CHAPTER

8

Augmentation and Recharge Program

8.1 INTRODUCTION

The purpose of the Augmentation and Recharge Program is to encourage the development, delivery, use, and storage of renewable water supplies now and in the future. The Augmentation and Recharge Program, in combination with conservation program efforts, is intended to support achievement of the safe-yield management goal for the Phoenix Active Management Area (AMA). Increasing the use of renewable supplies, particularly Central Arizona Project (CAP) water and effluent, to replace groundwater mining is a key component of achieving safe-yield.

For purposes of this chapter, "augmentation" means increasing the availability and use of renewable water supplies such as CAP and effluent in lieu of groundwater. "Recharge" means storage of water supplies for future use pursuant to the Underground Water Storage, Savings and Replenishment Act.

Although safe-yield remains the Phoenix AMA groundwater management goal, the objectives of the Augmentation and Recharge Program in the third management period reflect an increased awareness and improved understanding of the importance of water management on a smaller scale. An AMA-wide "paper balance" between supply and demand for groundwater does not address local concerns regarding groundwater level declines and subsidence, waterlogging, physical availability problems, and poor groundwater quality, because it allows for substantially variable water level conditions in the AMA. The Third Management Plan incorporates a new focus on water management by taking these site-specific or "critical areas" into consideration, and looks for solutions to the problems where possible.

Conservation activities will continue to play an important role in achieving safe-yield by ensuring the efficient use of the finite groundwater resources of the AMA. However, the augmentation and recharge of renewable water resources will be the principal mechanism by which the AMA can meet its safe-yield and subregional goals. Through its Third Management Plan Augmentation and Recharge Program, the Arizona Department of Water Resources (Department) will use the authorities available to facilitate and encourage the development, efficient use, and recharge of renewable water supplies for the AMA, especially in critical areas.

The state's Recharge Program, authorized under the Underground Water Storage, Savings and Replenishment Act (Arizona Revised Statutes, Title 45, Chapter 3.1), is an important tool in the Third Management Plan Augmentation Program. While the development and direct use of renewable water supplies is an important component of the Augmentation Program during the third management period, the Recharge Program provides a cost-effective means of storing water that is currently available to the AMA but that has no direct use. Additionally, the Recharge Program can be an effective tool in helping to mitigate problems associated with critical areas, depending where storage and recovery occur.

One of the most important factors that will shape the Augmentation Program for the third management period is the unique opportunity to bring excess CAP water into the AMA and store it underground for future use. A substantial supply of CAP water is physically available to augment the AMA's water supply during the third management period, but will be fully utilized at some point in the future. Therefore, taking advantage of this supply and storing it now while it is currently available is an opportunity that must be encouraged to the fullest extent possible. The Arizona Water Banking Authority (AWBA) provides the means to purchase and store CAP water that is not currently economically feasible for direct use, and that would otherwise remain along the Colorado River. Furthermore, the AWBA statutes specify that some of this water may be used "to fulfill the water management objectives" of the Groundwater Code (Code). Taking advantage of this opportunity now while excess supplies are available will be a significant component of the Augmentation Program for the third management period to meet safe-yield and to alleviate some of the problems in critical areas.

While the Department will work with the AWBA to augment the AMA's water supplies for water management purposes, the Department recognizes that the principal responsibility for developing additional water supplies remains with the region's water users. Local water users have invested millions of dollars in the treatment facilities necessary to put CAP water to direct use. Additional investments have been made in treating effluent to high quality standards. Still additional investments have been committed or used to construct storage facilities for both CAP water and effluent so that water supplies not currently put to direct use can be stored for use in the future. The Department will continue to work with the local community during the third management period to encourage these activities and to facilitate them where possible. The Department has limited authority to address water management and augmentation issues that face the AMA. The current scope of the Department's authorities and activities in augmentation and recharge includes the following:

- Statutory roles. The director of the Department is statutorily designated as the representative of the State of Arizona in Colorado River and interstate water issues; advisor to the Secretary of the Interior (Secretary) in allocating water among users; coordinator of Arizona's review and comments on water development proposals by the United States Army Corps of Engineers, Secretary, and Secretary of Agriculture; chairperson of the AWBA; and manager of the state's water rights to ensure achievement of water management objectives.

- Regulatory and permitting authority. The Department's regulatory and permitting authority regarding use of water rights and development of underground storage and recovery projects ensures that these uses of water are consistent with water management objectives.

- Regulatory incentives. Regulatory incentives established in the agricultural, municipal, and industrial conservation programs (chapters 4, 5, and 6, respectively) and the Department's Assured Water Supply Rules (AWS Rules) facilitate the implementation of augmentation activities by water users.

- Staff support to the Arizona Water Banking Authority and the Arizona Water Protection Fund. The Department's staff assists the AWBA and the Arizona Water Protection Fund (AWPF) Commission in carrying out their mandates. Both entities are operated in close coordination with Departmental activities.

- Technical and planning assistance. The Department provides technical assistance by reviewing and providing input on proposals for water augmentation and recharge projects, planning and feasibility studies, project operations, and data interpretation.

- Data management and public information. The Department's responsibility for accumulation and dissemination of water use and water supply data provides the information necessary to develop water management plans, implement augmentation projects, conduct research related to increasing available water supplies, and identify areas requiring additional water management.

- Coordination and facilitation of efforts. The coordination and facilitation of augmentation and recharge activities, particularly between jurisdictions and multiple regulatory agencies, are an important component of the Department's statewide and regional water planning responsibilities.

- Financial assistance. The augmentation and conservation assistance fund, as well as specifically budgeted appropriations, provide financial assistance to entities implementing augmentation projects or studies that contribute to achieving the AMA management goal or resolving regional water management issues.

The Department is mindful that, in these early years of CAP water importation, water appears to be plentiful. Indeed, the Phoenix AMA is fortunate to have renewable water resources available to meet the growing demand of its water users. It must be recognized, however, that the CAP represents the last significant new supply of water for the Phoenix AMA for the foreseeable future. It must be used wisely so that the greatest possible use can be made of this and all our water resources. Wasteful uses of water, which will not be sustainable as water becomes scarce in the AMA, should be discouraged. The need to encourage the efficient use of renewable water resources will also shape the Augmentation Program for the third management period.
The remainder of this chapter will more fully describe these considerations and will explain the Augmentation Program for the Phoenix AMA for the third management period in the order listed below:

- An assessment of the groundwater supplies in the AMA
- An assessment of the renewable water supplies that are available to augment the AMA's water supplies
- An assessment of the Augmentation Program in the Second Management Plan
- An assessment of water management issues facing the Phoenix AMA
- The Third Management Plan Augmentation Program goals and objectives
- The Third Management Plan Augmentation and Recharge Program
- Future directions

8.2 PHYSICAL ASSESSMENT OF THE ACTIVE MANAGEMENT AREA

Attaining the safe-yield goal will not necessarily eliminate water supply problems facing the Phoenix AMA water users. Different localities within the AMA have very diverse water supply problems, including groundwater declines and other physical availability problems, subsidence and earth fissuring, poor groundwater quality, and waterlogging. These varied physical conditions and resulting impacts to AMA residents demonstrate a need to develop a subregional management strategy during the third management period.

8.2.1 Groundwater Overdraft

In 1995, groundwater use in the Phoenix AMA was 946,052 acre-feet. This amount is 41 percent of the total demand for water in the AMA. In the same year, "safe-yield recharge" was estimated to be approximately 586,033 acre-feet. Therefore, in 1995, approximately 360,019 acre-feet more water was withdrawn from the AMA's aquifers than returned. Thus, the Phoenix AMA has been using groundwater at more than one and one-half times the rate of aquifer replenishment. (See Table 11-12.)

Projections, based on current use scenario demands, by the Department indicate that the AMA's overdraft will increase to 471,085 acre-feet by 2025. Simultaneously, however, the AMA's population is projected to almost double, from 2.55 million in 1995 to 4.48 million in 2025. The dependability of our water supplies will be crucial as the population grows. (See Table 11-12.)

8.2.2 Local Areas of Drawdown

Groundwater conditions have changed dramatically in the Salt River Valley since 1900 due to an increase in agricultural pumping as described in Chapter 2. As a result, the five areas within the Phoenix AMA have or are experiencing significant drawdown of local water tables. (1) The West Salt River Valley (West SRV), including the areas of Luke Air Force Base, El Mirage, Surprise, and Sun City/Sun City West has experienced water level declines between 300-350 feet. (2) The northeast Phoenix and north Scottsdale water table has declined approximately 300 feet. (3) An area along the Mesa-Apache Junction border has experienced water level declines of more than 350 feet. (4) The Queen Creek area near the San Tan Mountains has had declines up to 400 feet. (5) The Carefree Subbasin has experienced water level

declines exceeding 10-12 feet per year due to growth and development since the 1960s (see Chapter 2, Figure 2-4).

Since 1992, the AMA has seen some improvements in water table elevations valley-wide in the range of 20-120 feet. These improvements are likely due to incidental recharge and artificial recharge, a decline in agricultural pumping, an increase in in-lieu water use, and higher than average stream bed recharge due to precipitation. Certain localized areas dependent on groundwater pumping, however, continue to experience declining water tables (see Figure 8-1).

8.2.2.1 Projected Water Level Trends

While excessive historic groundwater level declines are associated with current problems in regions of the AMA, it is also the rate at which the declines are projected to occur that can increase the cost and reliability of future groundwater supplies. Exacerbating these problems are the regulatory authorities that allow groundwater mining by residual pumpers to continue. This section summarizes the decline projections in the AMA and frames the regulatory problems that contribute to these projections.

