

“Securing Sustainable Water Supplies in Arizona”

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Introduction and Background

Arizona is a rapidly growing state. Statewide, the population grew 40 percent between 1990 and 2000. The natural beauty of the state and its climate are two of the many factors contributing to this high growth rate. Associated with the climate, however, are the challenges of living in a desert environment. In Central Arizona, home to 80 percent of the state's population, rainfall averages between 19 to 30 centimeters annually. Groundwater is the water supply serving approximately 40 percent of Arizona water demand. Rapid growth and reliance on groundwater have resulted in groundwater overdraft in some parts of the state. Aquifers are being depleted faster than nature can replenish them. Streams and rivers are important sources of water, yet the water demands associated with rapid population growth have affected and will continue to affect riparian areas dependent on stream flows, thereby potentially jeopardizing the very environment so important to tourism and the quality of life for Arizona residents. Arizona has adopted regulations to manage groundwater resources in some regions of the state. This paper provides a brief overview of Arizona's approach to groundwater regulation, including its innovative programs to recharge water, and highlights several unresolved water issues, many of which are actively being addressed.

Groundwater Regulation in Arizona

In 1980, the Arizona legislature passed the Groundwater Management Act (Act). It established regions, called Active Management Areas (AMAs), where groundwater management is required. With the 1994 split of the Tucson AMA into two, there are now five AMAs in the state, as shown on Figure 1. Each AMA has a statutory management goal. Safe-yield, or a balance between groundwater withdrawals and natural and artificial recharge, is the primary water management goal for four of the five AMAs. The management goal of the Pinal active management area is to allow development of non-irrigation uses and to preserve existing agricultural economies in the active management area for as long as feasible, consistent with the necessity to preserve future water supplies for non-irrigation uses.

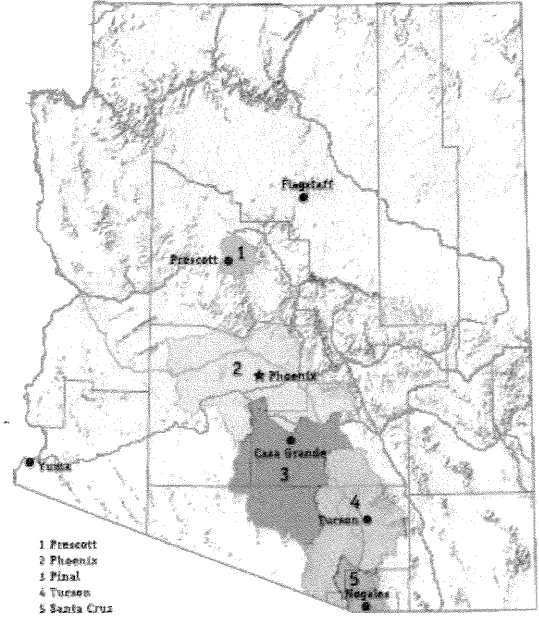


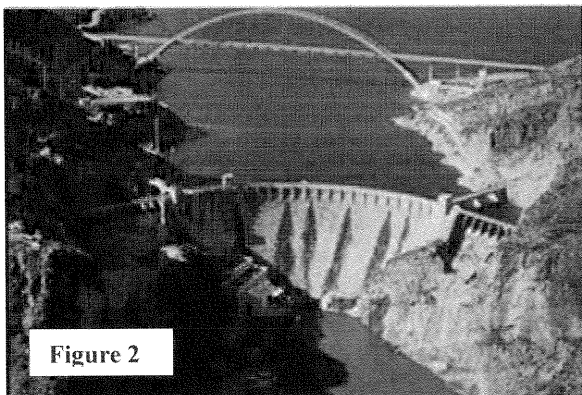
Fig. 1 Active Management Areas

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The Act mandated the adoption of Assured Water Supply Rules, which require municipal growth to depend primarily on renewable water supplies. Conservation programs for each water using sector (agricultural, municipal and industrial) are included in the management plans adopted every 10 years by the Arizona Department of Water Resources, the agency charged with implementing and enforcing the Act. The Groundwater Management Act also restricted agricultural activity in the AMAs to acreage irrigated at some time during the period 1975 to 1979. In addition to creating the AMAs, the Act established three irrigation non-expansion areas (INAs). In these areas, agriculture can not expand beyond historical acreage, but otherwise groundwater water use is not subject to regulation. While the state establishes the management goals, rules and regulations, determining how to meet the regulations is left to the water suppliers and users. Political jurisdictions involved in the provision of water and private entities are therefore involved in water management decision-making.

