
NATURAL RESOURCES JOURNAL

Volume 22
Issue 4 *Symposium on Anticipating Transboundary Resource Needs and Issues in the U.S. - Mexico Border Region to the Year 2000*

Fall 1982

Water Availability in the New Mexico Upper Rio Grande Basin to the Year 2000

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INTRODUCTION

The New Mexico portion of the Upper Rio Grande Basin stretches from the New Mexico–Colorado border in the north to Elephant Butte Reservoir in the south, vertically bisecting the state. Map 1 illustrates these geographic boundaries. It is an area that has long been characterized as water-scarce. This condition of water availability in the Upper Rio Grande Basin continues today and reflects the confluence of a water supply, limited both physically and institutionally, and the pressures of expanding demand for water.

The 1906 Treaty with Mexico,[1] the 1939 Rio Grande Compact[2] and the New Mexico State Engineer's 1956 Declaration of the Rio Grande Underground Water Basin all serve as institutional constraints on the amount of water available within the Upper Rio Grande. According to the 1980 Census, 52.3 percent of the New Mexico population lives within the boundaries of the Upper Rio Grande and this population is expected to nearly double by the year 2000. Almost 55 percent of all state economic activity, as measured by 1979 New Mexico employment levels,[3] takes place within the Upper Rio Grande Basin and this region is expected to be one of the top economic growth areas in the United States. An expanding regional economy and population will give rise to increased future demand for water.

This paper analyzes the present and future water demand and supply circumstances of the New Mexico Upper Rio Grande Basin. This includes information on present water use within the region and a discussion of how various institutional factors restrict the water supply available to

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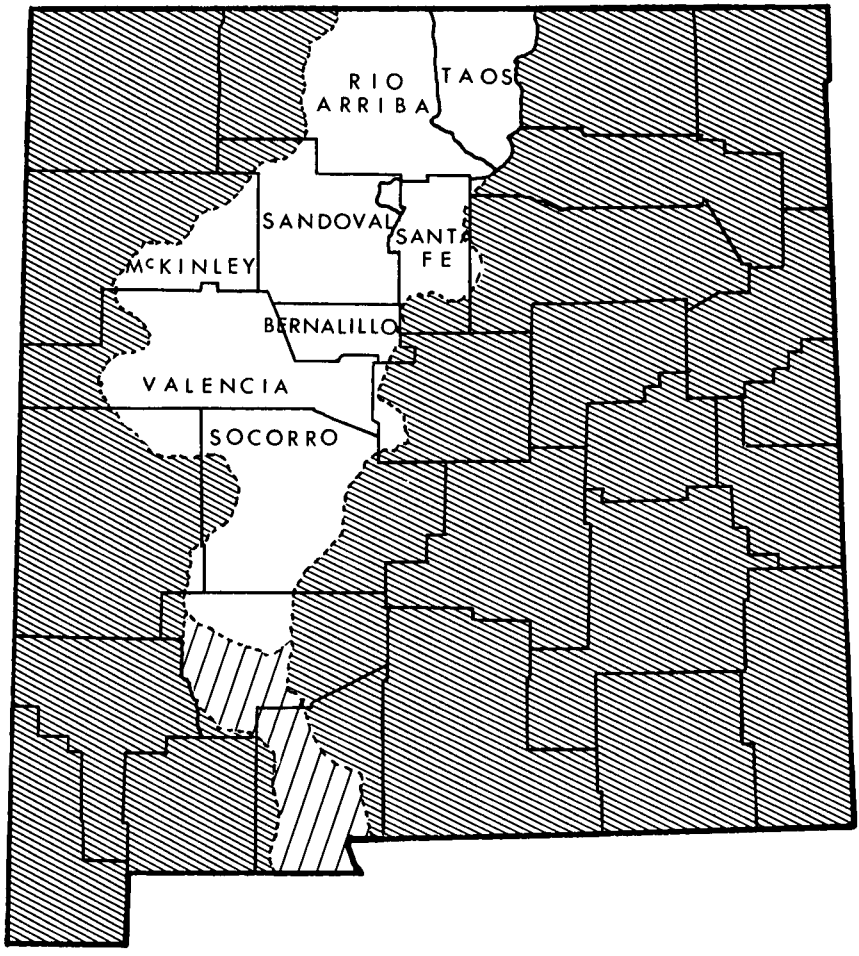
1. Convention between the United States of America and Mexico, May 21, 1906, 34 Stat. 785, T.S. No. 455.

2. Rio Grande Compact (1938), N.M. STAT. ANN. § 75-34-3 (1953), Act of May 31, 1939, ch. 155, 53 Stat. 785.

3. NEW MEXICO EMPLOYMENT SECURITY DEPT., NON-AGRICULTURAL WAGE AND SALARY EMPLOYMENT FOR 1979 (1979).



MAP 1

NEW MEXICO UPPER RIO GRANDE BASIN

Source: New Mexico State Engineer Technical Report No. 44 (1975).

users within the Upper Rio Grande Basin. Projections of population and economic activity within the region to the year 2000 are made and are used to establish future demand for water outside of the agricultural sector. The future supply of water is assumed to be fixed, except for the existence of San Juan–Chama project water. The results indicate that water supplies within this region, augmented by the San Juan–Chama project water, will be sufficient to match the projected water use to the year 2000.

Water Supply Conditions

The surface flows of the Upper Rio Grande have long been appropriated, in fact over-appropriated. It was this circumstance which led to the 1906 Treaty with Mexico. Mexico had filed a claim for damages of $35 million against the United States, alleging that water shortages near Juarez were the result of increased diversions from the Rio Grande by users in Colorado and New Mexico. The 1906 Treaty settled this claim wherein the United States guaranteed the annual delivery of 60,000 acre-feet in the Rio Grande at the head of the Mexican Canal near El Paso. Elephant Butte Reservoir was constructed at this time for storage and regulation of the Rio Grande so that the terms of the treaty could be met.

