Water Resources and Growth of the Mesilla Valley:
An Issue Paper

by

Thomas G. Bahr
Director
New Mexico Water Resources Research Institute
Las Cruces, New Mexico

June 1, 1979

PREFACE AND ACKNOWLEDGMENTS

This short report is based on an issue paper I presented at the Mesilla Valley Regional Conference on Growth, March 20-21, 1979 held on the Campus of New Mexico State University. I would like to acknowledge the help of Mr. Steve Reynolds and his staff of the State Engineers Office, Mr. Jesse Gilmer, Texas Commissioner of the Rio Grande Compact Commission, and Mr. Clyde Wilson of the U.S. Geological Survey for their review and helpful comments on the original manuscript. I should emphasize that this report is highly subjective in many respects and was originally written for the purpose of stimulating discussion at the March 20-21 Conference. The views expressed are those of the author and acknowledgment of the above reviewers is not intended to necessarily reflect their approval of this paper.

This publication was supported in part by funds provided through the New Mexico Water Resources Research Institute by the State of New Mexico through state appropriations and by the United States Department of Interior, Office of Water Research and Technology, as authorized under the Water Research and Development Act of 1978.

WATER RESOURCES AND GROWTH OF THE MESILLA VALLEY

Thomas G. Bahr

INTRODUCTION

Since man first set foot on New Mexico soil he was undoubtedly humbled by the rigorous constraints imposed on his life style because of limited water resources. Early man probably found the northern portions of our state more hospitable in this respect. In the north supplies were larger and stream diversions for agricultural purposes were probably more manageable. As new cultures immigrated into New Mexico, new techniques of water management were brought along which allowed population movement into many other areas of the state. If one were to single out the most important limiting factor in the past development of our state it would have to be the availability of a good water supply.

The history of the relationship of water to the development of the state is a long and complex subject. Projections of this relationship into the future are even more complex. This brief issue paper will attempt to summarize the nature of the constraints which water resources place on current and projected development in New Mexico with emphasis on the Mesilla Valley of the Rio Grande. The information used for this paper was selected from technical reports listed in the Bibliography and these sources should be used for more detailed data.

BACKGROUND

An excellent account of the role of water in the history of New Mexico is given by Christiansen, 1973. The following quote from the abstract of this report will serve to summarize hundreds of years of water history for New Mexico:

"The arid nature of New Mexico's climate forced all of its inhabitants, Indian, Spaniard, and Anglo-American alike, into maximum technical efforts toward water control. The Indian and the Spaniard tended to utilize similar techniques, and generally lived in proximity to one another. They both practiced subsistence agriculture. Both Indian and Spanish villages have, by-and-large, clung to methods centuries old and have not had the opportunity or desire to utilize new scientific and technological advances. On the other hand, the American settled in unoccupied areas, practiced commerical agriculture, and applied massive technology to water development. This heavy technical application in the major water courses resulted in important economic advances, but has also created serious problems which can only be solved by even more massive applications of technology. The history that unfolded told of a well-advanced technology backed by sound scientific principles, blended with a primitive simplicity mixed with superstitions, old wives' tales, magic, and faith."

CURRENT STATUS

Water Resources of the State

Surface supplies for New Mexico come from two sources, precipitation and inflowing streams. Figure 1 depicts the surface water budget for the state. Of about 85.5 million acre feet of precipitation which annually falls on New Mexico (slightly more than 12 inches per year) about 97% returns to the atmosphere through evaporation and transpiration. Assorted other losses and outflows result in 1.2 million acre feet that are left for beneficial use. For all practical purposes this amount is fully appropriated to current water users.

This page blank.

A highly simplified display of the ground water supply for the state is shown in Figure 2. As indicated about 5 billion acre feet of a total of 20 billion acre feet are fresh water supplies while 15 billion acre feet are classified as brackish and saline. The brackish supplies have potential for beneficial use either through desalting or direct use for new purposes. The fresh water supplies are, of course, highly valued for most uses.

Our water use on a state-wide basis is summarized in Table 1. Of the total amount of water withdrawals in the state, slightly more than half is from ground water supplies. Irrigated agriculture accounts for the largest single use, 83% of total.