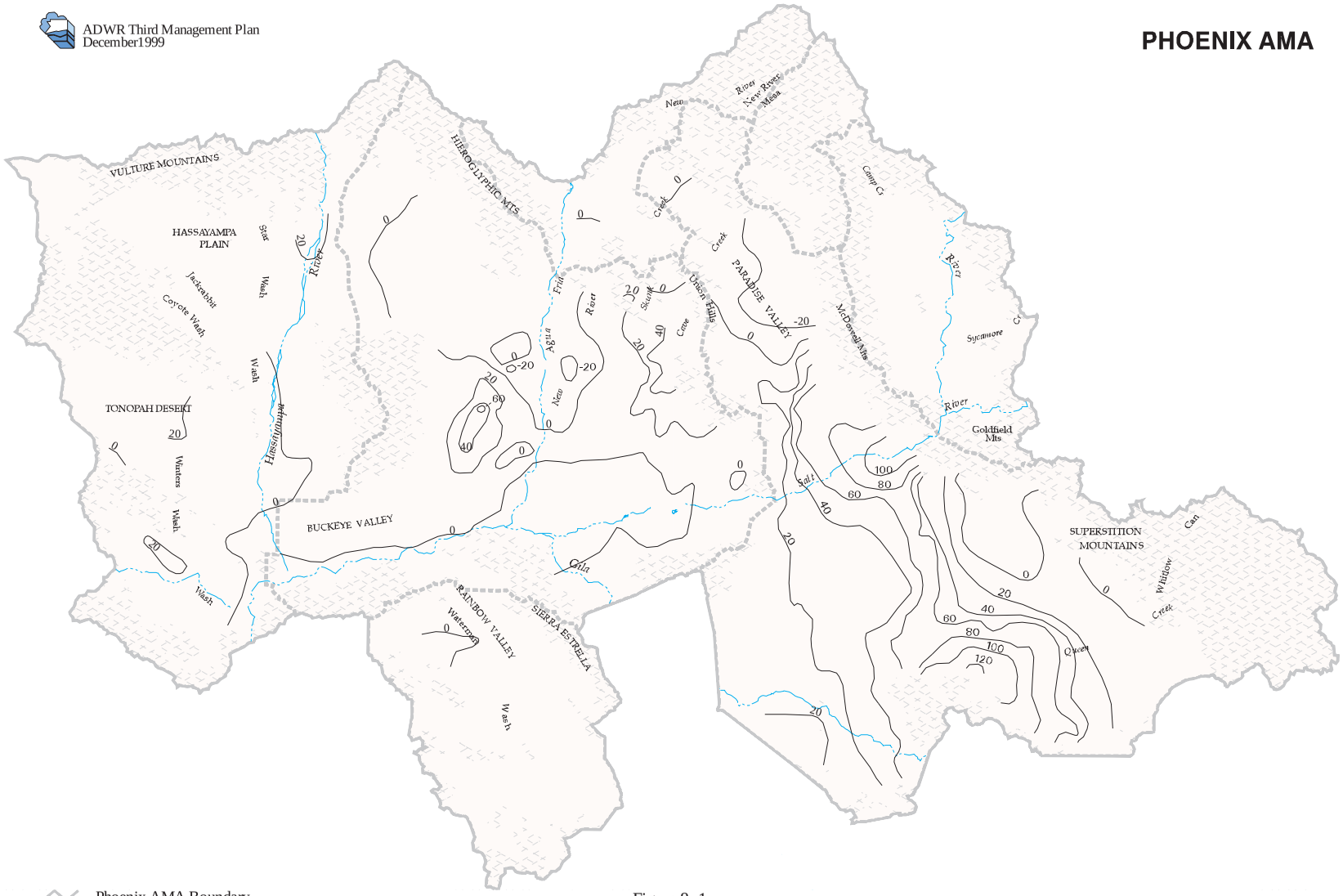
The Department, through its regional groundwater flow model of the Salt River Valley, has projected water level trends into the future based on extensive data gathered from municipalities, irrigation districts, and water companies, and annual water use data collected by the Department. The model projects maximum decline rates to the year 2025 of up to eight feet per year within the West SRV, particularly in the Sun City West area. Decline rates for other areas in the West SRV, including Surprise, El Mirage, Peoria, Youngtown, and a portion of Glendale, are projected to be a maximum of seven feet per year, and projected decline rates in the extreme north Scottsdale area are up to eight feet per year. While these projections to the year 2025 are significant, they do not account for designated providers depleting their respective groundwater allowance accounts beyond 2025, which will further impact the decline rate.

Future trends in water level declines relate to the withdrawal authorities established in the Code as well as groundwater use allocations under the AWS Rules. Existing water right allocations (irrigation grandfathered rights, Type 1, and Type 2 non-irrigation grandfathered rights) and withdrawal permit volumes alone exceed natural and incidental recharge by a factor of about 2.9 in the Phoenix AMA. Although state law mandates no new land be brought into agricultural production in the AMA, agricultural groundwater use may increase if more of the acreage associated with existing water rights is farmed. Industrial water users may acquire new groundwater withdrawal permits (e.g., General Industrial Use permits), may obtain Type 1 non-irrigation grandfathered rights through the conversion of agricultural rights, and may obtain, through purchase or lease, currently unused non-irrigation grandfathered rights to pump groundwater.

Of the agricultural, industrial, and municipal sectors, only new municipal use is legally required to utilize renewable supplies through acquisition of an assured water supply designation or Certificate of Assured Water Supply (Certificate of AWS) for the future. Because all new subdivisions must demonstrate the use of renewable supplies (through direct use or storage and recovery) or join the Central Arizona Groundwater Replenishment District (CAGRD) so that their groundwater pumping will be replenished, most municipal water use will gradually transition to renewable supplies. The transition is an important strategy in reducing the long-term reliance on groundwater. However, it does not reduce the fact that a significant amount of groundwater will be allowed to be pumped under the Assured Water Supply Program (AWS Program), which will further affect groundwater levels and the rates of decline in the AMA. Even at safe-yield, the water levels could be hundreds of feet lower than at present (to a maximum of 1,000 feet below land surface for pumping by designated providers, or lower for non-designated providers and other groundwater users outside of designated service areas).

ADWR Third Management Plan
December1999

PHOENIX AMA



Phoenix AMA Boundary
Water Elevation Change Isolines (Feet)
- 20 Water Level Decline
20 Water Level Rise
Hardrock
River
Grounwater Subbasins

Figure 8- 1

Water Elevation Change
1992 - 1998

0 3 6 9 12
Miles
North

ORIGINAL SOURCE
Arizona Department of Water Resources
Hydrology Division

Therefore, assuming that conservation opportunities are limited, water supply augmentation, retirement of existing rights, and management of new uses are needed to mitigate the groundwater overdraft. These measures could also address severe trends in groundwater level declines in certain parts of the AMA, which could lead to the further potential for degrading water quality, increased pumping costs, and subsidence.

8.2.3 Subsidence and Earth Fissures

As described in Chapter 2, subsidence and earth fissures are occurring in three areas of the AMA (see Figure 8-2). The most notable area is near Luke Air Force Base, where over 18 feet of subsidence reversed the gradient of the Dysart drain and reduced its carrying capacity from 1,000 cubic feet per second to 300 cubic feet per second (Hoff, 1998). Costs were incurred associated with flooding, as well as the repair of various water, wastewater, storm water infrastructures, and hospital and housing facilities. Additional costs to repair, design, and make improvements to the Dysart drain, including, but not limited to, replacing bridges, excavating a new drainage channel, and replacing concrete channel lining to account for additional subsidence until the year 2035 have cost taxpayers approximately $22 million (Wachter, 1997).

Eliminating the withdrawal of groundwater is the only way to prevent subsidence from occurring. However subsidence can continue for years after groundwater pumping has stopped in subsidence-prone areas (Slaff, 1993). Compounding the potential for damage in the AMA is the fact that rapid urbanization is now occurring in many areas where significant future subsidence and earth fissuring is anticipated and groundwater level declines as much as 700 to 800 feet are projected. These areas include Apache Junction, the northwest Salt River Valley Subbasin, Queen Creek, and east Mesa, in addition to currently urbanized areas like Paradise Valley where earth fissuring has already occurred.

Supporting the use of renewable supplies to replace groundwater pumping and increasing underground storage of those supplies (especially at groundwater savings facilities) in areas where future subsidence and earth fissures are predicted will be a strategy to consider in addressing this very serious water management objective in the third management period.

8.2.4 Areas Lacking Physical Supplies

The communities of Carefree, Cave Creek, and Apache Junction have undergone, or are projected to undergo, extensive growth. All groundwater in these areas has been fully pledged for existing and committed demand under the AWS Program and the communities are now limited in their ability to grow unless non-groundwater supplies are acquired. Other areas in the AMA may become problematic in the future as well, such as in Scottsdale and Peoria.

The problems associated with areas having fully committed supplies relates to one of the guiding principles described in Chapter 1. Ensuring reliable amounts of good quality water at a reasonable price is more difficult as water levels decline, groundwater pumping costs increase, and water quality worsens. Adverse impacts on both water quality and economic development in these areas as a result of limited supplies must be avoided to the greatest extent possible. Greater use of renewable supplies instead of groundwater pumping should be encouraged where possible.

8.2.5 Waterlogged and Shallow Groundwater Areas

In contrast to the areas of the AMA experiencing a physical shortage of groundwater, the area of the West SRV in the vicinity of the Buckeye Irrigation Company, the St. Johns Irrigation District, and the Arlington Canal Company is experiencing extremely shallow depths to groundwater, as has been described in Chapter 2, section 2.3.10.

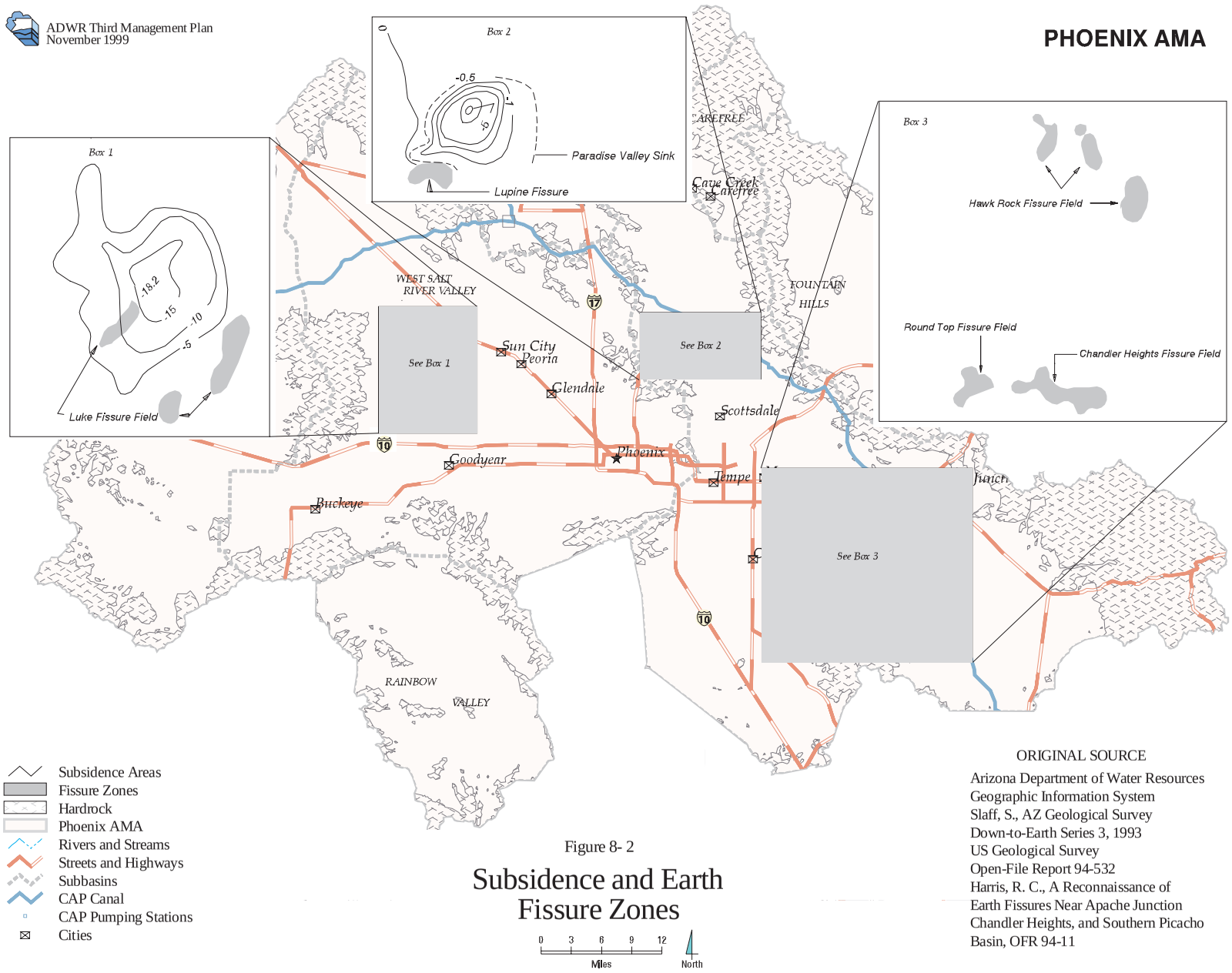


Figure 8- 2

Subsidence and Earth Fissure Zones

ORIGINAL SOURCE

Arizona Department of Water Resources
Geographic Information System
Slaff, S., AZ Geological Survey
Down-to-Earth Series 3, 1993
US Geological Survey
Open-File Report 94-532
Harris, R. C., A Reconnaissance of
Earth Fissures Near Apache Junction
Chandler Heights, and Southern Picacho
Basin, OFR 94-11

Waterlogging has occurred in this area as far back as 1927, when the construction of a nine-mile drainage system was first required (Halpenny, 1984). Since that time, dedicated drainage wells have been operating to remove nuisance groundwater where it is then conveyed to the Gila River via the drainage channels (Montgomery, 1988).