Interstate disputes by the three basin states—Colorado, New Mexico and Texas—over the division and use of the waters of the Rio Grande led to the formation of the Rio Grande Compact Commission in 1923 and a ratified compact in 1939.[4] The compact provided for an equitable apportionment of the surface water of the Rio Grande among the three states and for the required deliveries to Mexico under the 1906 Treaty. The annual riverflow is apportioned by a specific delivery schedule imposed upon Colorado and New Mexico. New Mexico's obligation[5] is a percentage of the waterflow at the Otowi gauge in north central New Mexico with delivery to Texas measured at a gauge below Elephant Butte Dam. The required percentage delivery is a progressively increasing one, increasing as the actual waterflow increases. For example, if the measured flow at Otowi is 100,000 acre-feet, then 57 percent or 57,000 acre-feet must be delivered below Elephant Butte Dam. If the measured flow is 1,000,000 acre-feet, then 62.1 percent or 621,000 acre-feet must be delivered. This percentage rises to 86.5 percent for water flows measured at Otowi of 3,000,000 acre-feet. Thus, the physical amount of surface water available to New Mexico within the Upper Rio Grande Basin is limited by both the Rio Grande Compact and the 1906 Treaty with Mexico.

A system of debits and credits is included in the delivery schedule for both Colorado and New Mexico. Colorado and New Mexico have both

4. Rio Grande Compact, *supra* note 2.
5. Report of the Rio Grande Compact Commission (1979) (hereinafter Report).

been in a debit status during most of the time since the Compact became effective.[6] However, in recent years, Colorado has taken steps to reduce her accumulated deficit to 699,300 acre-feet as of 1979, and New Mexico's accumulated deficit had been practically eliminated until 1979 when it increased by 101,800 acre-feet to 129,000 acre-feet.[7] Reynolds and Mutz[8] outline reasons why upstream states will not likely accumulate deficits in the future, e.g., active litigation by Texas to enforce the compact, stream improvements in the middle Rio Grande valley, and the control of groundwater in the New Mexico Rio Grande Basin. This highlights the severe water supply limitations imposed on the Upper Rio Grande Basin by the Rio Grande Compact.

In most of the Upper Rio Grande Basin there exists a direct hydrological connection between surface water and groundwater. Excessive groundwater pumping will, thus, ultimately reduce supplies of surface water available to valid appropriators and perhaps impair New Mexico's ability to meet its Rio Grande Compact commitments. For these reasons the New Mexico State Engineer declared the Rio Grande Underground Water Basin in November, 1956. The definition of this underground basin extends from Colorado to Elephant Butte Reservoir and includes all lands on which it might be practicable to develop wells with yields sufficiently large to materially affect the river's flow.[9]

Within the underground basin the State Engineer permits the drilling of new wells and new withdrawals of groundwater only if the effects of such groundwater development on the surface flow of the Rio Grande are compensated by the retirement of existing surface water rights. Since there is a time lag of varying duration between the withdrawal of groundwater and impact on surface flows, some portion of the groundwater withdrawal reduces the amount of water in underground storage, with no immediate effect on existing surface rights. The State Engineer has ruled that a new groundwater user does not have to offset this loss until such time as it impairs surface rights. Thus, some new water can be developed under this groundwater policy. The net effect of the State Engineer's declaration order is the maximum development of groundwater resources, while at the same time the older surface water rights and surface flow commitments under the compact are protected. However, this policy has rigidly controlled the use of groundwater and has necessarily constrained water development in the Upper Rio Grande Basin since 1956. The 1956

6. Reynolds and Mutz, *Water Deliveries Under the Rio Grande Compact*, 14 NAT. RES. J. 200 (1974).

7. Report, *supra* note 5, at 28.

8. Reynolds and Mutz, *supra* note 6.

9. Hudson and Borton, *Ground Water Levels in New Mexico, 1970*, New Mexico State Engineer Technical Report No. 39 (1970).

Declaration of the New Mexico State Engineer imposes yet another institutional constraint on water availability within this region.

Table 1 presents 1975 water use patterns by county within the New Mexico Upper Rio Grande Basin. The data represents total depletions in acre-feet from both surface and groundwater sources and, thus, the approximate quantity of water that is consumptively used within the region. Of the 373,814 acre-feet depleted in 1975, 76.8 percent was used by the agricultural sector (i.e., irrigated agriculture and livestock/stockpond evaporation). Domestic water use, both urban and rural, is the next largest user at 15.2 percent. Manufacturing, mining and power uses of water are relatively small, although these uses of water along with domestic use are expected to expand in the future.

Water use in irrigated agriculture is greatest in Valencia, Bernalillo and Socorro Counties. These are areas within the Middle Rio Grande Conservancy District. Urban and manufacturing water uses are greatest within Bernalillo County where the City of Albuquerque is located. Water use in mining is principally concentrated in Taos County where there is a large molybdenum mine and in McKinley and Valencia Counties where there is significant uranium development. Most of the electric power for this region is generated outside of the basin in northwest New Mexico in the Four Corners Regions. Within Bernalillo County both the Public Service Company of New Mexico and the Plains Electric have small natural gas-fired electric power plants. The large fish and wildlife water use in Socorro County represents the Bosque del Apache Wildlife Refuge. Reservoir evaporation principally reflects El Vado, Heron and Abiquiu Dams in Rio Arriba County and Bluewater Dam in Valencia County. Table 2 lists the identifiable major water users within this region.

The year 1975 was a near-normal year in terms of the natural availability of water within this region. According to the U.S. Geological Survey, in water year 1975 surface water flows at Rio Grande gauging stations near Lobatos, Colorado and Otowi Bridge, New Mexico were 94 percent and 98 percent of the 76 year average discharge, respectively.[10] Given the institutional constraints on water availability within this region discussed previously and the near-normal natural water conditions in 1975, the number in Table 1 which equals total depletions in the New Mexico Upper Rio Grande (373,814 acre-feet) is assumed to represent *the* available water supply for this region with one exception. That exception is the San Juan–Chama Project water which we assume is not yet reflected in the 1975 water use data and which represents new water available in the New Mexico Upper Rio Grande Basin in the future.

10. *Water Resource Data for New Mexico, Water Year 1975*, U.S. Geological Survey Water Data Report NM75-1 68, 116 (1975).