Water Resources of the Mesilla Valley

Climate: The climate of the Las Cruces area is generally considered to be arid with semiarid conditions occurring at higher elevations in the mountains. Precipitation in the Mesilla Valley averages about eight inches per year with more than half of it occurring during the three month period of July through September. Precipitation in the nearby mountains is nearly double that in the Valley (King, et.al. 1969).

Summer temperatures for the Valley generally reach 90°F or higher for about 100 days during the year. During the winter the daily average maximum temperature is 57°F. The high temperatures coupled with low relative humidity result in high evaporation rates. Evaporation from a free water surface as recorded in an evaporation pan averages about 97 inches per year, which is more than 10 times the average precipitation.

Surface Water: With the exception of arroyo runoff following storms the only source of surface water to the Mesilla Valley is from the Rio Grande. The supply from the Rio Grande is stored at Elephant Butte Reservoir and released on demand. Inflow to the Mesilla Valley is, of course, dependent on upstream supplies and will vary from year to year according to precipitation patterns in the upper watershed.

This page blank.

Table 1

*1975 Water Withdrawals--New Mexico

Thousands of Acre Feet

State Totals

	Surface	Ground	Total
Urban	27.0	177.4	204.4
Rural	1.7	25.7	27.4
Irrigated Agricultural	1,885.1	1,777.8	3,662.9
Manufacturing	0	5.3	5.3
Minerals	16.7	78.3	95.0
Military	0.6	14.9	15.5
Livestock	10.7	11.0	21.7
Stockpond Evaporation	32.7	0	32.7
Power	70.4	24.3	94.7
Fish and Wildlife	35.4	7.4	42.8
Recreation (land based only)	0	0.4	0.4
Reservoir Evaporation	186.7	0	186.7
Playa Lakes Evaporation	47.4	0	47.4

Total Ground Water Withdrawals 2,122.5

Total Surface Water Withdrawals 2,314.4

Total Withdrawals. 4,436.9

*From Sorensen, 1977

Allocation of water from the Rio Grande is governed by international treaty, interstate compacts and within the state by the doctrine of prior appropriation. Under provisions of the Rio Grande Compact, Colorado is required to deliver to New Mexico a certain proportion of the total quantity originating in Colorado and likewise, New Mexico must deliver to Texas a certain proportion of the flow at the Otowi gauge located near Espanola. Under the Rio Grande Compact the amount of 790,000 acre feet per year is considered the "normal" water supply available for release below Elephant Butte Reservoir. This amount furnishes irrigation water to about 160,000 acres of agricultural land within the Elephant Butte Irrigation District in New Mexico and the El Paso Water Improvement District No. 1 in Texas. Under international treaty, Mexico is entitled to 60,000 acre feet of this amount. During years of less than full supply, users (including Mexico) receive a proportional share of the available supply. Less than a full supply is generally the rule rather than the exception since during the past twenty-five years the water allotment to users has averaged only about two-thirds of the full 790,000 acre feet "normal" water supply.

The surface water supplies of the Rio Grande are fully appropriated. Simply stated there can be no additional consumption of Rio Grande water in the future. New users can only gain access to surface supplies through obtaining a water right of a former user and that older use would have to be retired.

Groundwater: The Mesilla Valley is an entrenched intermontane valley of the Rio Grande. Mountains in the area are fault blocks, domal uplifts or bodies formed by igneous intrusive and extrusive processes. The principal hydrologic role of the mountains in our area according to King, et.al. 1969 is that of providing a barrier to groundwater movement. Valley fill of the

Santa Fe formation (Miocene to middle Pleistocene) and Rio Grande formation (late Quaternary) constitute the two major groundwater reservoirs of the area.

The Santa Fe formation, exceeding 3,500 feet in thickness in places, has good hydrological properties for water well development. Coefficients of transmissibility in the better areas of this formation range from 30,000 - 80,000 gallons per day per foot with developed zones commonly ranging from 300 - 500 feet in thickness (King, et. al. 1969). The more recent and shallower Rio Grande formation or flood plain alluvium is made up of coarser alluvial deposits typical of flood plain sediments. These fluvial deposits are thinner than those of the Santa Fe formation and range up to 80 feet thick. Although not as extensive as the Santa Fe formation, the Rio Grande formation affords a valuable source of recoverable ground water especially to the irrigated areas of the Rincon and Mesilla Valleys.