In addition to this area of the West SRV, small localized areas having high water levels in other parts of the AMA, such as in central Phoenix, have needed emergency temporary dewatering to make the desired use of commercial property feasible.

Between 1969 and 1986, drainage pumping totaled 270,775 acre-feet (Montgomery, 1988). This averages approximately 15,000 acre-feet per year. Between 1990 and 1995, drainage and temporary dewatering due to shallow water level conditions exceeded 71,000 acre-feet and averaged approximately 12,000 acre-feet per year. Most of these supplies were not put to direct beneficial use.

8.2.6 Summary

The physical assessment of the Phoenix AMA emphasizes that overdraft of the AMA's aquifers is projected to increase between now and 2025, and shows the severity of local groundwater conditions in several areas of the AMA. At least five localized areas of the AMA, which include areas of the West SRV, north Phoenix and north Scottsdale, Carefree, eastern Mesa, western Apache Junction, and Queen Creek, have experienced significant drawdown of their water tables. In a number of these areas, drawdown is projected to continue at a high rate. A number of these areas have also experienced physical damage to the land surface and infrastructure from subsidence related to the dropping water tables. In some areas of the AMA, physical groundwater supplies for assured water supply purposes are fully pledged. In contrast, areas of the West SRV are experiencing difficulties caused by waterlogging and shallow groundwater. In designing and implementing the AMA's Augmentation and Recharge Program to achieve safe-yield, the Department is considering ways in which the program can also begin to address these localized water management concerns.

8.3 RENEWABLE WATER SUPPLIES ASSESSMENT

The Phoenix AMA has been favored geographically with renewable surface water resources. The confluences in the AMA of the Salt, Verde, Agua Fria, and Gila Rivers have provided the AMA with regular sources of water from the rain and snowfall in the mountains north and east of the desert valley.

Recently, the completion of the CAP has made a significant volume of the state's 2.8 million acre-foot per year allocation of Colorado River water physically available to central Arizona and the Phoenix AMA. This additional renewable supply will play a key role in meeting the future water needs of the AMA, especially while excess CAP water is available through the third management period.

Effluent is the third, and ever increasing supply of renewable resources available to the AMA. Putting more effluent to use will allow the AMA to use its groundwater, surface water, and CAP water multiple times, making those supplies more valuable.

These supplies of renewable water, particularly the unfulfilled potential of CAP water and effluent, can address the AMA's over-dependence on finite groundwater resources and are described herein. To the extent these supplies are not currently being put to direct use but are being stored underground is also described in this chapter in the recharge inventory (section 8.3.4).

8.3.1 Central Arizona Project Water

CAP water has been available to the Phoenix AMA since 1985. Although Colorado River water delivered through the CAP canal has already augmented the AMA's water supplies, the CAP has not yet achieved its full potential benefit in the AMA.

Most of the CAP's water has already been allocated among three user groups–Indian communities, the non-Indian agricultural sector, and the municipal and industrial sectors. Table 8-1 shows the CAP allocations among water providers and Indian Communities. Table 8-2 shows the CAP allocations to irrigation districts in the Phoenix AMA. In the Phoenix AMA, a volume of more than 312,000 acre-feet per year has been allocated among the municipal and industrial sectors. An additional volume of 262,200 acre-feet per year has been allocated among Indian communities for both municipal and agricultural use. This amount includes 173,100 acre-feet per year allocated to the Gila River Indian Community, which has lands both in the Phoenix AMA and the Pinal AMA. Additional Indian settlements have resulted in rights to CAP water by the Fort McDowell Indian Community and the Salt River Pima-Maricopa Indian Community (SRPMIC). The Fort McDowell settlement includes 18,233 acre-feet of CAP water that may be leased for up to 100 years off-reservation within Pima, Pinal, and Maricopa Counties. Of that amount, 4,300 acre-feet has already been leased to the City of Phoenix. The SRPMIC settlement agreement provided for a 99-year lease to Phoenix AMA cities (commencing in the year 2000) of its 13,300 acre-feet CAP allocation. The Ak-Chin Indian Settlement allows for the lease of its 75,000 acre-foot entitlement to users within the Phoenix, Tucson, or Pinal AMAs, of which 10,000 acre-feet has been leased to the Del Webb Corporation in the Phoenix AMA. Additionally, the San Carlos Apache Tribe may lease its 64,135 acre-foot entitlement of CAP water to users in Pima, Maricopa, and Pinal Counties. Finally, the Yavapai-Prescott Indian Tribe was authorized to market its 500 acre-foot CAP allocation to the City of Scottsdale.

Agricultural CAP use was relatively small in the early 1990s, ranging from a high of over 72,000 acre-feet in 1990 to a low of 5,480 acre-feet in 1993. Therefore, the Central Arizona Water Conservation District (CAWCD), the managing entity of the CAP canal, established an incentive pricing program for non-Indian agricultural CAP water, beginning in 1994 and ending in 2011, to encourage greater direct use of these supplies. This restructuring program was established primarily to deal with the inability of the irrigation districts in the Pinal and Phoenix AMAs to meet their obligations to CAWCD under their CAP subcontracts. In exchange for waiving their entitlement to CAP water under their subcontracts, the irrigation districts would receive excess and surplus CAP water. The program, called "target pricing," created three pools of agricultural supplies to be available to the Phoenix, Pinal, and Tucson AMAs. Pools 1 and 2 each contain a total of 200,000 acre-feet, whereas the amount in Pool 3 is not capped. Pool 1 was made available to each district that executed a CAP subcontract prior to October 1, 1993. Pool 2 water was made available to non-Indian irrigation subcontractors who relinquished part or all of their original entitlement between October 7, 1993 and January 1, 1994. The Phoenix AMA pool water allocations are also shown in Table 8-2. Pool 3 water consists of agricultural water remaining after sales of Pools 1 and 2 and is available to agricultural entities otherwise eligible to receive CAP water service at a price equal to pumping energy costs plus a capital charge.

The benefits of target pricing are twofold. First, CAWCD and the Department require the irrigation districts to use the low cost pool water prior to taking any in-lieu water if the district is a groundwater savings facility (GSF). This benefits water management efforts by ensuring that a portion of the agricultural water demand is met with CAP water and not with groundwater– groundwater that is either pumped today or the future pumping of long-term storage credits. Second, no interest is due on the total federal repayment obligation of the CAP canal for water supplied to agricultural lands. Therefore, the more CAP water, including Pool water, used on agricultural lands, the less the overall repayment debt becomes.

TABLE 8-1
CENTRAL ARIZONA PROJECT ALLOCATIONS, 1998
PHOENIX ACTIVE MANAGEMENT AREA

Subcontracts	Allocation (acre-feet)
Municipal and Industrial Subcontracts	
Arizona Water Company - Apache Junction	6,000
Arizona Water Company - White Tanks	968
City of Avondale	4,746
Berneil Water Co.	200
Brooke Water L.L.C.	3,932
Town of Buckeye	25
Carefree Water Company	400
Cave Creek Water Company	1,600
City of Chandler	3,668
Chandler Heights Citrus Irrigation District	315
Chaparral City Water Company	6,978
Citizens Utilities - Agua Fria Division	1,439
Citizens Utilities - Sun City Water Co.	16,215
Town of Gilbert	7,235
City of Glendale	14,183
City of Goodyear	3,381
Litchfield Park Service Company	5,580
Maricopa County Parks and Recreation Department	665
City of Mesa	34,888
New River Utility Company	1,885
Paradise Valley Water Company	3,231
City of Peoria	18,709
City of Phoenix	113,914
Phoenix Memorial Park	84
Queen Creek Water Co.	348
Rio Verde Utilities, Incorporated	812
San Tan Irrigation District	236
City of Scottsdale	45,297
Sunrise Water Company	944
City of Surprise	7,373
City of Tempe	4,315
Water Utilities Community Facilities District	2,919
Water Utility of Greater Buckeye	43
Water Utility of Greater Tonopah	64
West End Water Company	157
SUBTOTAL	**312,749**
Indian Subcontracts	
Ak-Chin	58,300
Fort McDowell	4,300
Gila River Indian Community	173,100
Salt River Pima-Maricopa Indian Community	13,300
Yavapai-Prescott	500
San Carlos Apache	12,700
SUBTOTAL	262,200

Source: CAP, 1998

[1] The original CAP allocation per the CAP Record of Decision was 58,300 acre-feet. The Ak-Chin Settlement Act allocated an additional 50,000 acre-feet of priority 3 water from the Yuma Mesa Division to the Ak-Chin Indian Community. The San Carlos Apache Settlement Act reallocated 33,300 acre-feet of the original CAP allocation for the Ak-Chin to the San Carlos Apache Tribe.

For 1998, costs of Pools 1, 2, and 3 were set at $31, $21, and $43 per acre-foot, respectively. The price of Pools 1 and 2 increases $1.00 per acre-foot annually and the price of Pool 3 will be determined annually.

TABLE 8-2
CENTRAL ARIZONA PROJECT ALLOCATIONS TO IRRIGATION DISTRICTS
PHOENIX ACTIVE MANAGEMENT AREA

I.D.	Original Allocation[1] (%)	Pool 1 Allocation[2] (%)	Pool 1 Supply (AF/YR)	Pool 2 Allocation[3] (%)	Pool 2 Supply (AF/YR)	Total Supply[4] (AF/YR)
CHCID	.28	.38	765	.52	1,037	**1,802**
Tonopah I.D.	1.98	1.11	2,217	1.50	3,005	**5,222**
San Tan I.D.	.77	.93	1,869	1.27	2,533	**4,402**
Queen Creek I.D.	4.83	6.65	13,113	8.88	17,770	**30,883**
New Magma I.D.	4.34	8.68	17,358	11.76	23,523	**40,881**
RWCD	5.98	7.60	15,205	0.00	0	**15,205**
TOTAL			**50,527**		**47,868**	**98,395**

Sources: CAP, 1994; CAP, 1998
I.D. = Irrigation District
CHCID = Chandler Heights Citrus Irrigation District
RWCD = Roosevelt Water Conservation District
[1] Allocation through 1993.
[2] Allocation from 1994 to 2011.
[3] Allocation from 1994 to 2003
[4] Pool 1 supply plus Pool 2 supply.

Table 8-3 summarizes the total amount of CAP water delivered to the Phoenix AMA through the second management period. These deliveries include CAP water delivered for direct use by agricultural, municipal, and industrial users and for recharge at both underground storage facilities (USFs) and GSFs.

TABLE 8-3
TOTAL CENTRAL ARIZONA PROJECT DELIVERIES (ACRE-FEET) 1990-1997
PHOENIX ACTIVE MANAGEMENT AREA

1990	1991	1992	1993	1994	1995	1996	1997
229,305	109,242	200,495	254,726	341,354	409,222	511,307	677,042

Source: CAP Annual Operations Summaries, 1990-1997

Table 8-4 compares the direct use of CAP water for the three water use sectors for the years 1990-1995. The volumes do not include CAP stored in the Phoenix AMA nor do they include contracts for direct delivery by non-regulated customers (i.e., golf courses that are not served by a city or that do not hold withdrawal authorities, etc.)