The Importance of Renewable Water Supplies to Efforts to Reduce Groundwater Use

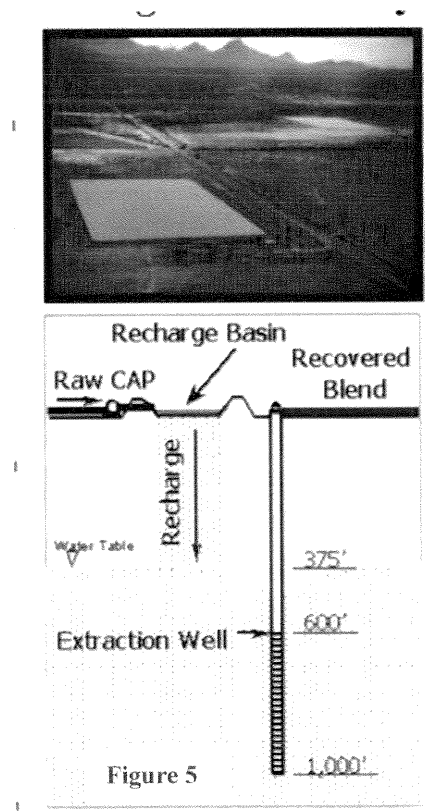
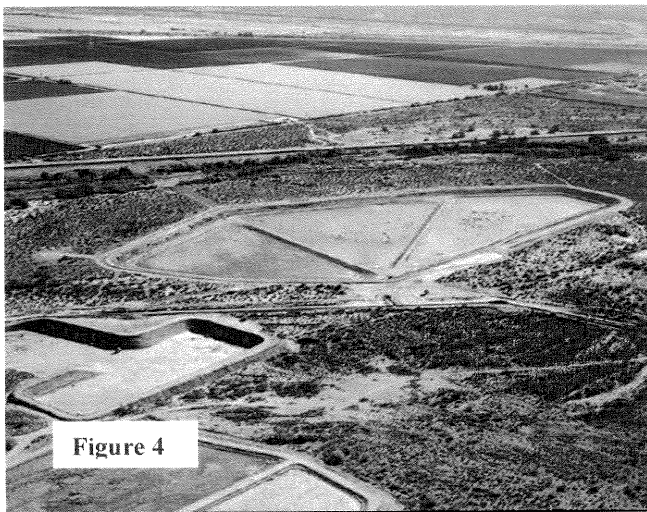
In Central Arizona, the Assured Water Supply Rules require municipal growth to depend largely on renewable water resources, such as surface supplies, or effluent. Construction of major water storage and conveyance projects has enabled the use of surface water in the heavily populated Phoenix and Tucson AMAs as well as in the Pinal AMA. The Salt River Project is a major water reclamation project delivering water into the Phoenix metropolitan area. Roosevelt Dam, shown in Figure 2, is one of several Salt River Project dams. Hoover Dam on the Colorado River, shown in Figure 3, is considered one of the man-made wonders of the world. The Central Arizona Project (CAP) which traverses 541 kilometers and rises from sea level to approximately 850 meters, was built at a cost of over \$4 billion and delivers 1.5 million acre feet² of Colorado River Water to Central Arizona. Without these supplies, Central Arizona would not be able to meet the Groundwater Management Act's management goals. In addition, utilization of effluent is an important component of water resource plans.



² An acre foot of water is 325,851 gallons. An acre foot of water is the amount that covers one acre of land with one foot deep water. It is equivalent to about 1.2335 thousand cubic meters.

Water Storage and Recovery in Arizona

The Groundwater Management Act has withstood the test of time, but improvements to it have been made. Perhaps the most significant of these has been the introduction of water storage and recovery programs. These programs have been developed because surface water or effluent some times is not where it is needed spatially or in time. Water is stored at Underground Storage Facilities and Groundwater Savings Facilities for recovery later in time or elsewhere. Underground Storage Facilities usually consist of basins built for the purpose of replenishing underground aquifers. Studies are done prior to the construction of the basins and permits from the Arizona Department of Water Resources are required to build and operate the storage facilities. At Groundwater Savings Facilities, agriculture substitutes CAP water or effluent for use of groundwater. Figure 4 shows the three-basin Lower Santa Cruz Replenishment Project, which is northwest of Tucson. Figure 5 is a schematic showing the principle behind a major storage and recovery program implemented by Tucson Water to blend Central Arizona Project with groundwater prior to delivery to customers. Separate storage permits are issued for those entities wishing to store water at the sites, with the Arizona Department overseeing the accounts of storage credits accrued and used.