Water Uses: Water withdrawals for various uses for the Rio Grande basin and Dona Ana County are shown in Tables 2 and 3. As in the case for the state as a whole, both the Rio Grande basin and Dona Ana County reflect a high percentage of water use for irrigated agriculture; 83% for the Rio Grande basin and 95% for Dona Ana County. Nearly one-third of the irrigation water used in the Rio Grande Basin comes from groundwater. In Dona Ana County, groundwater withdrawals amount to about one-fifth of the total used for irrigated agriculture but this percentage is increasing.

Irrigated acreage in Dona Ana County experienced a 20% increase from 1940-1955 but since that period has stabilized. In the twenty-year period since 1955 irrigated acreage in the County has grown by only 5% (Figure 3).

Table 2

*1975 Water Withdrawals - Rio Grande Basin

	Thousands of Acre Feet		
	Surface	Ground	Total
Urban	9.6	127.9	137.5
Rural	0.2	16.6	16.8
Irrigated Agricultural	1224.9	414.2	1659.1
Manufacturing	0	3.4	3.4
Minerals	3.4	23.5	26.9
Military	0.6	13.0	13.6
Livestock	2.8	2.8	5.6
Stockpond Evaporation	8.3	0	8.3
Power	0	9.4	9.4
Fish and Wildlife	7.9	6.8	14.7
Recreation (land based only)	0	0.3	0.3
Reservoir Evaporation	82.6	0	82.6
Playa Lake Evaporation	18.6	0	18.6

Total Ground Water Withdraw 617.9

Total Surface Water Withdraw 1378.9

TOTAL 1996.8

*From Sorensen, 1977

Table 3

*1975 Water Withdrawals - Dona Ana County

Acre Feet

	Surface	Ground	Total
Urban	0	9,705	9,705
Rural	0	3,508	3,508
Irrigated Agriculture	412,270	72,930	485,200
Manufacturing	0	365	365
Minerals	0	181	181
Military (not Mesilla Valley)	0	2,000	2,000
Livestock	268	269	537
Stockpond Evappration	180	0	180
Power	0	3,503	3,503
Fish and Wildlife	250	0	250
Recreation (land based only)	0	0	0
Reservoir Evaporation	0	0	0
Playa Lake Evaporation	3,200	0	3,200