TABLE 8-4
SECTOR CENTRAL ARIZONA PROJECT USE COMPARISON (ACRE-FEET) 1990-1995
PHOENIX ACTIVE MANAGEMENT AREA

Sector	1990	1991	1992	1993	1994	1995
Agricultural	72,480	26,967	10,102	5,480	142,124	121,238
Municipal	150,827	74,187	92,223	111,476	143,419	151,791
Industrial	395	204	163	311	903	1,530
TOTAL	**223,702**	**101,358**	**102,488**	**117,267**	**286,446**	**274,559**

Although direct use of CAP water is expected to continue to increase during the third management period, full direct use of all CAP water available to the AMA is not expected, primarily due to the lack of infrastructure needed to directly deliver CAP water to the subcontractors. Adding to the unused supply, occasional declarations by the Secretary that surplus conditions exist on the Colorado River may, in some years, increase the amount of Colorado River water available to the state. Unused entitlement (either surplus supplies or subcontracted water that is not ordered and used, known as excess supplies) can be contracted on an annual basis to other users. This provides an opportunity for the AWBA, the CAGRD, and users who would like to order CAP water in excess of their contract to acquire CAP water. Figure 8-3 illustrates the projected excess supplies of CAP water, the mainstream Colorado River supply, and the CAP supply used. The unused entitlement is a temporary resource because, as the Colorado River becomes more heavily utilized, less excess water will be available. Therefore, a significant opportunity exists through the third management period to import into the AMA any CAP water that is available, and not used directly, for underground storage and future use.

Through 1996, many cities, towns, private water companies, and other entities had stored more than 500,000 acre-feet of CAP water for future use, as shown in Figure 8-5. In 1997, its first year of storage, the AWBA stored an additional 164,000 acre-feet of CAP water. These activities will continue to augment the AMA's water supplies during the third management period. As will be discussed later in this chapter, the powers and duties of the AWBA can be of particular use in addressing the AMA's augmentation needs and water management objectives through the storage of CAP water.

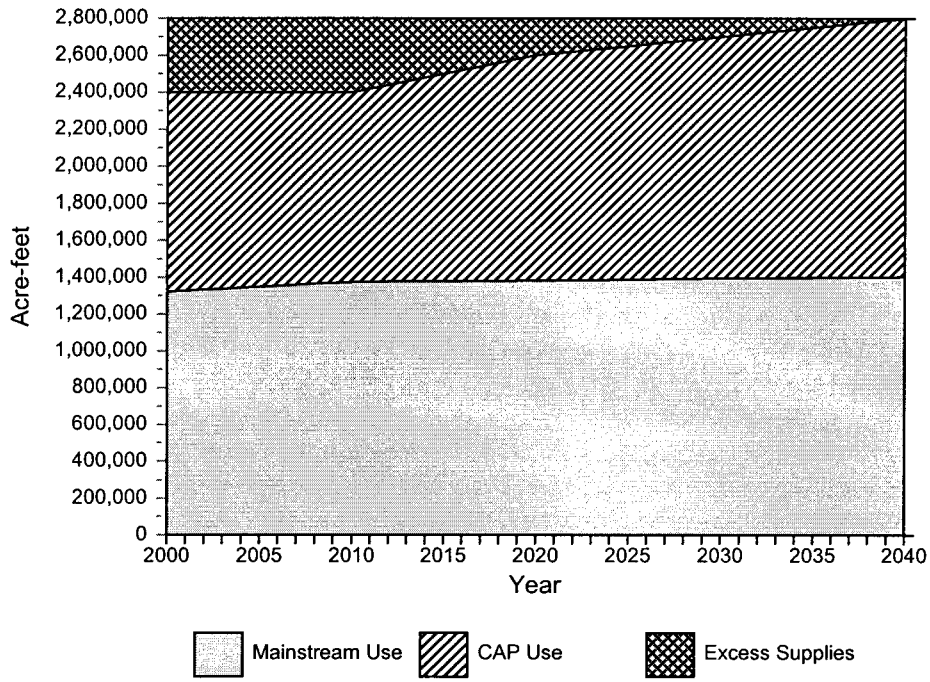
8.3.2 Effluent

Phoenix AMA cities, towns, and water companies have spent millions of dollars in investments to construct wastewater treatment plants and recharge facilities to use and store treated effluent in their service areas over the last decade. Although effluent use has increased during the second management period, the production of treated effluent has also increased with the population growth. Once the excess CAP water is gone, effluent will be our only available and increasing renewable future supply. Although direct human consumption of treated effluent is not expected during the third management period, the potential for greater use of effluent for other direct non-potable uses remains, as well as indirect potable uses through storage and recovery. Storage of effluent underground can improve its quality while preserving it in the AMA for future use. Direct use of effluent and its storage and recovery recycles our water supplies. When effluent is captured and reused, the original source water gets used more than once, and may cycle through the system multiple times prior to its full consumption. This increases the value of effluent as a resource in the Phoenix AMA.

Total effluent generated in the AMA is estimated to be 286,000 acre-feet per year. This figure is based on the 1995 AMA population of 2.5 million multiplied by an average 100 gallons of effluent produced per person per day. By the end of the third management period in 2010, over 374,000 acre-feet of effluent will

be generated per year based on a population of 1,395,725. The single largest use of effluent is 53,000 acre-feet per year used at the Palo Verde Nuclear Generating Station, followed by 30,000 acre-feet per year delivered to Roosevelt Irrigation District, and 30,000 acre-feet per year delivered to Buckeye Water Conservation and Drainage District.

FIGURE 8-3
PROJECTED EXCESS COLORADO RIVER SUPPLIES 2000-2040
STATE OF ARIZONA



The major single source of treated effluent is the 91st Avenue Wastewater Treatment Plant (WWTP). This facility has a capacity of 161.75 million gallons per day (MGD) with an expansion to 184 MGD planned, and has produced an average of approximately 142 MGD, or 159,060 acre-feet, of effluent per year since 1989. Currently all but approximately 53,000 acre-feet (used by Palo Verde Nuclear Generating station) is discharged to the Salt River downstream of the wastewater treatment plant. Natural recharge of the effluent occurs downstream of the treatment plant, which is also downstream from the majority of users in the Phoenix AMA. This discharge has created a riparian area that provides many benefits; however, much of this natural recharge contributes to the Buckeye waterlogged area, and approximately 53,000 acre-feet of the discharged effluent exits the AMA downstream of the 91st Avenue WWTP annually.

During the second management period, many alternatives to discharging effluent from the 91st Avenue WWTP to the Salt River were explored. The two alternatives remaining for the effluent under consideration are: (1) discharge to the Tres Rios constructed wetland and (2) recharge of the effluent into the groundwater aquifer alongside the Agua Fria River (Kinshella, 1998). Both alternatives together have the potential to provide many water management benefits to the AMA.

As shown in Table 8-5, many cities, towns, and private water utilities have constructed wastewater treatment plants within their service areas because they recognize the value of having a reliable water resource that will continue to grow, and remain within each city's control. It is likely that additional facilities will be needed to treat increased amounts of wastewater as the population grows. Placement of

these additional treatment facilities in areas where the effluent can be used within the AMA to offset groundwater use will be crucial to meeting the future water needs of the AMA.

TABLE 8-5
WASTEWATER TREATMENT PLANTS
PHOENIX ACTIVE MANAGEMENT AREA

Treatment Plant	Capacity (MGD)	Average Production (MGD)	Use of Effluent
Apache Junction	2.14	0.49	Stream Discharge
Avondale	3.50	1.80	Stream Discharge
Buckeye	0.60	0.29	Stream Discharge, Agricultural Use
Carefree/Boulders	0.16	0.11	Golf Course Irrigation
Cave Creek WWTP	0.27	0.05	Golf Course Irrigation
Chandler/Ocotillo WWTP	10.00	7.50	Recharge, Turf Irrigation, Cooling Water
Chandler/Lone Butte WWTP	10.00	7.50	Agricultural Irrigation
Sunshine Mobile Home Park	0.10	N/A	Landscape Irrigation
El Mirage WWTP	0.75	0.37	Golf Course Irrigation
Fountain Hills Sanitary District WWTP	1.20	1.19	Turf Irrigation, Fountain
Gilbert WWTP	7.00	5.15	Recharge, Turf Irrigation
Glendale/Arrowhead Ranch WRP	2.50	1.65	Lakes, Discharge to 91st Ave WWTP
Goodyear/157th Avenue	3.00	1.40	Recharge
Goodyear/Estrella	0.20	0.10	Stream Discharge, Proposed Golf Course Irrigation
Goodyear/Loral Defense System	0.45	0.11	Stream Discharge
Luke Air Force Base	1.20	0.55	Stream Discharge, Golf Course and Park Irrigation
Paradise Valley/Indian Bend Wash WRP	0.75	N/A	Flows to 91st and 23rd Avenue WWTPs
Peoria Beardsley WWTP	3.00	0.30	Recharge, Proposed Future Recreation or Irrigation
Mesa/Williams Air Force Base	1.00	0.23	Turf Irrigation

TABLE 8-5
WASTEWATER TREATMENT PLANTS
PHOENIX ACTIVE MANAGEMENT AREA

Treatment Plant	Capacity (MGD)	Average Production (MGD)	Use of Effluent
Mesa/Southeast WRP	4.00	1.97	Turf Irrigation
Mesa/Northwest WRP	8.00	3.60	Recharge, Stream Discharge
Phoenix/91st Avenue WWTP	161.75	142.00	Stream Discharge, Agricultural Irrigation, Palo Verde Nuclear Generating Station
Phoenix/23rd Avenue WWTP	63.00	60.00	Agricultural Irrigation, Stream Discharge
Queen Creek/Rancho Del Rey WWTP	0.02	N/A	N/A
Arizona Boys Ranch	0.02	0.01	Discharge to Leach Fields
Scottsdale/Gainey Ranch	1.70	1.00	Turf Irrigation
Scottsdale/Troon Village	0.40	0.13	Turf Irrigation
Scottsdale/Desert Mountain	0.06	N/A	Turf Irrigation
Scottsdale/Taliesin West	0.02	0.02	Landscape Irrigation
Scottsdale Water Campus	6.00	4.00	Turf Irrigation, Recharge
Sun City West (Citizens)	3.14	2.08	Recharge
Surprise/Litchfield Road WWTP	0.40	0.14	Turf Irrigation
South Surprise WWTP	3.20	1.20	Recharge, Agriculture, Irrigation
Tempe/Kyrene	3.00	1.06	Recharge, Turf Irrigation
Tolleson	17.50	9.30	Palo Verde Nuclear Generating Station

N/A = information not obtained
WWTP = Wastewater treatment plant
WRP = Wastewater reclamation plant
MGD = million gallons per day

Water exchanges have contributed to the increased direct use of effluent in the Phoenix AMA. The 1992 Water Exchange Act laid the legal framework for water exchanges, which has provided opportunities to manage renewable water supplies, including effluent, more efficiently. A three-way exchange between the City of Phoenix, Roosevelt Irrigation District, and the Salt River Project (SRP) has resulted in putting 30,000 acre-feet per year of effluent from the 23rd Avenue WWTP to beneficial use.

Four factors limit the ability to directly use all of the effluent generated in the Phoenix AMA. First, the quality of the effluent is insufficient to directly introduce it into potable water supply systems. Direct use, therefore, is limited to agricultural irrigation, turf watering, and some industrial applications. Second, users of effluent for agricultural irrigation and turf watering purposes have high summer and low winter water demands. However, effluent generation is directly related to indoor water consumption and tends to be higher in the winter months due to winter season visitors. Third, the effluent supply will exceed the demand for effluent for these purposes over time. Fourth, infrastructure is lacking to treat and deliver all the effluent supplies for direct use.

