

## WATER RESOURCES - THE PRIMARY FACTOR IN TUCSON'S FUTURE GROWTH

Thomas M. McLean, P.E.  
Tucson Water  
P.O. Box 27210  
Tucson, Arizona 85726

### Abstract

The community of Tucson faces a tremendous future challenge regarding the management of its local water resources. With the advent of the new Groundwater Code and a plan to balance the basin by the year 2025, it is impossible to discuss the growth of the metropolitan area without first questioning the availability of adequate water resources. In Tucson, water will soon become the yardstick by which community expansion will be measured.

The Tucson Water Utility plays a significant role in the management of the local water resource. Although there is currently complete reliance on groundwater, Tucson has received a tentative allocation of Colorado River water by means of the Central Arizona Project to supplement the groundwater supply in the future. In addition, the reuse of wastewater effluent and further conservation efforts must be planned in order to accommodate growth. The key ingredient to regional resource management, however, involves the cooperation that must exist among the major water-using entities of the area: Tucson Water, the mines, farmers, private water companies, and private well owners. This paper addresses the potential favorable and unfavorable impacts of limited water resources on future growth with respect to these concerns.

### Introduction

The metropolitan community of Tucson, situated in eastern Pima County (see Figure 1), is experiencing growing pains of a slightly different nature than one would normally expect. These pains come from the realizations that future growth carries with it a high price tag and that the major water-using entities of the region look forward to some difficult water resource-related decisions in the coming years.

A brief overview of the current water supply situation in eastern Pima County is appropriate at this point. The Tucson Water Utility is the major purveyor of water for municipal and industrial users in the metropolitan area of Tucson, but it is only one of many local water-using entities all of which subsist entirely on groundwater for their source of supply. There are four copper mining companies in the near vicinity; several agricultural interests such as the Cortaro-Marana Irrigation District, the Avra Valley Irrigation District and the Farmers Investment Company; a number of private water companies; and various private well owners. Agricultural interests utilize the largest amount of water consumptively followed by the mines and then the City Water Utility (see Figure 2). Pumpage in this area is estimated to exceed natural recharge by a factor of approximately five to one, and, as a result, there exists a large imbalance between groundwater supply and demand which has resulted in long-term declines in local groundwater levels.

### Projected Growth of the Tucson Metropolitan Area

The Tucson Water Utility presently provides service to approximately 450,000 people through 130,000 service connections. As the major metropolitan area water utility, Tucson Water's interaction with regional planning efforts can and does provide an important element in the process of formulating projected urban growth patterns. The Water Utility is represented on an intergovernmental planning team along with other governmental agencies and utilities. This group coordinates the necessary technical expertise which contributes to the process of developing regional land use plans. Additionally, local governmental agencies (including Tucson Water) play a significant role in outlining the State of Arizona's regional population projections administered by the Department of Economic Security.

A great deal of development pressure exists in the Tucson vicinity. It is pushing to the peripheral areas of the community in search of large portions of undeveloped land. Urban growth, and, therefore, intensive land use planning is currently focused on three major regions: the northwest, southwest and southeast (see Figure 3). Expansion to these areas must be accompanied by a number of basic support services, and never before has the availability of water supply been such an integral

factor in the decision-making process as it is today. Evidence of this situation is demonstrated by the fact that coordination with land use planning efforts has resulted in the establishment of area-specific water plans (McLean, 1980). These water plans are aimed directly at resource management, but more essentially provide technical and financial solutions to the problem of water delivery to specific areas of the community. The water plans address the need for short and long-term water supply concepts which provide an overview for future residential and associated water system expansion. A financial mechanism is also established in an effort to provide funds for the capital improvements required to support growth in that particular area as it occurs.

Recently, land use plans for new major urban areas in the southeast and northwest portions of the metropolitan area have been under consideration for adoption by the local governing body. It is apparent that there exists political indecisiveness regarding proposed land use densities due to the long periods of deliberation required before the plan is adopted. These delays appear to reflect the difficulty with which officials must decide regarding the location and extent of urban expansion and the capability of supporting such growth with the available and projected services.

The propensity for growth in the Tucson area is not only displayed by the activity of land use planning, but is also reflected in the statewide population projections produced by the Arizona Department of Economic Security (DES). In 1979, the DES projected that Pima County would have a population of 818,600 people by the year 2000 and 1,269,000 people in the year 2030. In 1982, the DES revised these projections and now estimates that Pima County will have a population of 921,938 in the year 2000 and 1,680,560 by the year 2030 (see Figure 4). Five years beyond that, in 2035, it is predicted the population will increase further to 1,867,400.