TABLE 1

COUNTY WATER USE PATTERNS IN THE NEW MEXICO UPPER RIO GRANDE BASIN 1975

	Total Depletions[a] (acre-feet)										
	Rio Arriba	*Taos*	*Los Alamos*	*Santa Fe*	*Sandoval*	*McKinley[b]*	*Valencia*	*Bernalillo*	*Socorro*	*N.M. Upper Rio Grande Total*	*Water Use Category as % Total*
Irrigated Agriculture	48,450.0	49,160.0	0.0	9,200.0	19,650.0	430.0	82,440.0	24,140.0	45,630.0	279,100	74.7%
Domestic Water Use, Urban and Rural	838.0	684.5	2,178.0	3,832.5	1,765.3	76.5	2,548.7	43,936.9	859.6	56,720	15.2
Manufacturing	43.0	43.0	0.0	106.0	57.0	0.0	60.0	1,241.0	59.0	1,609	0.4
Mining/Minerals	36.6	1,256.4	0.0	40.0	15.0	1,940.0	2,601.5	196.5	8.0	6,094	1.6
Power	0.0	0.0	0.0	8.0	700.0	0.0	0.0	3,654.0	0.0	4,362	1.2
Livestock and Stock Pond Evaporation	1,532.0	402.0	5.0	826.0	912.0	811.0	1,476.0	687.0	1,285.0	7,936	2.1
Fish and Wildlife	646.0	64.0	2.0	30.0	270.0	0.0	579.0	375.0	6,561.0	8,527	2.3
Recreation (Land Based)	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	200	0.1
Reservoir Evaporation	2,387.0	415.0	0.0	408.0	47.0	300.0	1,429.0	0.0	10.0	4,996	1.3
Military	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4,270.0	0.0	4,270	1.1
COUNTY TOTAL	54,032.6	52,124.9	2,185.0	14,450.5	23,416.3	3,557.5	91,134.2	78,500.4	54,412.6	373,814	100.0%

[a]Depletion is equal to water that is consumptively used by all factors, i.e., evapotranspiration, carriage loss, etc.; ground and surface water.
[b]Includes only that portion within Upper Rio Grande Basin.

Source: *Water Use by Categories in New Mexico Counties and River Basins,* and *Irrigated and Dry Cropland Acreage in 1975,* New Mexico State Engineer.

TABLE 2

MAJOR IDENTIFIABLE WATER USERS IN THE NEW MEXICO UPPER RIO GRANDE

User	*1975 Water Depletion (acre-feet)*
Middle Rio Grande Conservancy District	145,410
% of Total Depletions	38.9%
City of Albuquerque	35,328
% of Total Depletions	9.5%
City of Santa Fe	3,418
% of Total Depletions	1.0%
Kirtland AFB/Sandia Base	4,270
% of Total Depletions	1.1%
Public Service Company of New Mexico (power use only)	3,654
% of Total Depletions	1.0%

Source: *Water Use by Categories in New Mexico Counties and River Basins*, and *Irrigated and Dry Cropland Acreage in 1975*, New Mexico State Engineer.

The San Juan–Chama Project was approved by Congress on June 13, 1962 as a means to deliver to New Mexico its share of the surface waters of the Upper Colorado River. Water is diverted from the San Juan River, a tributary of the Colorado River in southern Colorado, flows through a series of tunnels across the continental divide and enters the Chama River, a tributary of the Rio Grande in northern New Mexico. The annual diversion is 110,000 acre-feet, of which 101,800 is deliverable with the difference lost to evaporation and carriage loss. Since the San Juan–Chama Project water represents new water to the Rio Grande Basin, all of the 101,800 acre-feet may be consumptively used. This amount is a significant addition to the Upper Rio Grande Basin water supply, representing a 27 percent increase in the effective water supply of this region.

San Juan–Chama Project water first flowed in early 1971,[11] although at levels far below capacity. Much of this initial San Juan–Chama water has been used to build up the reservoir storage for the project in Heron Reservoir, to create permanent recreation pools at Cochiti and Elephant Butte Reservoirs, and to add to available storage in El Vado and Abiquiu Reservoirs. The latter storage of about 80,000 acre-feet belongs to the City of Albuquerque which presently does not need the water committed to the City from the San Juan–Chama Project. The use of the San Juan–Chama Project water up to this point for reservoir storage and recreation

11. Much of the information on the San Juan–Chama Project presented here was obtained from a conversation with Mr. Gary Roe, Water and Power Resources Service, Albuquerque Office, April 22, 1981.

pools justifies our earlier assumption that this new project water was not reflected in the 1975 water use data in Table 1.[12] In 1980 the San Juan–Chama Project flowed at capacity and will be available for expanding future water demand in the region.

At this time only 80 percent of the San Juan–Chama Project water is committed to specific contract users. And not all the contract users are able to take their full commitments. For example, the City of Albuquerque has contracted for 48,200 acre-feet or 47.3 percent of the total available project water. Yet the City will not actually need this water for domestic uses for some time. As mentioned previously, Albuquerque has stored some of this project water in El Vado and Abiquiu Reservoirs. The City's request to store additional amounts in Elephant Butte Reservoir was turned down by the Courts, since storage was not a stated purpose for the construction of Elephant Butte Reservoir. Albuquerque is attempting to obtain permission to store its unused San Juan–Chama Project water for future use in Abiquiu Reservoir at this time. Complicating matters is a suit by the Jicarilla Apaches to obtain the temporary use of Albuquerque's San Juan–Chama Project water for new beneficial uses on their reservation. The Indians argue that storing the water wastes it through evaporation, and since Albuquerque is not putting this project water to beneficial use, it should be forced to forfeit its right to the water.[13]

What the discussion above highlights is the present surplus water supply condition within the New Mexico Upper Rio Grande Basin. Intra-basin water supplies have been augmented significantly by the introduction of transbasin water under the San Juan–Chama project. The effective basin water supply has increased from 373,814 acre-feet in 1975 to 475,614 acre-feet at the present time by the addition of 101,800 acre-feet of San Juan–Chama Project water. This favorable water supply condition will allow continued economic expansion within this region without major

12. In 1975, 38,614 acre-feet of San Juan–Chama water was made available to water users under contract commitments. Approximately half of this amount went to the City of Albuquerque which stored it; the rest went to users such as the City of Santa Fe and the Middle Rio Grande Conservancy District. Some of this latter amount may have been depleted by the users and, hence, reflected in the 1975 water use data. However, no precise information to document this is available. Since it represents such a small portion of the total San Juan–Chama Project water, our assumption that this project water was not included in the 1975 water use data seems reasonable.