Groundwater recharge allows effluent to be stored during low demand periods and later recovered during high demand periods. Recharge also allows the possibility of indirect potable use of effluent through recovery wells. As of August 1998, there were nine full-scale USFs permitted to store over 33,000 acre-feet of effluent on an annual basis in the Phoenix AMA. Through 1996, a volume of over 47,000 acre-feet of effluent had been stored. See Appendix 8A for a listing of all storage facilities in the Phoenix AMA as of August 1998.

8.3.3 Surface Water

Surface water resources in the Phoenix AMA have historically met and continue to meet a large proportion of the demand for the municipal and agricultural sectors in the AMA. In 1995, use of water from the Salt, Verde, and Agua Fria River watersheds met 40 percent of the demand, over 889,000 acre-feet of water, in the AMA. Surface water supplies are not typically underutilized in the Phoenix AMA because they are an economical source, they are available in most years, and the demand of municipal and agricultural users is in close proximity to the surface water canals.

Salt River Project (SRP) facilities have a maximum reservoir storage capacity of over 2 million acre-feet of Salt and Verde River water. The amount of SRP surface water delivered each year depends on the amount of surface water in storage each year. When reservoirs are low, SRP supplements its surface water deliveries with groundwater to meet customer demand. SRP surface water use is based on decreed and appropriative water rights, and is available only to water users on SRP lands.

Many providers with rights to surface water utilize USFs and recovery wells to manage their surface water supplies. Appropriable surface water generally must be recovered within the same month it is stored. If stored and recovered in this manner, referred to as annual storage and recovery, it is considered a direct use of the supply. Through 1996, approximately 9,000 acre-feet of Salt and Verde River was put to use through annual storage and recovery activity.

8.3.3.1 Plan 6 Water

Plan 6 refers to the development of reservoir facilities for storing CAP water. Plan 6 included construction of New Waddell Dam on the Agua Fria River, modifications to Roosevelt Dam, and the proposed construction of Cliff Dam on the Verde River. The plans to construct Cliff Dam were halted in 1987 due to environmental concerns; however, Phoenix area cities were ensured by the Arizona Congressional Delegation and the Secretary that they would receive water supplies necessary to replace the additional resources that would have been provided by Cliff Dam. This was provided through the assignment of the Hohokam Irrigation and Drainage District agricultural subcontract to the cities in exchange for the payment of private and federal debts related to the district's distribution system.

Plan 6 water provides opportunities for additional surface water resources from the Agua Fria River and the Salt River to augment supplies in the AMA. Waddell Dam on the Agua Fria River was replaced by New Waddell Dam which has an increased storage capacity. The original dam and reservoir stored up to 150,000 acre-feet while the new dam and reservoir store up to 800,000 acre-feet (Maricopa Association of

Governments, 1993). Not only has this increased capacity allowed Colorado River water to be delivered into central Arizona for storage throughout the year (which was not possible previously), it resulted in additional appropriative rights to CAWCD of up to 698,800 acre-feet of Agua Fria River water captured by the increased storage capacity. The Maricopa Water District (MWD) retained the historical appropriative and storage rights associated with the original Waddell Dam.

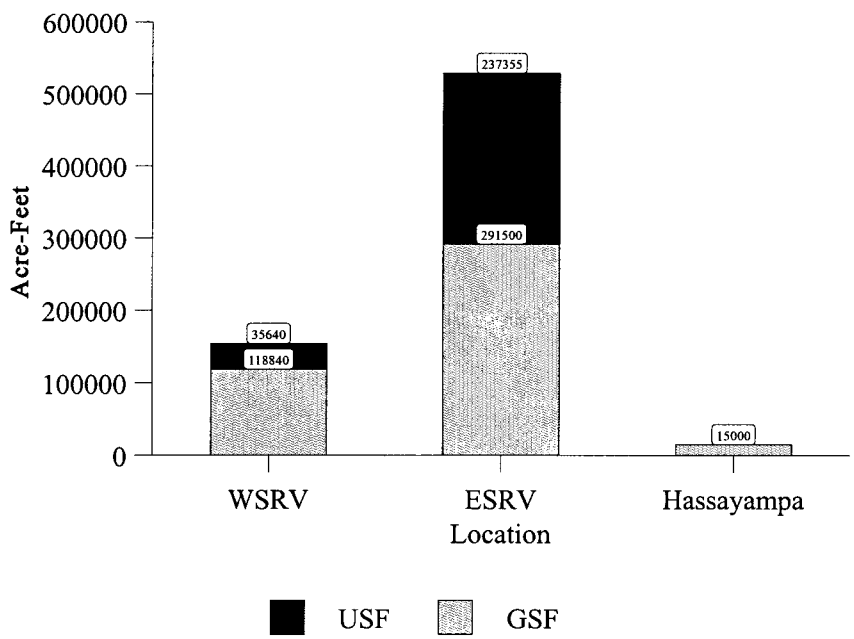
Plan 6 also included modifications to Roosevelt Dam on the Salt River. These modifications increased storage capacity in the reservoir by approximately 255,100 acre-feet, not including flood control space. The appropriative rights to the additional surface water captured by the modified dam were obtained for municipal use by the cities of Chandler, Glendale, Mesa, Phoenix, Scottsdale, and Tempe, who contributed funding toward the construction of the dam modifications. Unlike Salt and Verde River water, this Plan 6 water supply may be used off SRP member lands or recharged underground for long-term storage.

8.3.4 Recharge Inventory

Additional above-ground reservoirs to store renewable supplies are not planned for the foreseeable future; therefore, the greatest potential for increasing storage of these supplies in the AMA is in the development and full use of additional underground storage and savings facilities. Recharge facilities will play an important role in storing currently unused renewable water supplies for future use. Storing water in specific locations to prevent further declines and land subsidence, and also to protect water quality, as described in Chapter 7, are also important water management strategies for the third management period. The locations of current facilities and the siting of future storage facilities with respect to critical areas in the AMA play an important role in water management efforts.

The volume of water currently permitted to be stored at USFs and GSFs in the Phoenix AMA through the second management period exceeds 698,000 acre-feet per year. Figure 8-4 shows the total annual

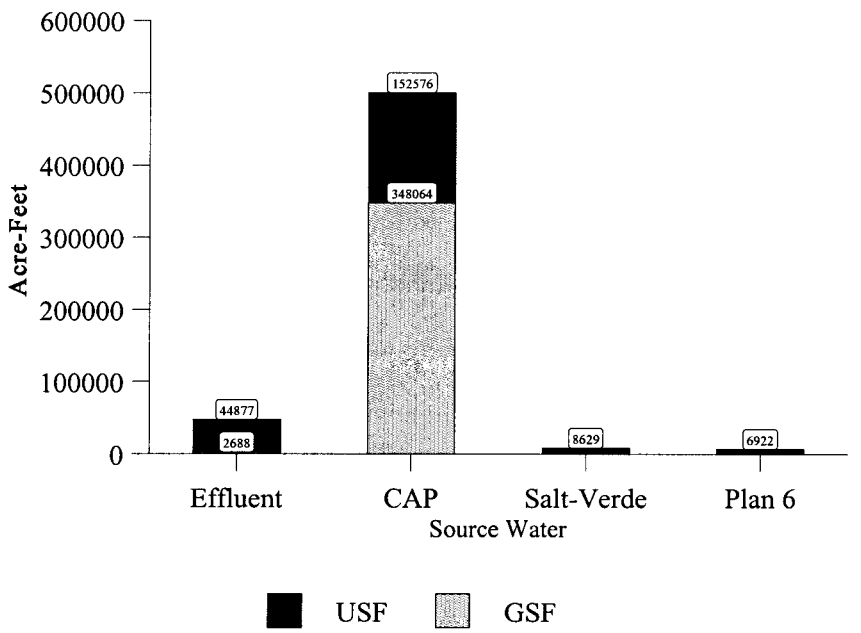
FIGURE 8-4
PERMITTED STORAGE VOLUMES
PHOENIX ACTIVE MANAGEMENT AREA



permitted volumes of facilities in the AMA for each subbasin, through 1996. While the potential storage capacity has grown in both the East and West Salt River Valley Subbasins, the discrepancy among the subbasins in terms of current permitted storage capacity is evident. It should be noted that the Carefree Subbasin, which has been identified previously with physical availability problems, has no storage facilities. Appendix 8A lists all the permitted storage facilities in the Phoenix AMA through the first quarter of 1998.

Figure 8-5 shows over 563,000 acre-feet of underground water storage that has occurred in the AMA through 1996. (These amounts are approximate and do not equate to recovery rights because evaporation, system losses, and other deductions from storage volumes have not been subtracted from these amounts.) The amounts also do not reflect the minimal amount of recovery that has occurred to date– less than 10,000 acre-feet, or approximately 1 percent of total storage.

FIGURE 8-5
TOTAL STORAGE VOLUMES THROUGH 1996
PHOENIX ACTIVE MANAGEMENT AREA



The location of permitted and proposed facilities, as of 1998, is shown on the map in Figure 8-6.

8.4 ASSESSMENT OF THE SECOND MANAGEMENT PLAN AUGMENTATION PROGRAM

The Code did not require the Department to include a water supply augmentation program in the Phoenix AMA's First Management Plan. However, the Code did require the Department to include such a program, including incentives for artificial groundwater recharge, in the Second Management Plan for each AMA. A.R.S. § 45-565(A)(6).

The Augmentation and Reuse Program in the Second Management Plan identified a number of augmentation measures designed to encourage and facilitate the augmentation of the AMA's water