#### Future Water Resources Available to Meet Tucson's Growth Needs

Responsible land use planning together with a reasonable projection of future population distribution obviously provide the key ingredients for planning the community's water system expansion. Major additions to Tucson's water system are proposed in these same areas of intense development pressure. However, the question that must logically come first can be simply stated -- will there be adequate water resources to supply the projected demand? Projected growth translates directly into additional water supply requirements, and the alternatives available to this arid region can be enumerated as we see them today.

The continued use of groundwater to meet local requirements is envisioned to some extent, but the limitations on the availability of this resource are extremely difficult to quantify due to a number of extenuating circumstances.

- 1) A New State Groundwater Law - In June of 1980, the State of Arizona passed into law a Groundwater Management Act which sets forth ambitious goals for the regulation of groundwater use within the State. With its eye on balancing demand with groundwater supply within the Tucson Active Management Area by the year 2025, the State Department of Water Resources proposes to formulate and administer a series of groundwater management plans designed to impose various conservation regulations for all water using-entities. New subdivisions are required to prove an assured water supply for a period of 100 years.
- 2) Potential for Land Surface Subsidence - As previously mentioned, a serious overdraft condition exists in eastern Pima County. Historical declines over a 35-year record in some areas of Tucson's central basin (where the municipality of Tucson resides) are in excess of 120 feet. Continued long-term pumping from this area represents a concern for Utility officials due to the potential for land surface subsidence (particularly differential) and its associated impacts.
- 3) Legal Limitations - The value of groundwater resources in the Tucson area and the intense competition for rights to its use are exemplified by the current legal confrontation with the Papago Indian Tribe. Due to the President's veto of the Southern Arizona Water Rights Settlement Act of 1982, negotiations with the Tribe and the Federal Government have been reopened. If the lawsuit persists, injunctions could be issued by the court requiring cessation of pumping in both the City's Avra Valley and Santa Cruz wellfields.
- 4) Groundwater Contamination - The community of Tucson faces another challenge to its current water supply from Trichloroethylene (TCE) contamination. The historical disposal of industrial waste in the southwestern parts of the city has resulted in the contamination of small portions of the aquifer. As a result, a number of public and private wells have had to be shut down until measures can be taken to mitigate the problem.

Facing a relatively complex disposition of its future groundwater supply, Tucson looks to the importation of a surface water supply as a potential remedy to its water source problems. Tucson has a tentative allocation of Central Arizona Project (CAP) water which is proposed to be delivered by 1990 through the Tucson Aqueduct. The CAP in itself is not a panacea, however. As part of the Central Arizona Project Act of 1968, Arizona is obligated to curtail pumping from the Colorado River during periods of low flow as measured by water elevations in reservoirs along the river. The project itself

is behind in its original schedule of construction and is subject to constant scrutiny of its projected economic benefits. As can be expected, statewide competition is keen for long-term allocations of this water and will continue as such until the federal government finalizes CAP allocations and sales contracts are signed. The final costs of CAP water are not defined. The Tucson community anticipates that the purchase of CAP water will represent a fairly sizeable impact on the rate payers. Planners and administrators must carefully assess these economic factors before long-term community commitments can be extended. Lastly, the quality impacts of this new future source are yet another question mark. Tucson, accustomed to relatively high quality, low TDS groundwater must now re-orient its supply system configuration to operate with its first water treatment facility. While this plant will remove suspended solids and taste and odor problems associated with surface water, hardness and total dissolved solids will increase.

In an effort to maximize the availability of its potable water supplies, Tucson plans to maximize the use of its wastewater effluent available at two secondary treatment plants in the northwest portion of the Tucson metropolitan area. Studies are underway to ascertain the most efficient and practical future use of effluent to replace potable water use wherever possible. Examples of this are already realized through the application of effluent on a number of local golf courses. In this manner an extension to the life of local groundwater reserves can be accomplished.

A final option for augmenting Tucson's water resources lies with increased conservation efforts. Since 1977, Tucson Water has successfully advocated a summer demand management program known as "Beat the Peak." A by-product of this voluntary program has, in fact, been the realization of a significant amount of water conservation. Per capita usage was reduced from 205 gallons per person per day (gpcpd) in 1973-74 to approximately 150 gpcpd in 1978-79. This resulted in not only less pumpage overall, but also a reduction in the expenditure of capital funds due to decreased demand. In effect, the life of some water facilities was extended. Since "Beat the Peak" is a summertime campaign, other conservation programs have followed such as "Slow the Flow". This program is designed to take advantage of the successful summertime effort and broaden the public's awareness of the need for intelligent indoor water conservation to reduce sewage volume and extend the life of wastewater treatment and conveyance facilities. Once again it is noted that these efforts are voluntary, and increased emphasis in these areas in the future may positively impact the water resource situation locally. As previously mentioned, the new groundwater code will bring more attention to water conservation through guidelines that are mandatory in nature which stem from an overall management plan with time-specific per capita use goals.