13. Since the presentation of this report in April 1981, the U.S. 10th Circuit Court has ruled in Jicarilla Apache Tribe v. U.S., 657 F.2d 1126 (10th Cir. 1981) that storage of project water for extended periods, without application to a recognized beneficial use incidental to that storage, is not a use of water which would protect a valid water right as contemplated in the 1902 Reclamation Act; and, therefore, the storage for future use contemplated by the City would not protect the City's San Juan–Chama entitlements from appropriation by others until the City's beneficial use of the water could be demonstrated. The Court shared the concern about waste by evaporation, stating that the plan contemplated by the City would result in the loss of approximately 92 percent of the water stored prior to its ultimate beneficial use.

TABLE 3

NEW MEXICO UPPER RIO GRANDE BASIN
1980 POPULATION

County	*Population*
Rio Arriba	29,282
% Upper Basin	4.3%
Taos	18,862
% Upper Basin	2.8%
Los Alamos	17,599
% Upper Basin	2.6%
Santa Fe	75,306
% Upper Basin	11.1%
Sandoval	34,799
% Upper Basin	5.1%
McKinley*	10,541
% Upper Basin	1.6%
Valencia	60,853
% Upper Basin	9.0%
Bernalillo	419,700
% Upper Basin	61.7%
Socorro	12,969
% Upper Basin	1.9%
TOTAL UPPER RIO GRANDE BASIN	679,911
New Mexico	1,299,968
Upper Rio Grande Basin as % of New Mexico	52.3%

*Includes only the portion within Upper Rio Grande Basin.
Source: U.S. Bureau of Census, 1980 preliminary count.

disruptions due to water supply constraints. It is to these present and future economic circumstances within the New Mexico Upper Rio Grande Basin that we now turn.

Current Demographic and Economic Profile

According to the 1980 Census data 679,911 people, or 52.3 percent of the total state population, live within the New Mexico Upper Rio Grande Basin. This population is concentrated in Bernalillo County where Albuquerque is located. Other significant population centers are the City of Santa Fe in Santa Fe County, and Grants and Belen in Valencia County.[14] Table 3 presents the basin population by county.

The New Mexico Upper Rio Grande Basin economic profile is con-

14. On July 1, 1981, Valencia County was divided into Valencia County and a new county called Cibola. Belen remained within Valencia County; Grants, however, was redistricted into Cibola County.

TABLE 4

NEW MEXICO UPPER RIO GRANDE BASIN ECONOMIC PROFILE
1979

Employment Sector	*State of New Mexico*	*Upper Rio Grande Basin*	*Upper Rio Grande Basin, % of State Total*
Agriculture	20,545	4,219	20.5%
% of Total	4.3%	1.6%	
Manufacturing	34,800	20,268	58.2%
% of Total	7.2%	7.7%	
Mining	27,100	6,525	24.1%
% of Total	5.6%	2.5%	
Construction	35,600	20,075	56.4%
% of Total	7.4%	7.6%	
Transportation, Communication, Utilities	28,100	13,961	49.7%
% of Total	5.8%	5.3%	
Trade	104,100	60,031	57.7%
% of Total	21.6%	22.8%	
Finance, Insurance, Real Estate	21,200	13,510	63.7%
% of Total	4.4%	5.1%	
Services	89,600	56,988	63.6%
% of Total	18.6%	21.6%	
Government	120,500	68,134	56.5%
% of Total	25.0%	25.8%	
TOTAL	481,545	263,711	54.8%

Source: New Mexico Employment Security Commission and U.S. Department of Commerce, Bureau of Economic Analysis (agricultural employment).

tained in Table 4. Employment by sector for 1979 is presented for the region and contrasted to the state as a whole; the largest economic sectors within this region are trade, services, and government, corresponding exactly to the state. This region is less agricultural than the rest of the state, with agriculture representing only 1.6 percent of all jobs compared to 4.3 percent in the state. While there is significant uranium development within the New Mexico Upper Rio Grande Basin, mining activity is less important here than it is for the rest of the state. Outside this region there is significant coal, copper, potash, oil and natural gas development reflecting the diverse natural resources of the state of New Mexico. Compared to the state, manufacturing is more concentrated within the basin area due primarily to manufacturing activity within Bernalillo County; trade, services and finance, insurance and real estate sectors are more important to this region reflecting Albuquerque's role as a regional center for trade, banking, health care and law; the transportation, communication, utilities sector is less important due to the previously mentioned

fact that most electric power for this region is generated outside the basin. A total of 263,711 jobs were located within the New Mexico Upper Rio Grande Basin, or 54.8 percent of all state jobs in 1979.

Table 5 shows the same employment profile disaggregated to the individual counties within this region. The previously noted concentrations of manufacturing, trade, services and finance, insurance and real estate within Bernalillo county is highlighted in this table. Rio Arriba and Socorro Counties are more predominantly agricultural than the other counties. Mining is concentrated in three counties: Taos (molybdenum), McKinley (uranium) and Valencia (uranium). Taos and Santa Fe have larger trade and services sectors reflecting the impact of tourism and winter skiing. Los Alamos is totally dependent upon the federal government's Los Alamos National Laboratory, while Socorro County's large government sector is due to the location of the New Mexico Institute of Mining and Technology in the City of Socorro.

Demographic and Economic Projections

The New Mexico Upper Rio Grande Basin is expected to be one of the fastest growing areas in the U.S. between 1980 and 2000. In a news release in March, 1980, Chase Econometrics' Regional Forecasting Group ranked Albuquerque sixth among the top ten U.S. growth areas in the 1980s.[15] Uranium mining, while presently depressed because of national concerns about nuclear energy, is expected to recover in the future along with new coal developments in this region. Several electronics manufacturers (e.g., Intel, Signetics) are presently constructing new plants within the Albuquerque area and have plans to expand manufacturing employment by 10,000 jobs by 1990. And there are plans for two new large electric power plants in this region by 1990–1995.

Future growth in the New Mexico Upper Rio Grande Basin will, of course, require expanded use of water. The principal water use categories that will be expanding in the future include domestic use related to population growth, manufacturing, mining and power. Table 6 contains our projections for population, manufacturing and mining employment for the year 2000 by county and for the region as a whole. Later in the paper these projections will be used to convert the expected population and economic growth into projected water use to the year 2000.