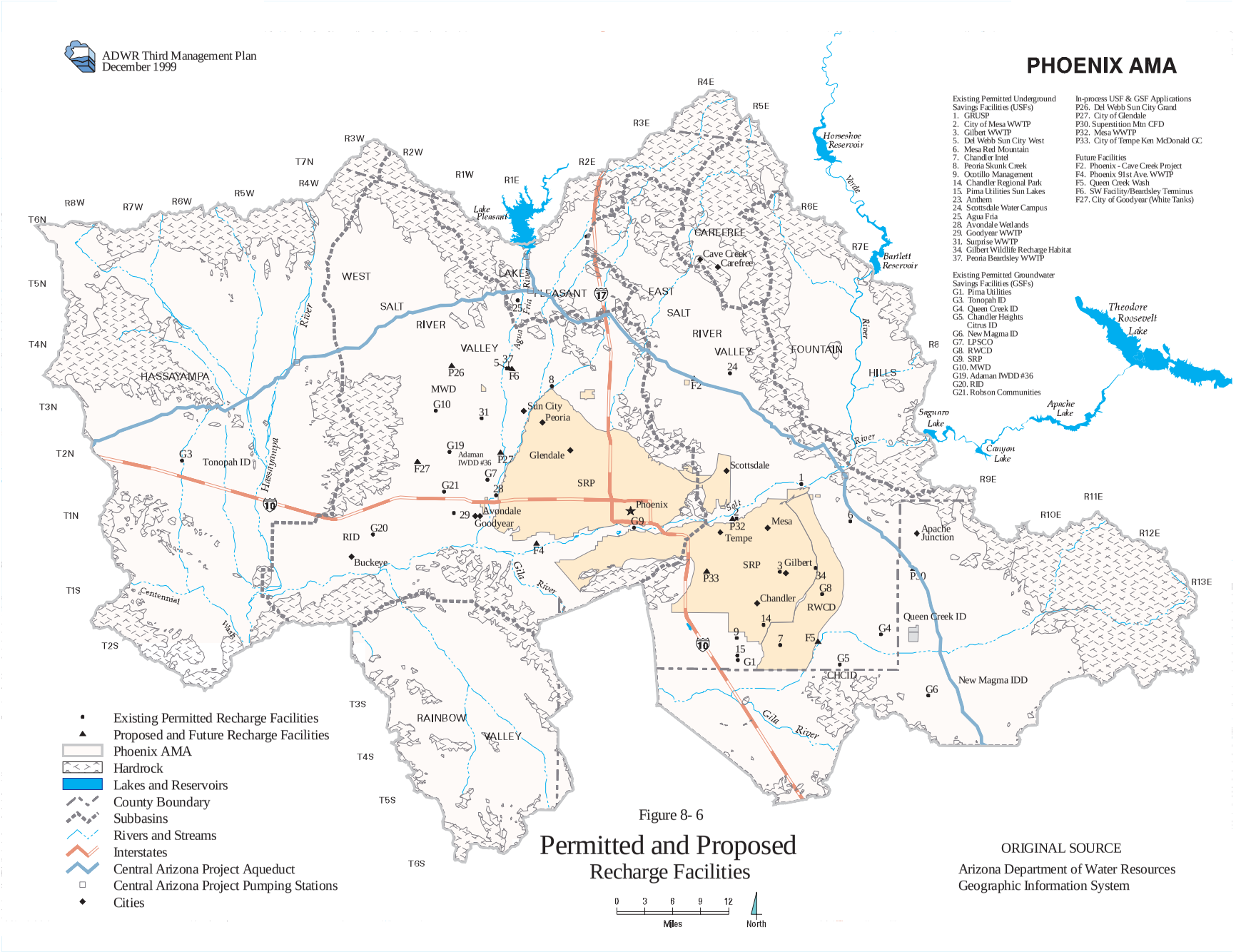


Figure 8- 6

Permitted and Proposed Recharge Facilities

supplies. They included watershed management, weather modification, water transfers, storm water runoff utilization, effluent reuse, maximizing the use of CAP and Plan 6 water, and underground water storage. During the second management period, some of the measures identified in the Second Management Plan were implemented. These few measures focused on increasing the use of renewable water supplies within the AMA and are discussed below.

The augmentation measures that were the most feasible for implementation were underground water storage, maximizing the use of CAP and Plan 6 water, and effluent reuse. In addition, provisions established in the First and Second Management Plan conservation programs for the agricultural, municipal, and industrial sectors; the Code; and the AWS Program provided incentives for water users to implement augmentation and reuse measures. In particular, the AWS Program provided the most direct regulatory requirements for using alternative water supplies for new municipal growth within an AMA. The measures not implemented will continue to be evaluated as future water augmentation alternatives.

8.4.1 Second Management Plan Program Goals and Objectives

The Second Management Plan Augmentation and Reuse Program goal was to develop additional water supplies and to increase the use of renewable water supplies in the Phoenix AMA for the purpose of attaining safe-yield. The program encouraged full utilization of CAP water and effluent to preserve groundwater for future uses in the AMA. To maximize the use of these water supplies, the program included provisions to incorporate recharge into plans for water supply development.

Six objectives were identified for the Second Management Plan Augmentation and Reuse Program. They were: (1) maximize the use of CAP allocations within the AMA; (2) utilize the CAP delivery system to the fullest extent possible to deliver "surplus" Colorado River water and other waters to the AMA; (3) maximize recharge of developed water supplies, including effluent, for the water that cannot be used directly; (4) generate additional water supplies within the state to maximize the benefit to the AMA of interregional water transfers and exchanges; (5) resolve technical, institutional, legal, and environmental constraints that inhibit the development and beneficial use of alternative water supplies; and (6) research and identify augmentation measures for future implementation.

8.4.2 Second Management Plan Program Implementation

The Second Management Plan Augmentation and Reuse Program included five main elements designed to assist water users in developing new water supplies to meet the objectives identified above: (1) regulatory incentives; (2) technical assistance; (3) coordination and facilitation of efforts; (4) resolution of legal and institutional barriers; and (5) implementation of the augmentation and conservation assistance fund. The Second Management Plan recognized that while the Department may provide incentives and coordination efforts, the principal responsibility for developing water supplies remains with the region's water users. Each element of the Second Management Plan Augmentation and Reuse Program is discussed below.

8.4.2.1 Second Management Plan Regulatory Incentives

Provisions established in the conservation programs of the Second Management Plan provided regulatory incentives for water users in the Phoenix AMA to augment their supplies, especially by encouraging the direct use of effluent. The overall effectiveness of these regulatory incentives, discussed in previous chapters of this management plan, has been limited. The principal reason for this lack of effectiveness is that the incentives have little or no impact on water cost or availability, which are the main factors in determining whether renewable supplies will be used instead of groundwater. Availability is especially critical in the case of effluent use. In older, developed areas of the Valley, only water users in close proximity to wastewater treatment plants are able to receive effluent for direct use because of limited existing distribution systems and the high cost of expanding these systems. The benefit of these incentives

did not offset higher water costs associated with converting to renewable supplies. However, providers serving newer growth areas in the AMA are incorporating more sophisticated effluent distribution systems from local plants to end users, and are storing and recovering effluent to take advantage of the incentives.

8.4.2.2 Technical Assistance Through the Second Management Plan

The Second Management Plan stated that the Department would support augmentation project construction, planning, and research activities during the second management period.

The Department provided technical assistance to water users by assessing the need for developing augmentation projects and determining their feasibility. Department staff also assisted with study, design, data collection, data analysis, and information dissemination.

Arizona's Legislature enacted House Bill 2239 in 1994, which authorized a water resources study for the West SRV to examine the state of the water resources and to facilitate long range water planning. The Department worked closely with Western Maricopa Coalition's Water Resources Committee and secured additional technical and financial assistance from the Bureau of Reclamation to complete the study using the Department's existing hydrologic flow model. The study included an inventory of available water resources, plans for the incorporation of CAP water, a range of water supply and demand scenarios, and an examination of potential recharge projects. All of this was done in coordination with area water users.

Additionally, the Department developed the hydrologic model for the East and West Salt River Valleys. This model has been a useful tool within the Department and with the regulated community in projecting water level trends associated with various groundwater pumping scenarios. The primary users of this information have been consultants representing various water providers, irrigation districts, and Indian communities. Requests for model data sets became so numerous that the Department has made them available through the Internet.

8.4.2.3 Coordination and Facilitation of Efforts During the Second Management Plan

Because cooperative efforts among government agencies, water users, and other groups allow the development of larger, more effective augmentation projects and studies, the Second Management Plan stated that the Department would work with organizations to coordinate and facilitate augmentation activities.

In 1992-93, the Department staffed extensive studies on the underutilization of CAP water in the state for the Governor's CAP Advisory Committee. These studies facilitated the establishment of incentive pricing of agricultural CAP water by CAWCD and the passage of legislation to address the underutilization problem.

Since passage of the Underground Storage and Recovery Act in 1986, the Department and the AMA have worked closely with water users to issue over 33 USF and over 68 water storage permits. This level of facilitation is critical, especially for storage facility permits, since applicants are required to submit substantial, often detailed information that must be reviewed by the Department.

In addition, in the early and mid-1990's, the Department coordinated a multi-agency research effort known as the Arizona Atmospheric Modification Program to assess the technical feasibility of using weather modification in the Verde River watershed to increase water supplies. The study confirmed that it is possible to accurately predict both the amount and distribution of precipitation resulting from cloud seeding.

8.4.2.4 Resolution of Institutional and Legal Barriers During the Second Management Plan

The Second Management Plan stated that the Department would work with interested parties in the AMAs and around the state to draft rules and to propose legislation that would resolve legal and institutional problems in developing large scale augmentation projects. This element of the Second Management Plan Augmentation Program may have been one of the most successful during the second management period. The following sections describe rules, legislation, and programs that have resulted from the efforts of the Department, water users, and other interested parties.

8.4.2.4.1 Assured and Adequate Water Supply Rules

In February 1995, the Department adopted new rules for its Assured and Adequate Water Supply Program, which requires new subdivisions to use renewable supplies and provides a critical incentive for underground storage of unused supplies for future use.

8.4.2.4.2 Central Arizona Groundwater Replenishment District

The establishment of a replenishment entity in the AMA is closely tied to the AWS Program. In 1993, the Legislature authorized CAWCD to undertake replenishment activities that allow municipal providers and new subdivisions who wish to obtain Designations of Assured Water Supply (Designation of AWS) or a Certificate of AWS to become members of the CAWCD replenishment authority, known as the CAGRD. By joining the CAGRD and pledging to finance the replenishment of groundwater used in excess of the amount allowed by the AWS Rules, members can use groundwater for new development and legally meet the assured water supply provisions, which requires that projected water use of new development be consistent with the achievement of the AMA's management goal.

8.4.2.4.3 Groundwater Transportation Act

Passage of the 1991 Groundwater Transportation Act severely restricted the ability of municipal water providers to transfer groundwater from rural basins to AMAs. In general, the Groundwater Transportation Act of 1991 restricts the transport of groundwater from rural groundwater basins to initial AMAs, which includes the Phoenix AMA. A.R.S. §§ 45-551, *et seq.* The act, however, contains several exceptions that allow transportation of limited amounts of groundwater to the Phoenix AMA from groundwater basins outside the AMA. Thus, under the Act, and under very limited circumstances, groundwater could be imported into the AMA from a number of locations. These locations include the McMullen Valley Groundwater Basin, the Butler Valley Groundwater Basin, the Harquahala Irrigation Non-Expansion Area, and the Pinal AMA. Although the Act in general prohibits groundwater transfers, it does specifically identify which water supplies are available to augment the Phoenix AMA supplies.

8.4.2.4.4 Water Exchange Act

Passage of the 1992 Water Exchange Act establishes a legal mechanism to allow water-for-water trades between two or more parties. A.R.S. §§ 45-1001, *et seq.* Exchanges allow for improved management of limited water supplies. Water exchanges can reduce the cost of water deliveries and allow the quality of water to be matched with the requirements of the user. Entities in the Phoenix AMA have engaged in water exchanges to satisfy Indian water settlements, to overcome distribution system limitations, and to obtain less expensive sources of water.

8.4.2.4.5 Underground Water Storage, Savings and Replenishment Act

In the late 1980s and early 1990s, the Legislature enacted a series of underground water storage programs. The first of these programs established a legal mechanism to physically store water underground and to

later recover that water. Later enactments allow for unused renewable water supplies to be provided to groundwater users in lieu of groundwater. This program has had the result of providing affordable CAP water to farmers and saving groundwater that would otherwise have been pumped. In 1994, the Underground Water Storage, Savings and Replenishment Act repealed these previous enactments and consolidated all of the storage programs into a unified program. A.R.S. §§ 45-801.01, *et seq*. The result has been a more unified permitting system, a unified accounting system for all water stored, and readily assignable storage credits accrued under the program.

8.4.2.4.6 State Demonstration Program

One of the recharge programs enacted in the early 1990s and included in the Underground Water Storage, Savings and Replenishment Act is the State Demonstration Program. This program collected funds through an ad valorem tax assessed in Maricopa and Pima Counties. These funds were then made available to CAWCD to construct and operate recharge facilities. Although funding for the program was discontinued after 1995, the funds collected have been used by CAWCD to store water at the Granite Reef Underground Storage Project. The remaining funds collected from Maricopa County are being used to construct additional storage facilities in the Phoenix AMA.

8.4.2.4.7 Arizona Water Banking Authority

Arizona does not currently use its full 2.8 million acre foot per year share of Colorado River water established under *Arizona vs. California*, 373 U.S. 546 (1963). Any of Arizona's apportionment not diverted from the mainstream by Arizona is available for use in California or Nevada. The AWBA was established in 1996 as a means to increase the utilization of Arizona's Colorado River apportionment and to store unused Colorado River water to meet Arizona's future water supply needs. As Arizona directly uses more of its Colorado River apportionment, the amount of excess CAP water available to the AWBA for storage is expected to decrease.