Since the early 1990s, millions of acre feet of water have been stored at the sites in Central Arizona. In addition to the water storage done by suppliers of water, two agencies established by law have as their primary purpose the storage of water to assist in meeting the water utilization and management goals of the state. The Central Arizona Groundwater Replenishment District (CAGR) was created in 1993 to assist water providers and developers

in the three Central Arizona AMAs in meeting the Assured Water Supply Rules requirements to utilize renewable water supplies. The CAGRDR is operated by the operators of the CAP, a three-county multi-water conservation district known as the Central Arizona Water Conservation District, which is governed by a 15-person elected board. The CAGRDR is obligated to replenish or replace through recharge certain groundwater used by its members within three years of its use. CAGRDR replenishment obligations have been ramping up rapidly as membership has been growing. Estimates show that the membership expected by 2015 will require annual replenishment obligations of less than 100,000 acre feet in that year, with the replenishment obligation growing to well over 200,000 acre feet by 2040.³ The CAGRDR is in the process of developing its second plan of operation. The plan of operation must be developed every 10 years and approved by the Arizona Department of Water Resources. The rapid growth in membership is resulting in a careful look at the renewable water supplies needed to meet the replenishment obligation, as the CAGRDR has to enter into contracts to obtain the water used for replenishment.

The Arizona Water Banking Authority (AWBA) was established in 1996. It has several mandates, the primary one being to store water for future shortages on the Colorado River or outages of the CAP canal. In addition to the 1.5 million acre feet of Colorado River water delivered through the CAP, Arizona water users hold the rights to use 1.3 million acre feet of water directly off of the Colorado River. This is the source water for much of the farming in southwestern Arizona and a significant source of municipal water supply for the cities and towns along the western boundary of Arizona. Through 2003, about 2 million acre feet of water has been stored by the AWBA, which is governed by a five-person board.⁴ A small portion of the storage has been done on behalf of the state of Nevada. Storage for the other states of the Lower Basin (California and Nevada) is allowed if all of Arizona's banking needs have been satisfied for a given year. This interstate storage program resulted from significant negotiations of agreements and rule-making by the involved states and the United States Department of Interior. Banked water can also be used to meet AMA water management goals and for settlement of Indian water claims, a subject beyond the scope of this paper.

Both the Arizona Water Banking Authority and the Central Arizona Groundwater Replenishment District store water that is otherwise unused by Arizona entities with CAP water subcontract or those purchasing water on a year-by-year basis. Key to both agencies is the availability of surplus CAP water. As other uses of CAP water grow, the drought conditions experienced by the Colorado River watershed continue, and the efforts of California to gradually reduce reliance on Colorado River water to its 4.4 million acre foot allocation progress, modeling the availability of surplus Colorado River water has become more important than ever.

Challenges Associated with Water Management in Arizona

While Arizona has made great strides in water management and planning for the future in the Active Management Areas and some other parts of the state, the state is experiencing a serious drought. The Governor's Drought Task Force is readying completion of its draft statewide drought plan, the first ever for Arizona. While drought conditions have underscored

³ "CAGRDR Conceptual Plan Discussion Paper," Central Arizona Groundwater Replenishment District, December 2003.

⁴ Source: Various annual reports and other public documents available from the Arizona Water Banking Authority, www.awba.state.az.us.

the importance of water planning and exacerbated the implications of limited water supplies, the need for water planning and sound water resource management is not dependent on drought conditions. Water supplies are finite and demand for water is growing. Water resource planning is no longer a choice for most Arizona communities; it is imperative.

Water professional, public officials and residents throughout Arizona have recognized this. They have organized themselves into watershed groups or other organizations to understand their water situation and determine the best way to meet future demands. Those not already in Active Management Areas have resisted the idea of state-level regulation. The focus is on developing local and regional solutions to local and regional water resource issues. However, in many areas, data and financial resources are sparse. To differing degrees, financial and technical assistance has come from the state and from federal agencies.