Total Ground Water Withdrawal 92,461

Total Surface Water Withdrawal 416,168

TOTAL 508,629

*From Sorensen, 1977

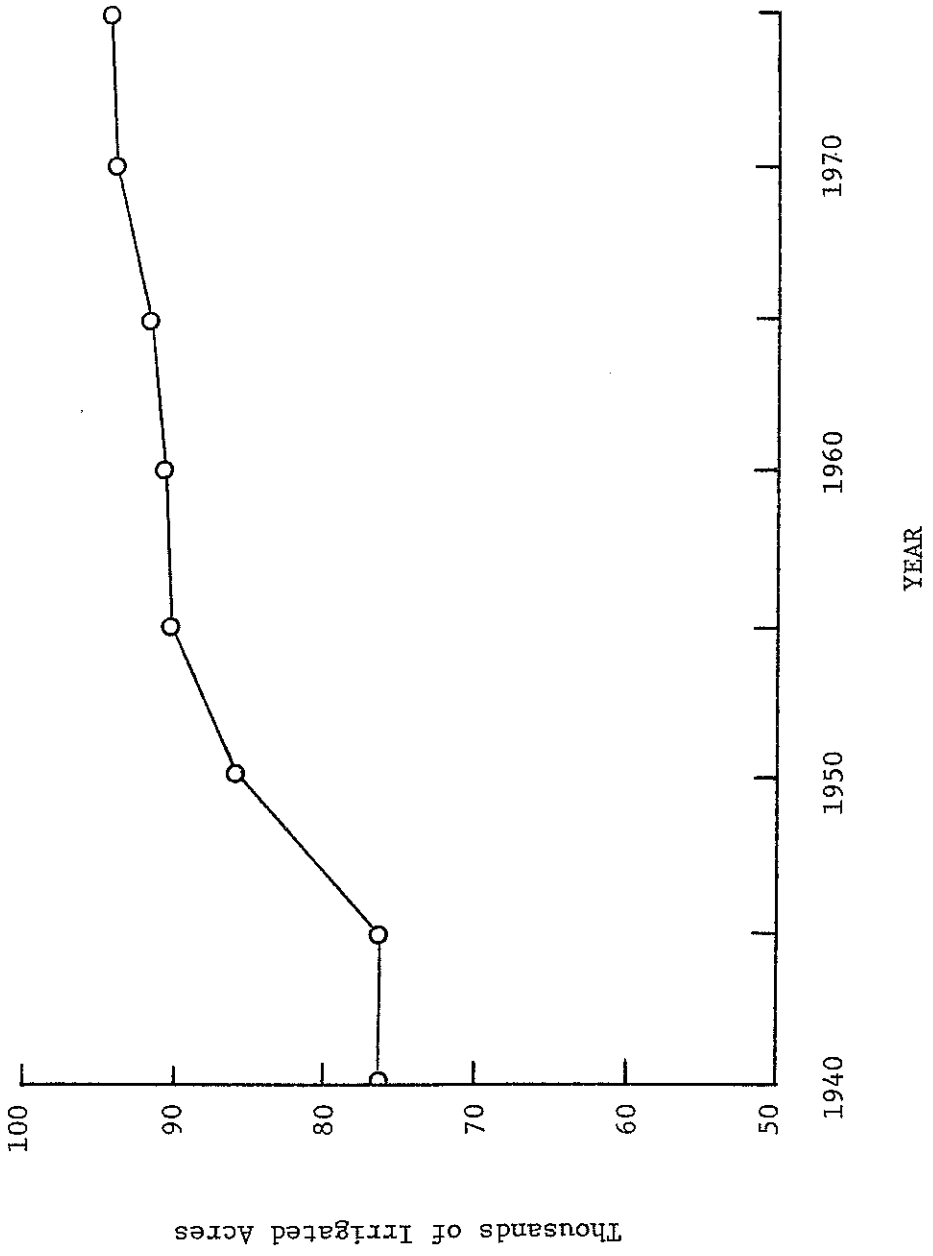

Figure 3. Irrigated Land in Dona Ana County, New Mexico

CURRENT ISSUES RELATED TO GROWTH

Two obvious issues which relate to water and growth in our area both center on water supply. They are:

1. Will there be enough water to supply all projected needs of the Mesilla Valley?
2. If demands outstrip supplies, water will have to be retired from one use (probably agriculture) to supply the needs of other uses. Water is a marketable commodity and will probably be sold to the highest bidder. In this regard, will the long-term interests of the area and state be best served under water transfers prompted by the economic market of today?

Both of these issues are unresolved at this time. It is likely that there is not enough water to meet all possible needs of the Mesilla Valley, but to fully address this issue we must first await results of detailed water resources surveys. The second issue is far more complex since it deals with long-term economic, social, legal and political scenarios. It should be recognized that water transfers are not permanent; yet, transfers to some areas (urban and industrial development) might eventually preclude transferring water back to former uses (eg. agriculture could no longer use the water if the landscape was converted to an urban or industrial setting).

FUTURE PROBLEMS RELATED TO GROWTH

Future problems in the face of complex current issues are even more difficult to articulate. Broadly speaking, however, I see at least two questions that we will ultimately be confronted with:

1. Deterioration of water quality generally accompanies its more intensive use. Will changing water use patterns accelerate or decelerate the deterioration of water quality?

2. Explosive urban growth in the El Paso-Juarez area will be severely limited by water in the not too distant future. Under current law, water from our state cannot be sold to Texas or Mexico to meet these needs. Mexico with its gas and oil resources may gain increasing political influence in the U.S. and New Mexico is certain to feel these effects. It is almost inconceivable however, that existing water compacts and treaties would be changed. Those far more knowledgeable than I about water agreements believe it would be easier to change state or international boundries than existing water agreements. Yet we are living in a dynamic world and it is possible that border relationships will impact on the extent and pattern of growth in the Mesilla Valley.

ALTERNATIVE FUTURES

Will growth in the Mesilla Valley be limited by its water supply? If so, what will be the extent of that limitation and what will be the social and economic consequences? At this time we have a fairly good idea about the amount and availability of surface water for the Mesilla Valley. It is measurable and within a reasonable degree of accuracy it is also predictable. Stated another way, we have only so much; we know about how much we can expect each year, and we aren't going to get much more. Furthermore, this surface supply is all appropriated.