Population is expected to increase from 576,660 in 1975[16] to 1,073,347 in the year 2000. This represents an almost doubling of the population—an 86.1 percent increase. These projections were developed by the Bureau

15. Chase Econometrics, "Chase Names Top Ten U.S. Cities for Job Growth in the 1980s," News Release, March 28, 1980.

16. 1975 population base is used here due to the availability of 1975 water use data as a basis for water use projections, as detailed in Table 1.

TABLE 5

COUNTY EMPLOYMENT PROFILES
1979 NEW MEXICO UPPER RIO GRANDE BASIN

Employment Sector	*Rio Arriba*	*Taos*	*Los Alamos*	*Santa Fe*	*Sandoval*	*McKinley**	*Valencia*	*Bernalillo*	*Socorro*
Agriculture	730	313	0	340	342	22	975	996	501
% of Total	11.0%	4.9%	0.0%	1.2%	6.9%	0.7%	6.8%	0.5%	12.5%
Manufacturing	263	414	47	1,307	834	0	344	17,001	58
% of Total	3.9%	6.5%	0.4%	4.7%	16.8%	0.0%	2.4%	9.3%	1.4%
Mining	21	686	0	346	16	2,300	2,882	274	0
% of Total	0.3	10.7%	0.0%	1.2%	0.3%	70.0%	20.1%	0.1%	0.0%
Construction	341	333	242	2,111	642	41	1,256	14,957	152
% of Total	5.1%	5.2%	1.9%	7.5%	12.9%	1.2%	8.8%	8.2%	3.8%
Transportation, Communications, Utilities	278	144	68	900	181	89	999	11,188	114
% of Total	4.2%	2.3%	0.5%	3.2%	3.6%	2.7%	7.0%	6.1%	2.8%
Trade	1,049	1,292	1,012	5,982	496	234	2,696	46,672	598
% of Total	15.7%	20.2%	7.9%	21.3%	10.0%	7.1%	18.8%	25.5%	14.9%
Finance, Insurance, Real Estate	176	195	244	1,357	275	23	494	10,641	105
% of Total	2.6%	3.1%	1.9%	4.8%	5.5%	0.7%	3.4%	5.8%	2.6%
Services	1,434	1,486	2,451	6,791	1,043	212	1,558	41,366	647
% of Total	21.5%	23.3%	19.1%	24.2%	21.0%	6.5%	10.9%	22.6%	16.1%
Government	2,369	1,526	8,798	8,941	1,137	364	3,143	40,017	1,839
% of Total	35.6%	23.9%	68.4%	31.8%	22.9%	11.1%	21.9%	21.9%	45.8%
TOTAL	6,661	6,388	12,861	28,075	4,965	3,285	14,347	183,112	4,015

*Includes portion within Rio Grande Basin; estimated by Bureau of Business and Economic Research, University of New Mexico.

Source: New Mexico Employment Security Commission and U.S. Department of Commerce, Bureau of Economic Analysis (farm employment).

TABLE 6

POPULATION AND EMPLOYMENT PROJECTIONS
NEW MEXICO UPPER RIO GRANDE BASIN COUNTIES
2000

	Rio Arriba	*Taos*	*Los Alamos*	*Santa Fe*	*Sandoval*	*McKinley**	*Valencia*	*Bernalillo*	*Socorro*	*Total*	*% Increase Over 1975*
Population	37,300	21,691	20,700	129,143	58,486	16,700	116,039	652,388	20,900	1,073,347	86.1%
Manufacturing Employment	200	1,243	0	3,150	3,000	0	380	59,905	70	67,948	294.2%
Mining Employment	0	1,372	0	990	300	3,974	3,880	210	0	10,726	179.5%

*Includes only the portion within Upper Rio Grande Basin.

TABLE 7

PLANNED COAL-FIRED POWER PLANTS IN NEW MEXICO UPPER RIO GRANDE BASIN

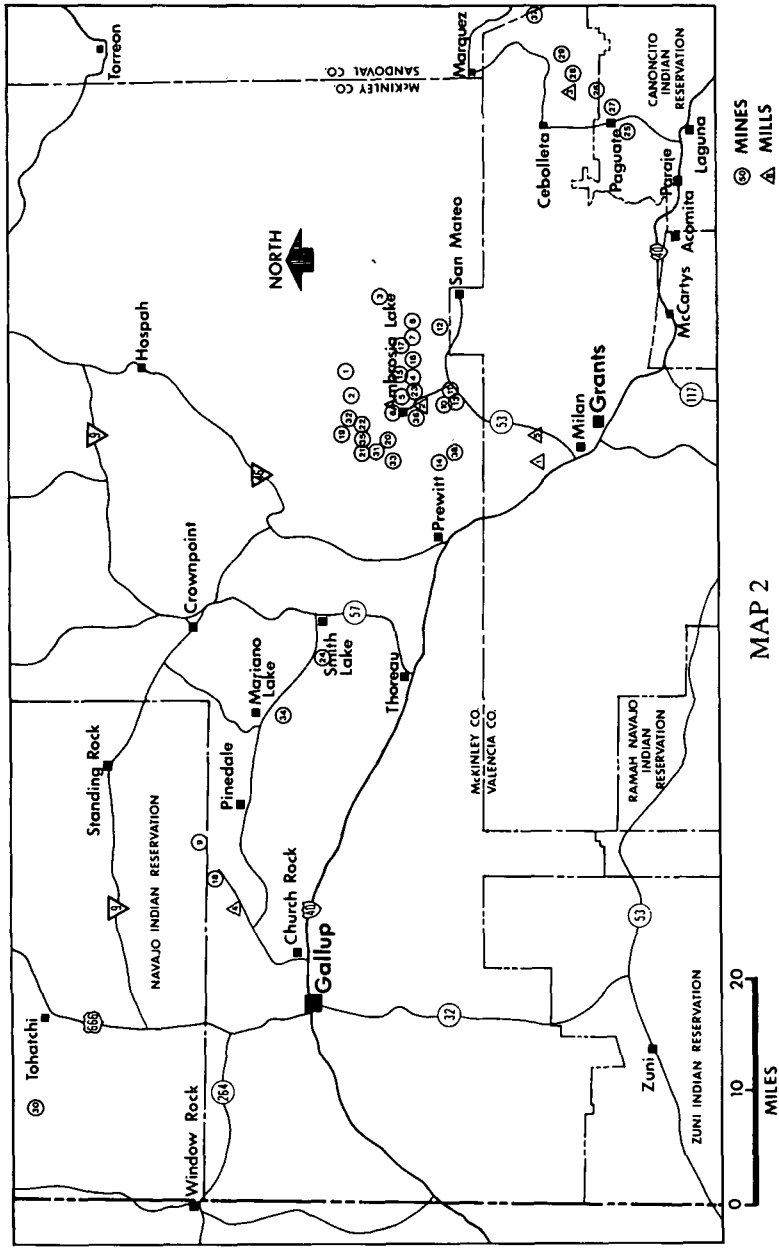
Unit	*Annual Capacity (megawatts)*	*County*	*Estimated Annual Water Usage*	*Energy Storage*
Seboyeta 1-4	600	Valencia	3,000 acre-ft.†	Pump-stor.
Escalante 1-2 Plains Electric, Prewitt, N.M.	443	McKinley	25,000 acre-ft.*	Coal-fired