The locations of the watershed groups are shown on Figure 6. They range from loosely organized groups to the now federally recognized Upper San Pedro Partnership (Number 17). This group is charged with developing with a plan to keep a reach of the San Pedro River flowing while having sufficient water to supply Ft. Huachuca and the growing Sierra Vista region. The Upper and Middle Verde area (Number 5) has a county-appointed advisory committee and many citizens groups working on preserving high-quality riparian areas while addressing the water demands of the rapidly growing region. The connection between surface water and groundwater complicates issues for that region. The Gila River watershed (Number 14) supports cattle ranching, agricultural production, and mining. The watershed group is working to resolve water quality issues such as salinity, turbidity, non-point source pollution, and flood mitigation. Like the other areas, environmental issues are extremely important. Financial constraints affect this group's ability to obtain the technical information requisite for decision-making. This is a common problem.⁵

Throughout the state, many outstanding issues must be addressed in order to secure sustainable water supplies. Resolution of them will necessitate working through some combination of technical, socioeconomic, environmental, legal, financial, political, and policy issues. Water quality issues, including those related to salinity, arsenic, and perchlorate, will

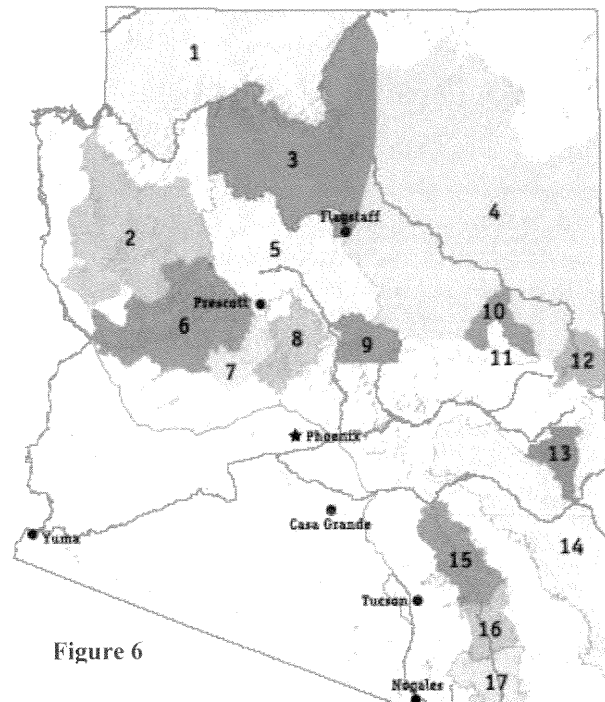


Figure 6

Arizona Watershed Alliance

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| 1 Arizona Strip | 10 Silver Creek |
| 2 Northwest Arizona Watershed Council | 11 Show Low Creek |
| 3 Coconino Plateau Regional Water Study | 12 Upper Little Colorado River Partnership |
| 4 Little Colorado Multi-Objective Management | 13 Eagle Creek |
| 5 Upper Verde and Middle Verde Studies | 14 Upper Gila |
| 6 Upper Hill Williams | 15 Lower San Pedro |
| 7 Upper Bassayampa | 16 Middle San Pedro |
| 8 Upper Agua Fria | 17 Upper San Pedro Partnership |
| 9 Northern Gila County Water Plan Alliance | |

Source: Arizona Department of Water Resources

⁵ See "Managing to Avoid Crisis: A Look at Water Management Efforts in Rural Arizona" by Sharon Megdal, Ph.D. and Jackie Moxley, *Arizona Review*, Fall 2003, <http://www.ag.arizona.edu/AZWATER/presentations/crisis-n.pdf>.

continue to require research and development of treatment and/or mitigation strategies. Optimal utilization of effluent is an important component of research efforts and infrastructure planning. Water security is of concern to all. Arizona shares a border with Mexico, so international issues related to water quantity and quality must be addressed. Arizona is home to several Indian Nations. Although several Indian water rights claims have been settled, some major settlements are awaiting development or approval. The adjudication of rights to surface water continues to employ the services of many attorneys. Determining the groundwater-surface water interface has significant implications for water planning. Environmental concerns, including those related to the Endangered Species Act, require significant attention. Examination of implications of long-term, large scale water storage, as well as the recovery of the stored water, is ongoing.

Concluding Remarks

Sustainable water supplies are necessary to support Arizona's economic vitality and its natural beauty. Arizona has long been an innovator in groundwater management. Since 1980, the state has introduced important programs to reduce reliance on groundwater in the Active Management Areas, where groundwater overdraft was of critical concern. Since adoption of the Groundwater Management Act, the state population has more than doubled to over 5.6 million people.⁶ Population growth is expected to continue at a rapid pace. The challenges of securing sustainable water supplies for the state will, therefore, require the attention and ingenuity of water professionals, policy makers, and researchers and analysts of many disciplines.

⁶ The July 1, 2003 official state estimate of Arizona's population is 5,629,870. Source: Population Statistics Unit, Arizona Department of Economic Security, http://www.workforce.az.gov/admin/uploadedPublications/999_03-00alphanew.pdf and Arizona Department of Commerce, <http://www.commerce.state.az.us/prop/eir/popanddemo.asp>.