We know less about the nature and extent of our groundwater supply. We do know, however, some basic hydrological principles. The first, is that if you withdraw groundwater faster than you allow it to be recharged, supplies will eventually become depleted. Another principle, is that in the Mesilla Valley our underground water supply is connected to the Rio Grande such that groundwater withdrawals can reduce the surface flow of

of the river. In other words, to maintain surface flows, groundwater withdrawals would have to be limited to the amount flowing into the valley from the Rio Grande and tributaries. Withdrawals in excess of this amount would result in groundwater mining. This relationship, although seemingly simple, is quite complex if one is faced with making predictions on how much the river flow will be affected under different groundwater withdrawal schemes.

A key question to many in the Mesilla Valley is how much groundwater do we have? At this time the published information on the storage volume and availability of groundwater is limited and incomplete.

Until enough facts become known about this groundwater resource, it is reasonable to expect that more and more water wells will be drilled in the valley and at some time in the future, if enough wells are drilled and pumped, we will begin to see reduced river flows and lowered groundwater levels. Our analytical capabilities may even give us an acceptable degree of predictability to head off these effects. Ultimately, however, even the most sophisticated prediction techniques cannot escape the fact that in the long run we will have to live off of our renewable supply -- the Rio Grande and tributaries.

For the purposes of stimulating discussion, however, it might be useful to advance a prediction. As of 1975 our annual groundwater withdrawal rate was about 92,000 acre feet. Observation of well levels by the U.S.G.S. indicate no constant water level declines in the valley; thus, it appears that there is enough recharge through the river and by irrigation return flows to avoid groundwater mining. A study by Lansford, et.al. 1977 suggests that by the year 2020 we will be pumping an additional 80,000 acre feet per year. This estimate is based on projected population growth, surface water limitations and optimal economic development. It appears to be a reasonable estimate. If we make the assumption that groundwater withdrawals beyond what we now use would represent a mining condition, we would deplete a storage

volume of about two million acre feet of groundwater by the year 2020. This assumes a linear increase in pumping rate from now until 2020. Do we have two million acre feet of groundwater? Probably yes.

There are test wells in the Mesilla Valley that indicate good supplies to a depth of at least 1000 feet. Others suggest even deeper supplies of fresh water. This would suggest an aquifer of rather large proportions. Making an assumption that the aquifer is bounded by the area of irrigated land (about 100,000 acres) and is a conservative thickness of 500 feet, we could estimate how much water it could produce. Assuming that water occupies only one-third of the space in this volume, and furthermore, that only half of this is recoverable, the net amount of water we could get from this aquifer would be about eight million acre feet. This is four times as much as the earlier projection of use between now and 2020.

The above calculation is very crude at best but was based on what I consider to be conservative assumptions. It would appear that we have more than an adequate groundwater supply for at least 45 years.

Projections beyond a 45 year period in this day of accelerating technology are, in my opinion, interesting, but probably of little use. Migration to the sun-belt is already an established fact and our relatively good supply of water in the Mesilla Valley is certain to act as an attractive force. I would also expect that this supply would attract in-state movement to this area in the future.

Our closeness to the El Paso/Juarez metropolitan area cannot be ignored despite the fact that these two cities are located outside the boundaries of New Mexico. The water problems of that metropolitan area are already beginning to be felt and many already have their eyes on the water resources of Dona Ana County. Although it is unlikely that New Mexico will ever give additional water to non-New Mexicans I expect that many non-New Mexicans when

faced with critical water shortages will seriously consider becoming New Mexicans and more specifically, residents of Dona Ana County!

LITERATURE CITED

Christiansen, P. W., 1973. The Quest for Water in New Mexico. Technical Report 029, New Mexico Water Resources Research Institute, Las Cruces. August 1973.

King, W. E., J. W. Hawley, A. M. Taylor and R. P. Wilson, 1979. Hydrology of the Rio Grande Valley and Adjacent Intermontane Areas of Southern New Mexico. Technical Report 006, New Mexico Water Resources Research Institute, Las Cruces. June 1969.

Lansford, R. R., S. Ben-David, F. Roach, B. J. Creel and B. R. Beattie, 1977. Regional Water Management with Full Consumptive Use. Technical Report 088, New Mexico Water Resources Research Institute, Las Cruces, June 1977.

Sorensen, E. F. 1977. 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.