The objectives of the AWBA include: (1) protecting municipal and industrial (M&I) users of CAP water from shortages or disruptions of the CAP system; (2) assisting in meeting the management objectives of the state's Code; (3) assisting in the settlement of Indian water rights claims; (4) exchanging water to assist Arizona's Colorado River communities; and (5) exploring opportunities for interstate water banking with Nevada and California. Although the AWBA has been working closely with the AMAs to identify storage opportunities that would also help support water management objectives of each AMA, some recharge projects ideally located to meet some of these AWBA objectives may not optimally assist the AMAs in meeting their specific water management goals, for example, hydrologically feasible sites located outside of the AMA.

Annual funding for the AWBA comes from four sources: (1) an ad valorem property tax of four cents per $100 assessed valuation in the three-county CAP service area; (2) a groundwater withdrawal fee of $2.50 per acre-foot in the Tucson, Phoenix, and Pinal AMAs; (3) general fund appropriations; and (4) the proceeds of interstate banking activities. The ad valorem tax collected for the AWBA in Maricopa County is estimated to be $6.1 million in 1998. The 1997 groundwater withdrawal fee (collected in 1998) should generate $2.2 million. General fund money projected to be used for storage in the Phoenix AMA in 1998 is $235,000. Based on the $8.5 million that are currently available, the total recharge capacity that could be utilized by the AWBA in the Phoenix AMA is estimated at 121,000 to 170,000 acre-feet per year, based on water costs of $70 to $50 per acre-foot, respectively, which may be optimistic for the long-term. In 1998, the AWBA actually stored over 117,000 acre-feet of water.

The AWBA, under certain conditions, is authorized to enter into interstate banking agreements with entities in Nevada and California. Under these agreements, the out-of-state entity would finance the storage of Colorado River water in Arizona. Later, when that entity needed additional water supplies, the

AWBA would provide for the recovery of the previously stored water. The recovered water would be used in place of diverting Arizona's full mainstream Colorado River apportionment. The additional water left on the mainstream would be made available to the participating out-of-state entity. To the extent interstate water is stored in the Phoenix AMA, the AMA would receive a short-term benefit of additional water supplies imported into the AMA in advance, perhaps by decades, of when those supplies would be needed for direct use by the out-of-state entity.

The Phoenix AMA's specific recommendations to the AWBA regarding siting of storage facilities and contributions to water management appear in section 8.7.1.

8.4.2.4.8 Governor's Central Arizona Project Advisory Committee Recommendations

As the CAP moved into its final phases of construction in the early 1990s, concern over a variety of issues related to the project led to the formation of the Governor's CAP Advisory Committee, which was staffed by the Department. The Committee issued a number of recommendations which led to legislative changes. One significant change was the date at which municipalities with CAP contracts were required to establish Designations of AWS. The date was moved up from January 1, 2001 to January 1, 1998. To address some of the environmental issues associated with the CAP, the Arizona Water Protection Fund (AWPF) was established in 1994. This fund, partially financed by CAP water users outside of the three-county CAWCD service area, is administered by a commission and issues grants to water users for implementing projects to protect the state's rivers and streams, including the use of excess CAP water for riparian enhancement.

8.4.2.4.9 Indian Water Rights Settlements

In the Phoenix AMA, the Fort McDowell and the SRPMIC water claims have been settled. The Fort McDowell settlement resulted in annual rights provided to the Fort McDowell community of 35,950 acre-feet of water from the Verde River and the CAP. This amount includes 18,233 acre-feet of CAP which may be leased for up to 100 years off-reservation within Pima, Pinal, and Maricopa Counties. The SRPMIC settlement agreement provided 122,400 acre-feet of Salt and Verde River supplies, groundwater, and CAP water to the community. The agreement requires the SRPMIC to achieve safe-yield at the same time as the Phoenix AMA. In addition, the agreement provides for a 99-year lease (commencing in the year 2000) of its 13,300 acre-feet CAP allocation to Phoenix AMA cities.

8.4.2.4.10 Other Resolutions

Outside the legislative arena, other issues associated with increasing the use of CAP water are being addressed. The CAWCD has established numerous pricing policies intended to encourage both the direct use and the storage of CAP water. The non-Indian agricultural water pricing policy has already been discussed in section 8.3.1.

Toward the end of the second management period, CAWCD and the United States federal government were engaged in litigation over issues involving the Master Repayment Contract for the CAP, as well as other issues. Resolution of these issues, either through a negotiated or litigated means, will likely bring more certainty of the cost and availability of CAP water to all of the project's users.

8.4.2.5 The Second Management Plan Augmentation and Conservation Assistance Fund

The Phoenix Active Management Area Augmentation Grant Program has been an effective and popular complement to the regulatory functions of the AMA. The program facilitates development of technologies and dissemination of information to assist water users in their attempt to attain the goal of safe-yield by 2025.

The Augmentation Grant Program and its associated Conservation Assistance Grant Program have been financed by fees on groundwater withdrawals in the AMA. Through 1996, $1.75 of the $2.75 per acre-foot withdrawal fee was dedicated to the two grant funds. However, this funding has been reduced beginning in 1998 with the fees collected for groundwater pumped in 1997. Beginning in 1997, and through 2016, a minimum of $.25 per acre-foot, not to exceed $.50 per acre-foot, of the withdrawal fees collected will go to the Augmentation and Conservation Assistance Fund; the remainder will be used to augment AMA water supplies through AWBA activities.

The Department has been collecting funds for the Augmentation Grants Program since 1990 and for the Conservation Assistance Grants Program since 1991. Through 1997, a total of $9.6 million has been collected for both programs. Of that amount, the director has contracted for augmentation grants totaling approximately $2.6 million. Augmentation grants to date have financed augmentation planning, research projects, feasibility studies, demonstration projects, pilot recharge facilities, water treatment and reuse projects, and construction of full-scale recharge facilities. More discussion on augmentation and conservation assistance funding is found in Chapter 9, section 9.4.1.

8.4.3 Summary of Program Effectiveness

Overall, the implementation of the Second Management Plan Augmentation and Reuse Program for the Phoenix AMA has been effective. The Department has taken a lead role in facilitating and coordinating augmentation activities and in resolving many of the institutional and legal barriers to such activities. The Phoenix AMA has provided significant technical and financial assistance to entities seeking to implement augmentation projects during the Second Management Period. Program elements that focused on developing new supplies, like weather modification and watershed management, were determined not to be feasible augmentation alternatives during the Second Management Period.

The primary objectives identified for the Second Management Plan Augmentation and Reuse Program have generally been met. Effluent treatment plants have been constructed to treat wastewater from the growing areas of the AMA. The number of recharge facilities to store these supplies has grown in response to the need for non-groundwater supplies pursuant to the AWS Rules. Direct use and storage of CAP water within the Phoenix AMA has increased, although not to the full extent projected in the Second Management Plan. However, due to the storage activities of the AWBA, the CAP delivery system is close to being used to the fullest extent possible as the second management period ends.

8.5 PHOENIX ACTIVE MANAGEMENT AREA AUGMENTATION ISSUES

The physical assessment section of this chapter identifies several water management problems existing in the AMA. Even with positive strides made in renewable supply use and other water management efforts through the Second Management Plan, several augmentation issues still need to be addressed through the third management period and beyond.

First, although new municipal growth is expected to transition to renewable supplies as discussed in section 8.2.2.1, other pumping is expected to continue. Existing grandfathered rights (irrigation grandfathered rights, Type 1 and Type 2 non-irrigation rights) and withdrawal permits exceed total incidental recharge and natural recharge. No legal requirement exists for these withdrawals to diminish over time. In addition, Type 2 non-irrigation rights can be relocated anywhere in the AMA, including areas experiencing serious water table declines or areas where the groundwater supplies have been fully committed under the AWS Program. Furthermore, in most areas of the AMA, the cost of producing groundwater is lower than alternative water supplies; thus, it will remain the economic choice for many water users in the AMA.

Second, the review of the renewable water supplies available to the AMA establishes that excess renewable water supplies are available and should be stored now. CAP water and effluent, which are not currently fully utilized for direct use, are the supplies that are available for this purpose. Because CAP water is not projected to be fully and directly used in the next 40 years, a limited window of opportunity exists to store unused CAP water for the future.

The physical assessment of the AMA has also established that an augmentation program, particularly one that employs recharge as a means to store excess water for future use, must be implemented to provide the most benefit to the AMA. While certain areas of the AMA are experiencing serious water level declines and could be aided by local recharge, other areas of the AMA that are waterlogged or require dewatering would be inappropriate sites for recharge. Therefore, the third issue for the Third Management Plan is to consider developing a critical management area strategy during the management period. The AWBA and the CAGRD are tools to assist with this effort and with meeting other water management objectives. This chapter has also discussed areas of the AMA where local groundwater supplies have been fully committed for assured water supply purposes (thereby preventing growth in the area without additional renewable supplies) and where substantial groundwater declines have resulted in subsidence. Not only will the Third Management Plan attempt to encourage storage facilities in these areas in coordination with local partnerships, but will continue to provide storage and recovery criteria that help to maximize the benefits and reduce the negative impacts to the AMA.

Storage facilities are the primary tools used to augment the groundwater supplies of the Phoenix AMA. Evolution of the Recharge Program in the last decade has resulted in a change to the concept of an underground storage facility. Initially, facilities were constructed for the sole purpose of storing water supplies that could not be used directly, for recovery and use in the future. The first permitted facilities were constructed as multiple shallow spreading basins to allow for wet and dry cycles, which increased infiltration rates and stored renewable supplies at high efficiency rates. These were typically constructed in undeveloped areas, such as in the Salt River bed, near wastewater treatment plants, and in locations where aesthetics were not particularly an issue. Over the last ten years, however, increased growth and land prices in the AMA have caused many entities to design USFs that also incorporate recreation, wildlife habitat, educational opportunities, aesthetics, and economic development aspects not found in the typical recharge facility design. The fourth issue is that, while multipurpose facilities may provide a greater benefit versus cost than do traditional single purpose facilities, the effectiveness of multipurpose facilities in meeting water management goals and objectives depends on their achievement of their principal purpose– water storage.

In summary, an augmentation program established to assist the AMA in reaching its goal of safe-yield must be designed to consider local water issues. Recharge, particularly when recovery will occur away from the area of impact of storage, should be discouraged in areas where high water tables are problematic. However, recharge should be encouraged at the highest efficiency possible, facilitated in areas where water tables are low, and located where groundwater supplies are already fully committed. Additional protection of local water supplies, in conjunction with a local area commitment to help, may be needed in areas experiencing local supply problems.

8.6 THIRD MANAGEMENT PLAN AUGMENTATION PROGRAM GOALS AND OBJECTIVES

This Augmentation and Recharge Program Chapter has thus far highlighted the physical groundwater supply problems experienced in various locations throughout the AMA, the underutilization of available renewable water supplies, the successes and shortcomings of the Augmentation Program for the second management period in the AMA, and the water management challenges facing the AMA as the third management period approaches. The Department has developed the goals and objectives of the Augmentation and Recharge Program for the third management period based upon these AMA

considerations. The Augmentation and Recharge Program for the third management period is intended to move the Phoenix AMA toward its goal of safe-yield and to begin to address sensitive areas by emphasizing the following objectives:

To maximize the use of renewable supplies, the Department will:

- Provide renewable supply use incentives for each water use sector to encourage the development of infrastructure necessary for full and direct utilization of CAP and effluent supplies throughout the AMA.
- Evaluate new and more effective renewable resource use incentives or programs to increase the direct use of renewable supplies.