#### The Impacts of Limited Water Resources on Tucson's Growth

At this point in the discussion it is pertinent to pause and attempt to put the aforementioned information in perspective through the use of a rudimentary example. Estimates have been made that approximately 100,000 acre-feet (a-f) of natural recharge is available annually to the local water table. Assume that the basin is in balance in the year 2030 and all of this recharge is available for use by the municipality of Tucson (a sizeable assumption in itself). Further assume a reasonable expectation of CAP delivery for that year of 100,000 a-f. If a per capita usage characteristic of 150 gpcpd is applied to this situation, the total population which can feasibly be supported by these resources is 1,200,000 people (see Figure 5). At this point in time (year 2030) it is assumed that Tucson Water is providing retail or wholesale service to essentially all of eastern Pima County and only a very small amount of population exists outside the service area. As you may recall, it was previously indicated in this paper that the most recent planning efforts indicate a population projection for Pima County of 1,680,560 people by the year 2030. We are realizing, therefore, a potential disparity between what is projected as growth for the Tucson area and what can be reasonably accommodated. Since the maximum supply side of the equation is relatively fixed, the demand side must be reduced to match the supply.

The issues surrounding the future of water supply for the southwestern community of Tucson paint a complicated and undefined picture, to say the least. The governing bodies and the citizens at large must possess a keen awareness of the water resource question at the earliest possible stage in order to adequately address these issues. Prudent and responsible planning of the community's growth must carry a high priority with the realization that difficult tradeoffs lie ahead and choices must be made for the benefit of the majority. Competition for local water resources will only increase in the future, and all areas of the local economy will feel the impact. The agribusiness, being the highest consumptive user, will probably reduce. A limitation on municipal and industrial growth can be reasonably expected.

On the other side of the coin the impacts of limited water resources can be viewed favorably. As previously stated, it will encourage intelligent and prudent land use planning in order to efficiently accommodate the community's needs with the resources available. Since scarcity encourages efficiency, the integrity of local water delivery systems will undoubtedly improve. Similarly, the pricing of the commodity of water will be adjusted upward to a more efficient and proper level. Last, but not least, it is anticipated that the region will cooperatively resolve the overdraft situation and eventually realize the achievement of a "Safe-Yield" condition.

#### Conclusion

The availability of water resources is an extremely important factor in the growth of the Tucson area. It is no longer possible to discuss the expansion of the metropolitan area without first questioning the availability of adequate water resources. In Tucson, the nature and extent of the community's growth will be a measure of the ability of the local water-using entities to effectively manage and conserve the local water resources.

#### References Cited

McLean, Thomas M. "The Northwest Area Water Plan - Tucson, Arizona", Hydrology and Water Resources in Arizona and the Southwest, Volume 10.

