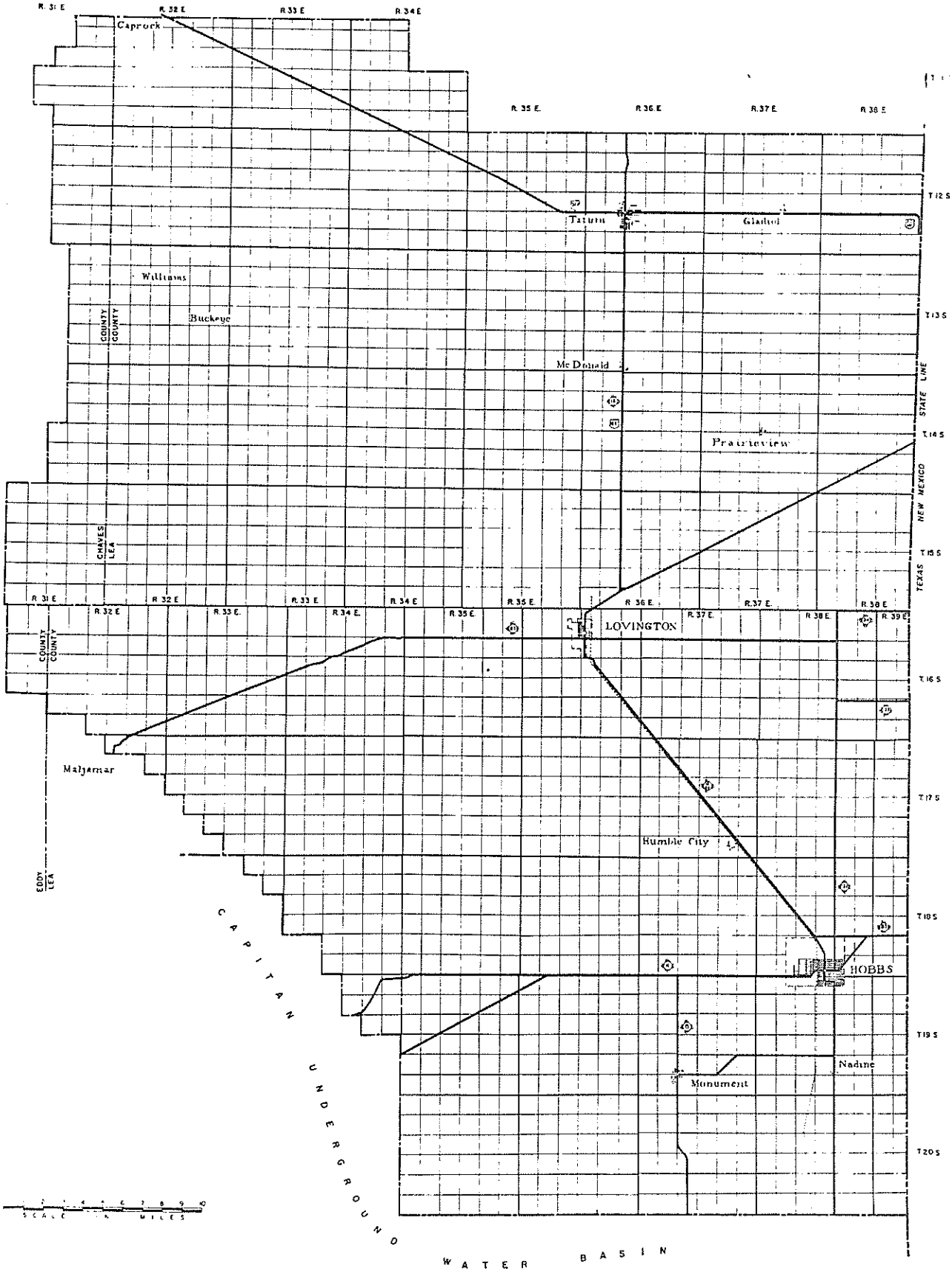


Chg. 1 March 29, 1974

LEA COUNTY UNDERGROUND WATER BASIN

N. MEX. STATE ENGINEER