*According to groundwater applications filed by Plains Electric, some of this water would be drawn from outside the Rio Grande Basin.
†Necessary water rights acquisitions for evaporation and percolation from storage reservoir.

of Business and Economic Research, University of New Mexico, for individual counties using an age/cohort survival model. This model provides for a disaggregate accounting of the different sources of population change—births, deaths and migration—by five-year age cohorts. Migration is projected based upon recent trends and consideration of expected economic conditions in each county. County population levels from the 1980 Census were used to calibrate the model projections, but age/sex characteristics are based upon the 1970 Census since these data are not yet available from the 1980 Census.

Manufacturing employment is projected to increase from 17,235 in 1975 to 67,948 in the year 2000, or a 294.2 percent increase. Manufacturing is presently a small economic sector within this region and strong growth is projected in the years ahead, particularly in the Albuquerque area. Thus, the percentage increase is quite large. Electronic manufacturers are now building new plants in the Albuquerque area, as mentioned previously. New firms are attracted by the low wages, low taxes, and availability of electric power and water in this region.

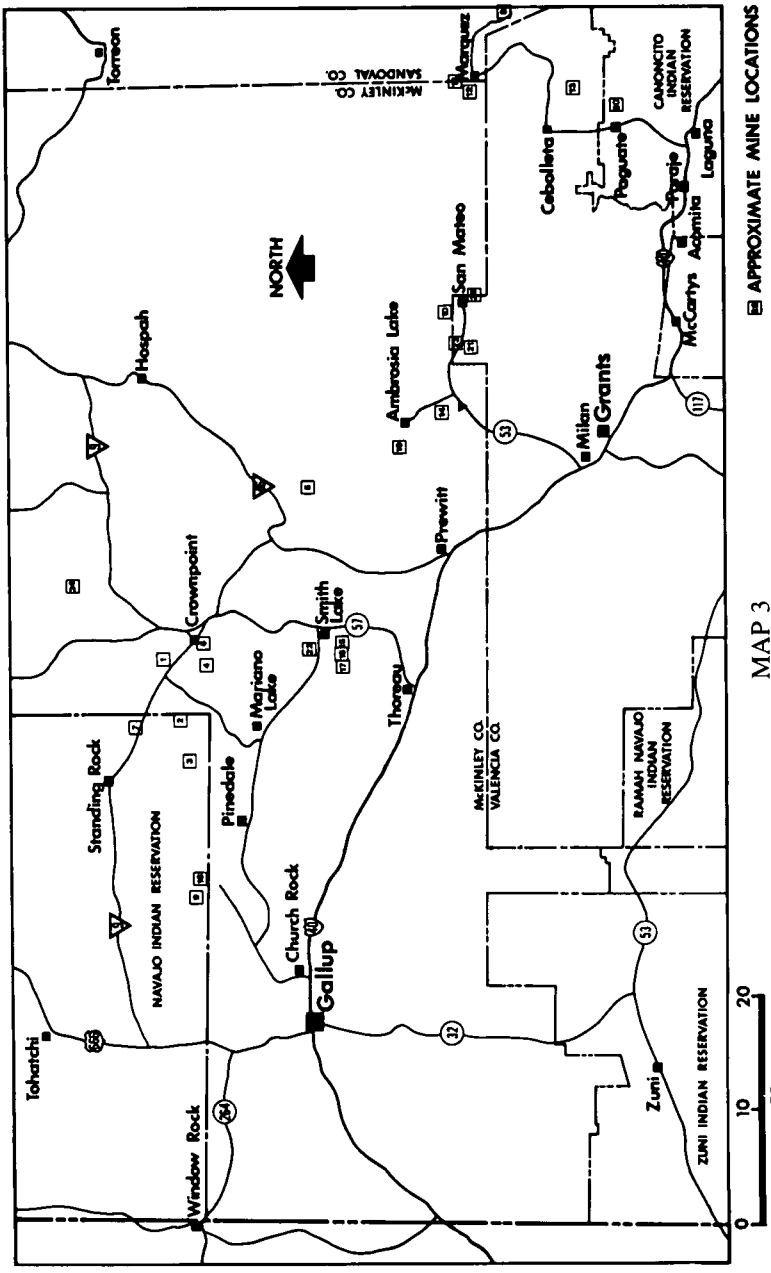
Mining employment is projected to increase from 3,838 in 1975 to 10,726 in the year 2000, or a 179.5 percent increase. Uranium mining is the principal mineral development in this region, although significant coal development is expected in the late 1980's and 1990s. The Molycorp Questa Mine in Taos also has plans to nearly double capacity in the near future. Maps 2 and 3 indicate where the present and planned uranium mines and mills are located. Our projections for uranium employment have been tempered by national concerns for nuclear power. However, it seems reasonable that eventually the nuclear power plants presently under construction will be completed and will therefore require increased uranium production. Table 8 presents information on existing and planned coal developments in the New Mexico Upper Rio Grande Basin. The



MAP 2

EXISTING MILLS & MINES

Source: U.S. Department of Interior, Bureau of Indian Affairs, *Uranium Development in the San Juan Basin Region*, Albuquerque, New Mexico, November, 1980.