# PIMA COUNTY

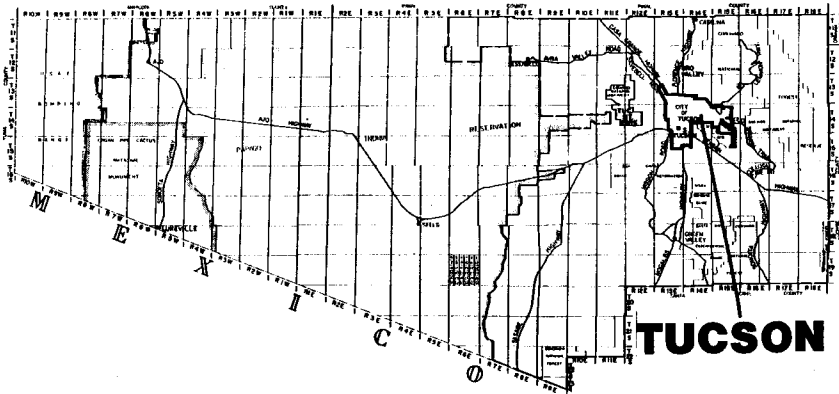


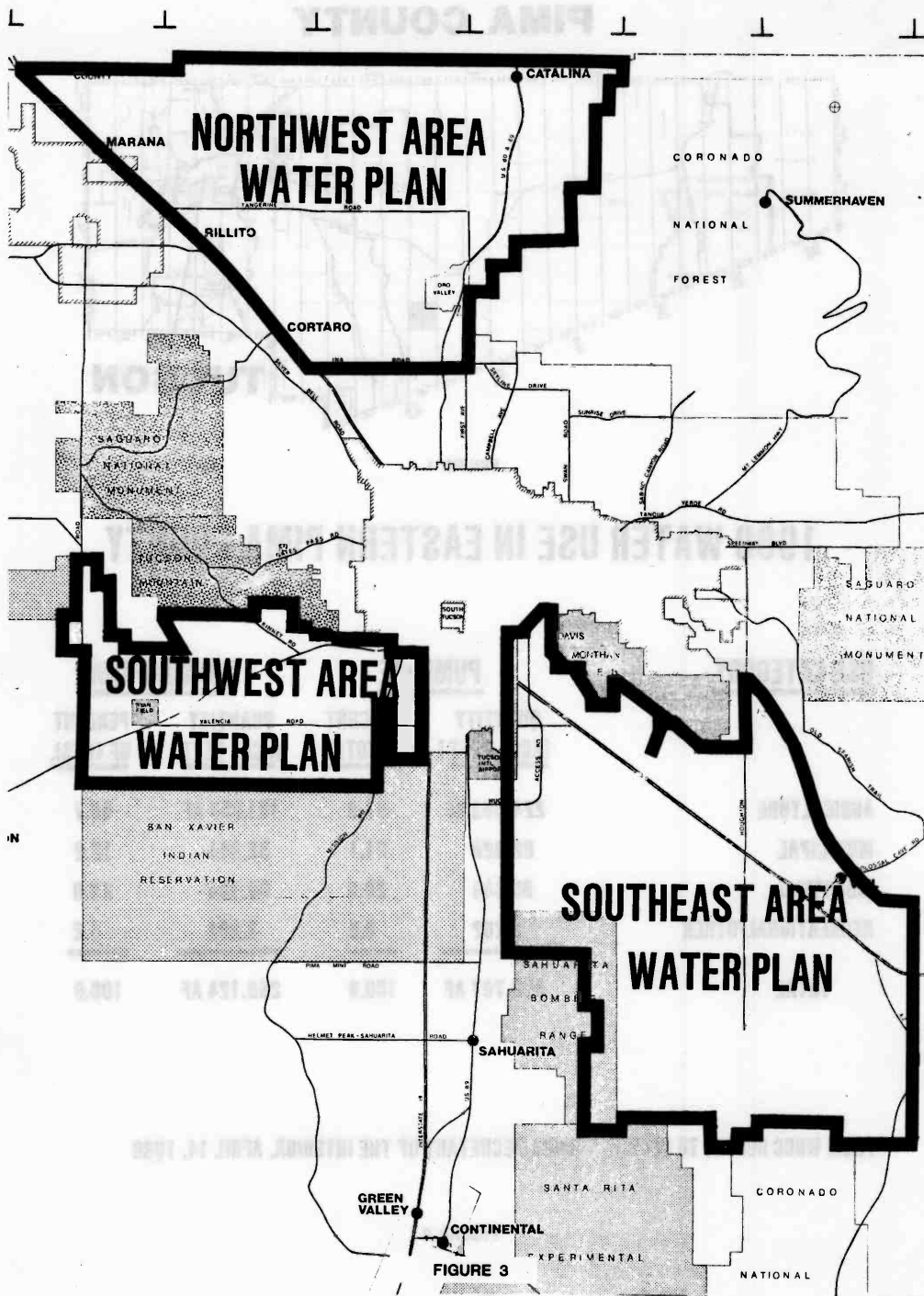
FIGURE 1

## 1980 WATER USE IN EASTERN PIMA COUNTY

<u>USE CATEGORY</u>	<u>PUMPAGE</u>		<u>CONSUMPTION</u>	
	<u>QUANTITY</u> <u>(ACRE FEET)</u>	<u>PERCENT</u> <u>OF TOTAL</u>	<u>QUANTITY</u> <u>(ACRE FEET)</u>	<u>PERCENT</u> <u>OF TOTAL</u>
AGRICULTURE	224,953 AF	57.6	151,857 AF	56.7
MUNICIPAL	82,328	21.1	32,841	12.2
INDUSTRIAL	80,144	20.5	80,144	29.9
RECREATIONAL/OTHER	3,282	0.8	3,282	1.2
TOTAL	390,707 AF	100.0	268,124 AF	100.0

FROM WRCC REPORT TO CECIL D. ANDRUS, SECRETARY OF THE INTERIOR, APRIL 14, 1980

FIGURE 2



# PIMA COUNTY POPULATION PROJECTIONS (DEPARTMENT OF ECONOMIC SECURITY)

	YEAR	
	2000	2030
DES-1979	818,600	1,269,000
DES-1981	921,938	1,680,560

FIGURE 4

## WATER SERVICE CAPABILITY AT VARIOUS PER CAPITA USE RATES ( WATER SUPPLY = 200,000 ACRE-FEET PER YEAR )



FIGURE 5