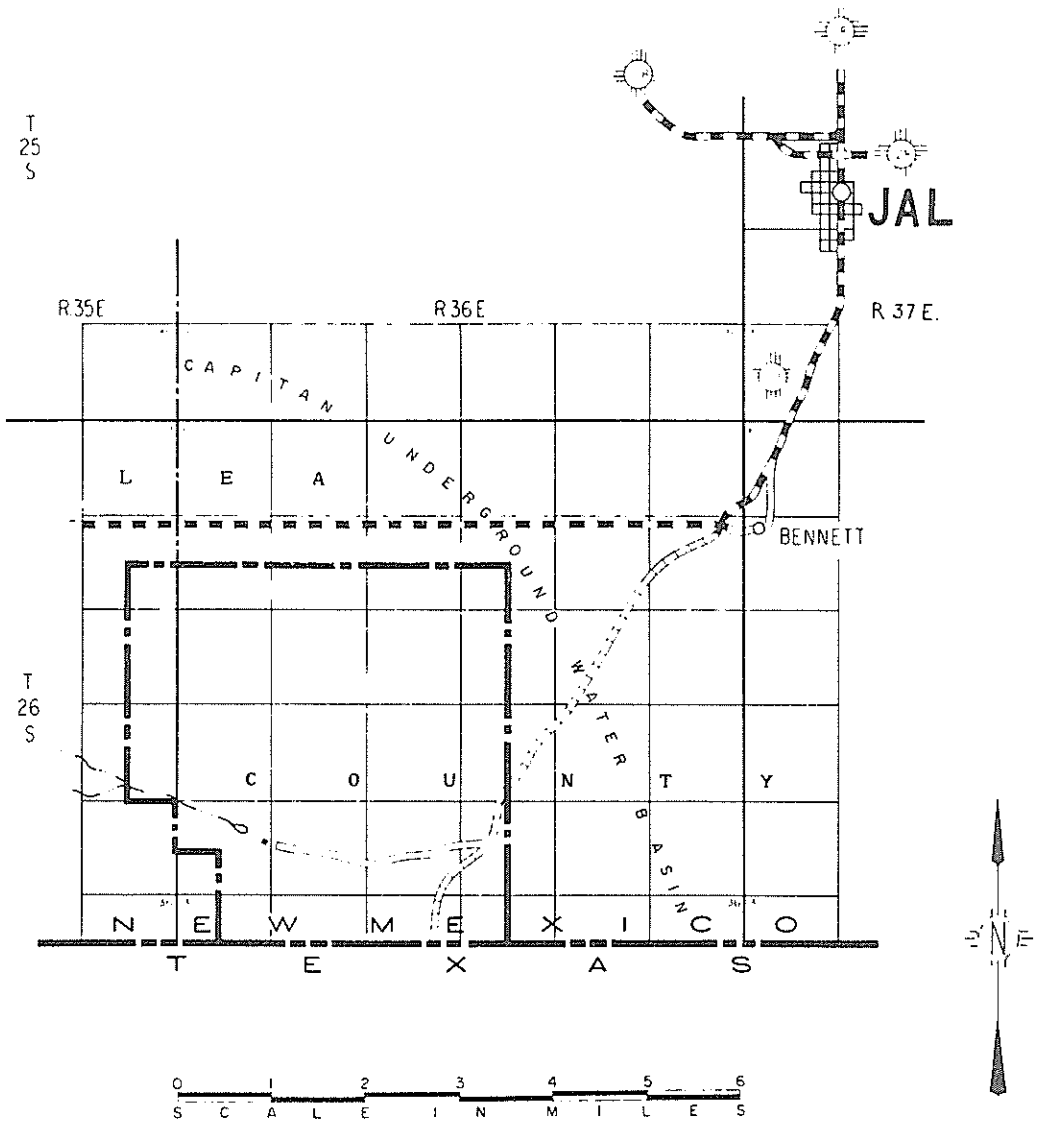
AUGUST 1966



JAL UNDERGROUND WATER BASIN

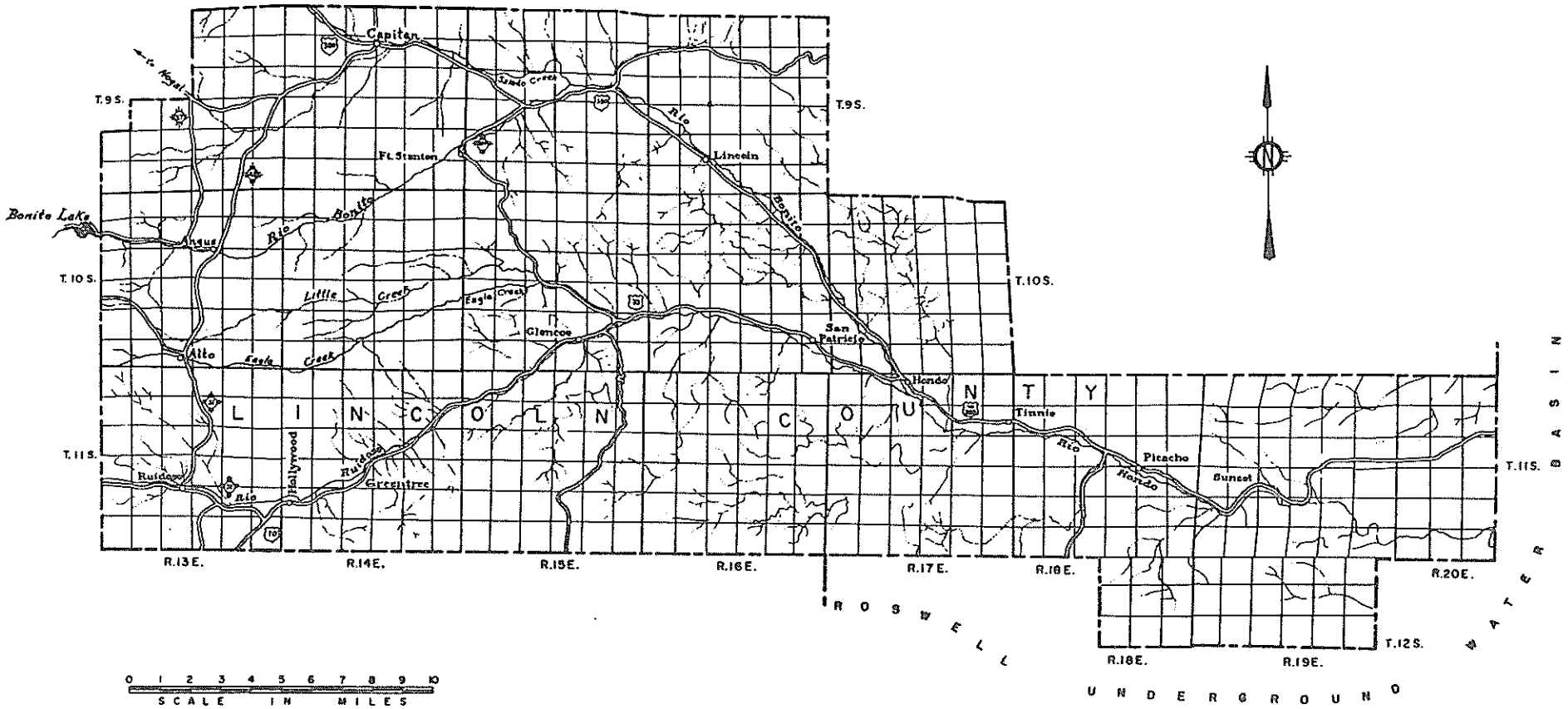