MAP 3

URANIUM MINES: UNDER CONSTRUCTION, ANNOUNCED OR PLANNED

Source: U.S. Department of Interior, Bureau of Indian Affairs, *Uranium Development in the San Juan Basin Region*, Albuquerque, New Mexico, November, 1980.

TABLE 8

EXISTING AND PLANNED COAL DEVELOPMENT IN NEW MEXICO UPPER RIO GRANDE BASIN

Existing Coal Mines	*New Mexico County*	*Annual Capacity*
Albert J. Firchau Arroyo #1 Mine San Luis, New Mexico	Sandoval	Unknown
Applications for Permit in Process		
Chaco Energy Company Hospah, N.M.	McKinley	3.4 million tons
Chaco Energy Company Star Lake, N.M.	McKinley	6.0 million tons
Ideal Basic Industries La Ventana Mine, Cuba, N.M.	Sandoval	1.5 million tons
Santa Fe Mining Inc. Lee Ranch, Star Lake, N.M.	McKinley	6.0 million tons

Source: New Mexico Energy and Minerals Department, memorandum from Jack Reynolds, Mining and Minerals Division to Emery C. Arnold, Director, Mining and Minerals Division, March 30, 1981; and *Coal Age*, February, 1981.

planned capacity of 16.9 million tons approximately equals the 18 million tons of coal that were mined in the whole state in 1980. Much of this planned coal capacity is not under long-term contracts. We project coal development will add 1,000 jobs in the region by the year 2000.

As mentioned previously, there are plans for two major power plants in this region by the year 2000. See Table 7. One in McKinley County will be coal-fired and will have a capacity of 443 megawatts. Water use associated with this power plant has been estimated based upon groundwater applications with the New Mexico State Engineer. The other in Valencia County will be a pump-storage power plant of the Public Service Company of New Mexico (PNM). Water stored in a reservoir will be released to generate hydroelectric power during peakload periods and then pumped back into the reservoir using off-peak power from other company plants. Water use associated with this power plant has been estimated based upon data from PNM.[17]

Water Use Projections

It is assumed that the expanding uses of water in the future will come from the domestic, manufacturing, mining, power and military water use categories. Agriculture is the largest present user of water in this region

17. Current conditions in the uranium market have forced curtailed production by many mines within the state, and resulted in Public Service Company of New Mexico's postponement of the pump-storage project until such time as conditions in that market improve.

and we expect no growth in this sector in the years ahead for three reasons. First, the last ten years have seen no trend in the growth in agricultural employment or irrigated acres within this region. In fact, because of the urbanization of Bernalillo and Valencia Counties land has been withdrawn from cultivation. Second, available new water supplies in this region will come from the San Juan–Chama Project water. Small amounts of this project water have been committed to irrigation projects, e.g., Pojoaque Valley Irrigation District and ditches along the Rio Chama, with only the Middle Rio Grande Conservancy having a major share (20,200 acre-feet) of this project water. However, contracts and payments to the Department of Interior are required to obtain the project water and it is unlikely that large scale use of this project water by low-valued agricultural use will occur. Third, continued urbanization is anticipated in the Bernalillo and Valencia County area, further reducing the lands dedicated to farming.

Water use projections by county were made to the year 2000 for five water use categories: domestic, manufacturing, mining, power, and military. Projections for domestic, manufacturing, and mining were made using the information in Table 9. Water use factors, i.e., acre-feet per capita, acre-feet per manufacturing employee, and acre-feet per mining employee, were calculated for 1975 by county. Multiplication of these water use factors by the projections of population, manufacturing and mining employment yielded projected water use for these water use categories. These projected water use calculations are contained in Table 10. Projections of water use for power were based upon the information in Table 7. Some additional military water use is also projected within Bernalillo County anticipating expanding activity at Sandia Base and Kirtland Air Force Base.

The largest increase in water use (47,737 acre-feet) is in the domestic water use category due to the expanding population. A total increase in water use of 78,167 acre-feet to the year 2000 is projected, 61 percent of which will be for domestic use. Expanded water use for power is next in importance (15,492 acre-feet) followed by mining (9,427 acre-feet), manufacturing (4,443 acre-feet) and military (1,068 acre-feet).

This projected increase in water use of 78,167 acre-feet by the year 2000 can easily be accommodated by the new water supplies of 101,800 acre-feet available to the New Mexico Upper Rio Grande Basin from the San Juan–Chama Project during this time period. For example, domestic water use within Bernalillo County alone is projected to increase by 35,003 acre-feet by the year 2000 and the City of Albuquerque within Bernalillo County has commitments to 48,200 acre-feet of San Juan–Chama Project water. Thus, the overall conclusion is that water availability will not be a critical issue within the New Mexico Upper Rio Grande Basin over the next 20 years. Water supplies should be sufficient to meet

TABLE 9

UPPER RIO GRANDE BASIN WATER DEPLETION BY END USE 1975 FOR NEW MEXICO COUNTIES

	Rio Arriba	*Taos*	*Sandoval*	*Santa Fe*	*McKinley**	*Valencia*	*Bernalillo*	*Los Alamos*	*Socorro*
Population	27,800	19,300	22,800	62,000	10,060	46,100	362,600	16,100	9,900
Domestic Water Use									
Acre-Ft. Depletion	838.0	684.5	1,765.3	3,832.5	76.5	2,548.7	43,936.9	2,178.0	859.6
Acre-Ft. Per Capita	0.030	0.035	0.077	0.062	0.008	0.055	0.121	0.135	0.087
Irrigated Acres	37,320	37,330	9,130	4,730	240	34,540	9,790	0	17,390
Agricultural Water Use									
Acre-Ft. Depletion	48,450	49,160	19,650	9,200	430	82,440	24,140	0	45,630
Acre-Ft. Per Acre	1.298	1.317	2.152	1.945	1.792	2.387	2.466	0.000	2.624
Manufacturing Employment	354	358	523	887	0	275	14,768	0	70
Manufacturing Water Use									
Acre-Ft. Depletion	43.0	43.0	57.0	106.0	0.0	60.0	1,241.0	0.0	59.0
Acre-Ft. Per Employee	0.121	0.120	0.109	0.120	0.000	0.218	0.084	0.000	0.843
Mining Employment	na	747	47	306	1,080	1,448	210	0	na
Minerals Water Use									
Acre-Ft. Depletion	36.6	1,256.4	15.0	40.0	1,940.0	2,601.5	196.5	0.0	8.0
Acre-Ft. Per Employee	na	1.682	0.319	0.131	1.796	1.797	0.936	0.000	na

*Includes only that portion of county within Rio Grande Basin.

na Not available.