N. MEX. STATE ENGINEER

AUGUST 1966



Chg. 1 September 5, 1969

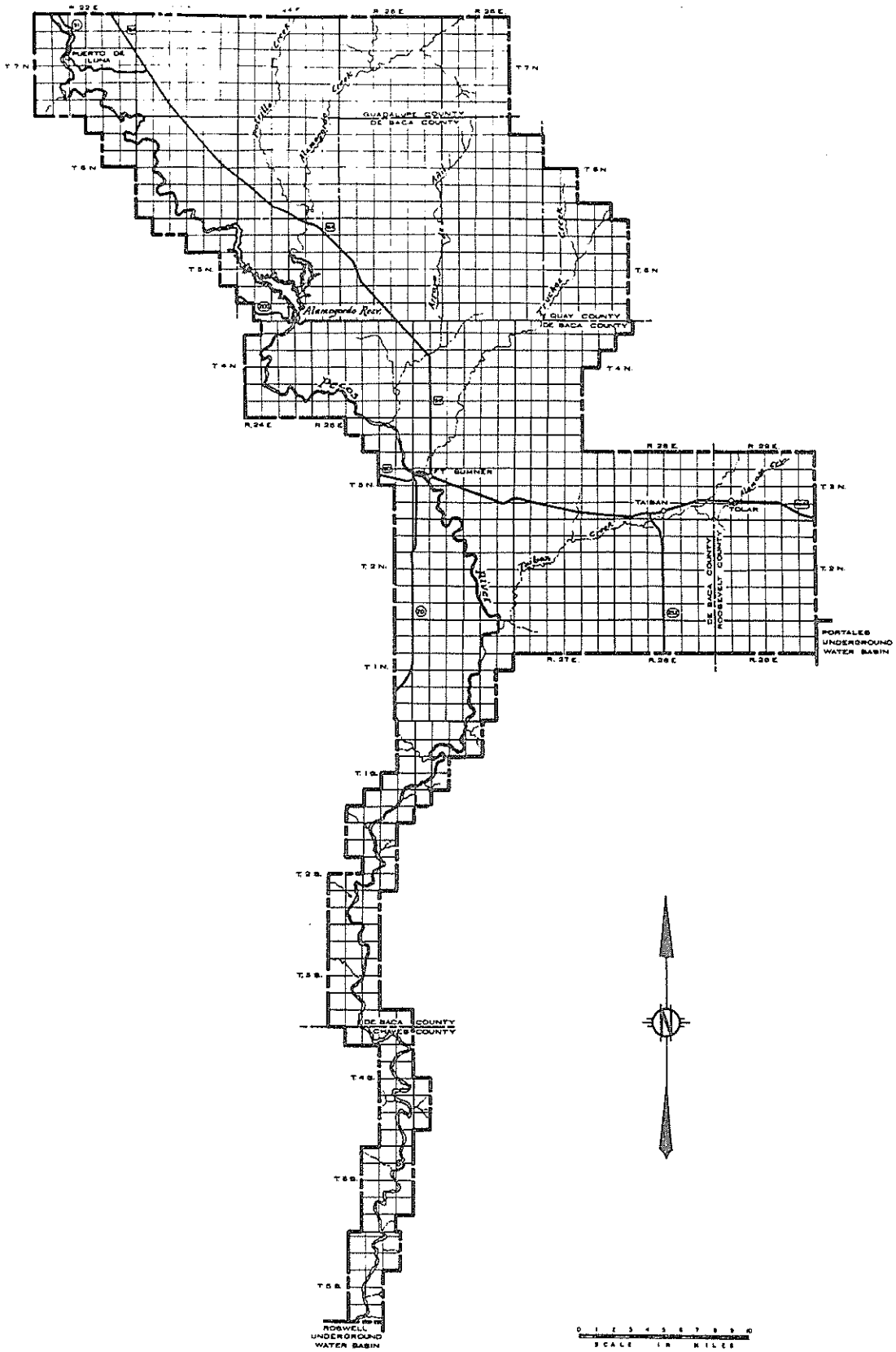
HONDO BASIN - MAP



FORT SUMNER UNDERGROUND WATER BASIN

N. MEX. STATE ENGINEER

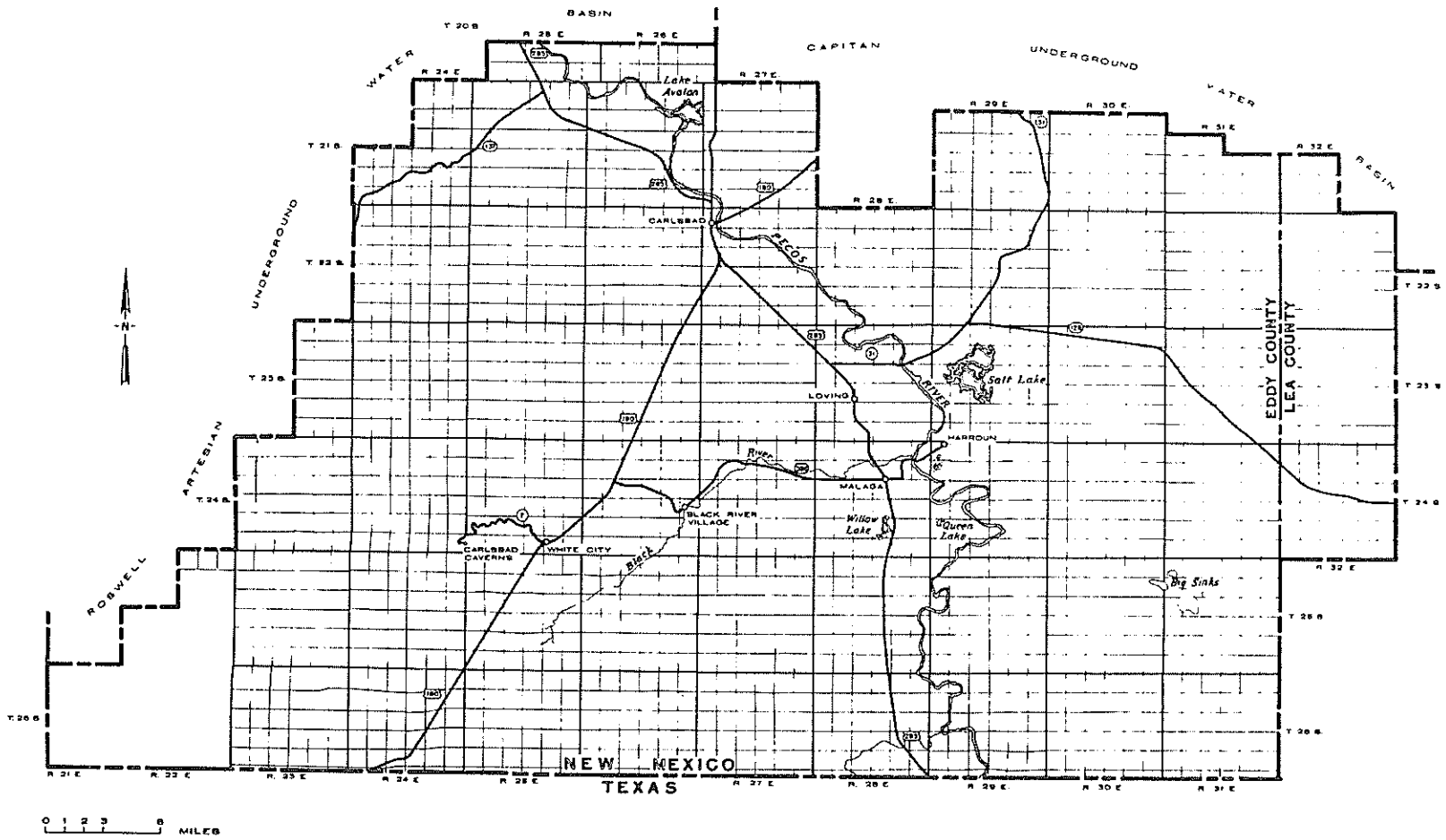
1970



Chg. 1 October 21, 1970

CARLSBAD UNDERGROUND WATER BASIN

NEW MEXICO STATE ENGINEER
1975



CAPITAN BASIN - MAP