Source: Population, U.S. Bureau of Census, Current Population Estimates, Series P-26, July, 1977 for all counties except McKinley; McKinley County Population, Bureau of Business and Economic Research, University of New Mexico; Water Use and Irrigated Acres Data, *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; Employment data, New Mexico Employment Security Commission, *Labor Market Review,* 1975, except McKinley County which is estimate of Bureau of Business and Economic Research, University of New Mexico.

TABLE 10

PROJECTED COUNTY WATER USE PATTERNS IN NEW MEXICO UPPER RIO GRANDE BASIN 2000

	Total Depletions (acre-feet)										
	Rio Arriba	*Taos*	*Los Alamos*	*Santa Fe*	*Sandoval*	*McKinley*	*Valencia*	*Bernalillo*	*Socorro*	*N.M. Upper Rio Grande Total*	*Increase Over 1975*
Domestic Water Use, Urban and Rural	1,119	759	2,795	8,007	4,503	134	6,382	78,940	1,818	104,457	47,737
Manufacturing	24	149	0	378	327	0	83	5,032	59	6,052	4,443
Mining/Minerals	37	2,308	0	130	96	5,773	6,972	197	8	15,521	9,427
Power	0	0	0	8	700	12,500	3,000	3,654	0	19,854	15,492
Military	0	0	0	0	0	0	0	5,338	0	5,338	1,068
										TOTAL INCREASE	78,167

the expanding demand for water. Water should not be a constraint on economic growth for this region. This also implies that New Mexico will be able to stand by her water delivery commitments under the treaty with Mexico and the Rio Grande compact.

LA DISPONIBILIDAD DE AGUA EN LA CUENA ALTA DEL RIO GRANDE EN NUEVO MEXICO PARA EL AÑO 2000

La cantidad de agua disponible en la superficie para Nuevo México dentro de la Cuenca Alta del Río Grande, está limitada por el Tratado con México de 1906 y por el Convenio del Río Grande. La Declaración de 1956 del Ingeniero Estatal de Nuevo México impide más todavía el desarrollo del agua. La introducción del Proyecto de Agua de San Juan–Chama, ha aumentado el abastecimiento de agua existente. Esto permitirá una expansión económica futura dentro de la región y que Nuevo México cumpla con sus compromisos de entrega.

Condiciones de suministros de agua en la Cuenca Alta del Río Grande

Los flujos de la superficie de la Cuenca Alta del Río Grande están sobre-asignados. En el Tratado de 1906, con México, Estados Unidos, garantizó la entrega anual de 60,000 acres-pies de agua en el Río Grande a tráves de la presa Elephant Butte. El compacto del Río Grande de 1923 repartió equitativamente el agua restante de la superficie del Río Grande, entre Colorado, Nuevo México y Tejas. Nuevo México tiene la obligación de entregar a Tejas un porcentaje del flujo de agua, del centro norte de su territorio, incrementándolo según ésta va aumentando progresivamente.

En 1956, el Ingeniero Estatal de Nuevo México estableció la Cuenca de las Aguas del Subsuelo del Río Grande, para limitar la excesiva extracción de agua subterránea que estaba reduciendo las reservas de agua de la superficie. Esta declaración dió como resultado un gran desarrollo de las aguas del subsuelo mientras protegía los antiguos derechos y compromisos del agua de la superficie. Sin embargo, la política de controlar el uso de las aguas del subsuelo ha impedido el desarrollo del agua en la Cuenca Alta del Río Grande.

La introducción de agua de más allá de la cuenca de acuerdo con el Proyecto San Juan–Chama ha aumentado significativamente el suministro de agua de la Cuenca Alta del Río Grande en Nuevo México. El proyecto fué aprobado por el Congreso en 1962 como un medio para entregar a Nuevo México su porción de aguas de la superficie del Río Alto Colorado en la Cuenca del Río Grande. Toda la desviación anual de 110,000 acres-pies puede usarse para consumo, representando un incremento del 27% en el abastecimiento efectivo de agua.

Mucha de esta agua inicial de San Juan–Chama ha incrementado los almacenajes en las presas de Herón, Cochiti y Elephante Butte. La ciudad de Albuquerque almacena 80,000 acres-pies de agua contratada, que todavía no necesita, en los depósitos de El Vado y Abiquiu. Los Apaches Jicarilla han presentado una petición para obtener un uso temporal de agua del proyecto, argumentando que Albuquerque debería perder el derecho al agua, de la que no ha puesto para ningún uso benéfico.

Proyecciones demográficas y económicas

Se espera que la Cuenca Alta del Río Grande de Nuevo México sea una de las áreas de mayor crecimiento en los Estados Unidos. Se espera que, entre 1980 y 2000, la población aumente un 86%, que el empleo de manufacturas aumente 294%, y la minería de uranio y carbón un 180%. Se proyectan también centrales eléctricas para esta región.

Proyecciones para el uso del agua

Para el uso del agua se proyecta un incremento total 78,000 acres-pies para el año 2000, de la cual el 61% será para uso doméstico. El uso ampliado de agua para energía es el segundo en importancia, seguido por la minería y las manufacturas. La agricultura, actual consumidora más grande del agua, no indica más crecimiento, y sólo pequeñas cantidades de agua del proyecto se han comprometido para proyectos de riego. Se espera una urbanización continua en los condados de Bernalillo y Valencia, reduciendo las tierras usadas para la agricultura.

Los neuvos suministros de agua del Proyecto San Juan–Chama pueden facilmente acomodar el incremento esperado. Nuevo México podrá asegurar sus compromisos de entregar agua, bajo el Tratado con México y el Compacto del Río Grande.