To maximize the storage of renewable supplies, the Department will:

- Coordinate the storage of water with the AWBA to fulfill the water management objectives of the state.
- Provide technical and financial assistance to water users to develop storage facilities.
- Encourage the storage of renewable supplies in areas that will contribute to the groundwater supplies relied upon for future use.
- Encourage maximum efficiency for all storage facilities.

To address local water supply problems, the Department will:

- Develop a critical management area strategy through local/ state partnerships that encourages the reduction of groundwater pumping and replenishment of those resources in areas which are currently experiencing or are projected to experience water supply problems, including cones of depression, subsidence, and/or earth fissures.
- Develop a critical management area strategy through local/ state partnerships that discourages underground storage in areas experiencing problems caused by high water tables.
- Protect groundwater supplies in areas lacking physical availability to meet current and committed demand.
- Encourage extinguishment of credits by the AWBA in critical areas.
- Evaluate the need for establishing a purchase and retirement program for groundwater rights in the AMA, and evaluate possible incentives to retire existing groundwater rights.
- Develop a program to put shallow groundwater to beneficial use.
- Improve the information available on groundwater availability and land subsidence through the continued development of monitoring programs to facilitate effective implementation of water augmentation and recharge plans.
- Encourage the reduction and replenishment of mined groundwater pumped by residual pumpers.

Additional Augmentation and Recharge Program objectives to assist with meeting the AMA goals are:

- Identify and assess the feasibility of potential future water supply augmentation measures.
- Integrate groundwater replenishment, water banking, assured water supply, recharge, and related activities to facilitate achievement of groundwater management objectives.
- Develop well spacing rules that protect existing well owners from excessive drawdown and limit damage, such as subsidence, caused by additional withdrawals.

8.7 THE THIRD MANAGEMENT PLAN AUGMENTATION AND RECHARGE PROGRAM

The Department is required to include in the Third Management Plan "a program for additional augmentation of the water supply of the active management area, if feasible, including incentives for

artificial groundwater recharge." A.R.S. § 45-566(A)(6). "Augmentation" in this context is statutorily defined to mean "to supplement the water supply of an active management area and may include the importation of water into the active management area, storage of water or storage of water pursuant to chapter 3.1 of this title." A.R.S. § 45-561(2). As described in the introduction, the Department must remain consistent with this statute, but for purposes of this chapter, a finer distinction has been drawn: *augmentation* means increasing the availability and use of renewable supplies such as CAP and effluent in lieu of groundwater and *recharge* means storage of water pursuant to Title 45, Chapter 3.1, the Underground Water Storage, Savings and Replenishment Act. The Augmentation Program therefore includes provisions for maximizing the use of renewable supplies and for storage of renewable water.

The Third Management Plan includes a number of other provisions related to augmenting the AMA's water supplies. A.R.S. § 45-566(A). Paragraph 9 of that subsection provides that the Third Management Plan may include a plan for the purchase and retirement of grandfathered rights beginning no earlier than January 1, 2006. Paragraph 13, subsections (a) through (c), requires that the plan include recommendations to the AWBA regarding:

(a) Whether additional water storage in the active management area would help to achieve the management goal for the active management area.
(b) Where additional water storage in the active management area would be most useful to achieve the management goal for the active management area.
(c) Whether the extinguishment of long-term storage credits accrued or to be accrued by the AWBA would help to achieve the management goal for the active management area.

The Augmentation and Recharge Program for the third management period in this chapter addresses all of these required elements of A.R.S. § 45-566(A).

The principal responsibility for developing water supplies and for storing that water for future uses lies with the area's water users. The Department's responsibility under A.R.S. § 45-566(A) is to design an augmentation program that encourages and facilitates the efforts of those water users. The program should particularly encourage augmentation and storage of water where groundwater supplies are limited. The Augmentation Program, however, must also allow the Department to use the authorities granted by the Legislature to prevent unreasonable harm to third parties and to not aggravate existing local water supply problems.

The Third Management Plan Recharge Program derives from A.R.S. § 45-801.01, *et seq.*, the Underground Water Storage, Savings and Replenishment Act, which details the statutory requirements for storing and recovering water within an AMA. The key statutory provisions for storage facilities relate to hydrologic feasibility, A.R.S. § 45-811.01(C)(2); protection from unreasonable harm to land and other water users, A.R.S. § 45-811.01(C)(3); and avoidance of water quality impacts, A.R.S. § 45-811.01(C)(5). Although this Act contains requirements for water storage and for recovery, it also includes requirements linking storage and recovery to the management plan goals. The provision that affects non-recoverable storage is found in A.R.S. § 45-833.01(A), with a special requirement that non-recoverable water storage must be consistent with the AMA's Augmentation Program. The provisions that affect recovery are found in A.R.S. § 45-834.01; it includes a requirement for consistency with the management plan in the case of recovery outside the area of impact where the water is stored. A.R.S. § 45-834.01(A)(2)(b).

The Department has developed the Augmentation and Recharge Program for the Third Management Plan based on the statutory authorities and tools available to address the goals and objectives identified in the previous section. The program components will be presented in the order listed.

- Recommendations to the AWBA (section 8.7.1)
- Underground Water Storage, Savings, and Replenishment Program (section 8.7.2)

- Regulatory Incentives (section 8.7.3)
- Purchase and Retirement of Grandfathered Rights (section 8.7.4)
- Technical Assistance, Coordination, and Facilitation of Efforts (section 8.7.5)
- Financial Assistance (section 8.7.6)
- Resolution of Legal and Institutional Barriers (section 8.7.7)

8.7.1 Recommendations to the Arizona Water Banking Authority

As previously described, the AWBA was created in 1996 for the purpose of importing and storing unutilized CAP water in Arizona. One of the stated purposes of the legislation is to "store water brought into this state through the central arizona project to fulfill the water management objectives of this state set forth in chapter 2 of this title." A.R.S. § 45-2401(F)(3). The AWBA is also required to coordinate with the director, who serves as chair of the AWBA Commission, in the "storage of water and distribution and extinguishment of long-term storage credits . . . in accordance with the water management objectives set forth in chapter 2 of this title [the Code]." A.R.S. § 45-2423(A)(3).

The Code requires the Third Management Plan to include recommendations to the AWBA on whether additional storage in the AMA helps to achieve the goals of the AMA, where the storage would be most useful, and whether the extinguishment of credits would assist in achieving the goals. Therefore, the Department provides the following recommendations to the AWBA for water storage in the AMA.

8.7.1.1 Advice to the Arizona Water Banking Authority on the Additional Storage Needs in the Active Management Area

Funding has been made available to the AWBA for fulfilling the state's water management objectives. The Legislature has given the AWBA a variety of funding mechanisms, each tied to specific purposes for which the AWBA was created. Groundwater withdrawal fees collected pursuant to A.R.S. § 45-611 in the Phoenix AMA must be used for the benefit of the Phoenix AMA. A.R.S. § 45-2457(B)(6). The long-term storage credits earned with these funds may be used for Indian water rights settlements or for fulfilling the state's water management objectives. These funds may be used to store water for future use or to extinguish credits. A.R.S. § 45-2457(B)(6).

Long-term storage credits accrued with general fund appropriations may be used by the AWBA only as follows: (1) to make water available to M&I water users of Colorado River water in this state that are outside the CAWCD service area, and to CAWCD for the purpose of meeting the demands of its municipal and industrial subcontractors (both are limited to situations when there are water shortages and require reimbursement); (2) to implement Indian water rights settlements; and (3) to fulfill the water management objectives of the Code. A.R.S. § 45-2457(B)(2-4).

In addition, credits accrued with ad valorem taxes may only be used to benefit the county in which the funds were collected. The Authority is also required to transfer the credits to CAWCD to meet the demands of CAWCD's municipal and industrial subcontractors during times of shortage. A.R.S. § 45-2457(B)(7). Finally, credits accrued with monies paid by California or Nevada agencies pursuant to the interstate banking provisions must be associated with a plan for forbearance from taking Colorado River water in the future. A.R.S. § 45-2472(A).

Thus, the Legislature has established and funded a valuable tool for achieving the AMA's water management goals. The mechanism is in place to bring water into the state and to store it specifically for the purpose of achieving safe-yield. Making use of this tool while unused CAP water is still available must be one of the highest priorities of the Augmentation and Recharge Program during the third management period.

Although achieving the state's water management objectives is only one of the AWBA's responsibilities, all of its storage activities in the AMA will augment the water supplies. Any or all of the water stored by the AWBA for its other purposes may be stored in areas of the AMA experiencing physical shortages of groundwater and recovered from areas that have more plentiful underground reserves. It is recommended that, as a part of the Augmentation and Recharge Program, the AWBA work with the Department to ensure that the AWBA storage in the Phoenix AMA serves as many water management objectives as possible, within the purposes for which the AWBA was created.

8.7.1.2 Advice to the Arizona Water Banking Authority on the Location of Water Storage in the Active Management Area

When the AWBA prepared its storage facility inventory for the Phoenix AMA pursuant to A.R.S. § 45-2452, it consulted with the Department to determine whether storage by the AWBA at each facility listed in the facility inventory promoted groundwater management objectives. It was determined that adequate storage capacity existed within the AMA in excess of the AWBA's needs for the following ten years. At the time the AWBA made this determination for the Phoenix AMA, it was recognized that the Department was still examining potential water storage sites that would be beneficial in fulfilling the water management objectives of the state. The AWBA storage facility inventory found that the AWBA would reconsider this finding of adequate storage facilities after additional planning studies were conducted by the Phoenix AMA (AWBA, 1997). Further, the AWBA is required to update and evaluate its facility inventory at least every five years.

While the Department continues to examine the issue of where storage facilities could best be located within the Phoenix AMA to fulfill the state's water management objectives, it is apparent that storage at the existing facilities do not fully address the groundwater management objectives for the Phoenix AMA. Most of the storage facilities in the AMA, including USFs and GSFs, are located in the East Salt River Valley (East SRV). These facilities are located where CAP water and SRP surface water supplies are already accessible through existing distribution systems. Consequently, groundwater is no longer the sole, or even primary, source of supply in much of this region, and groundwater levels are fairly stable in many areas.

Those regions of the AMA that rely predominantly on groundwater have groundwater levels that are declining and need additional storage facilities. The physical assessment section of this chapter emphasized five areas of the AMA where water level declines were or are projected to be particularly significant. Those areas are:

- West SRV encompassing Luke Air Force Base, El Mirage, Surprise, and Sun City/Sun City West
- Carefree Subbasin
- North Phoenix and Scottsdale
- Region between Mesa and Apache Junction
- Queen Creek area near the San Tan Mountains

Based on the physical assessment, the Department recommends that the AWBA consider storage in both the East and West Salt River Valley Subbasins. When planning efforts are completed, and as new facilities are permitted in the AMA, additional recommendations will be provided to the AWBA regarding where storage would provide the most benefit. It is further recommended that, as new storage locations are identified, the AWBA update its facilities inventory accordingly.

8.7.1.3 Advice to Arizona Water Banking Authority on Water Storage and Storage Credit Extinguishment

The physical assessment of groundwater supplies earlier in this chapter establishes that groundwater overdraft is projected to continue past 2025. Water storage and long-term storage credit extinguishment could eliminate, or at least greatly reduce, overdraft and allow the AMA to achieve its safe-yield goal.

During the third management period, the Department will undertake annual studies to project the extent to which overdraft is expected to continue beyond 2025. The Department recommends that AWBA create a bank of credits reserved for the purpose of achieving and maintaining safe-yield in the AMA. The Department recommends that the AWBA use groundwater withdrawal fees to reserve a minimum of 32,000 acre-feet of storage credits per year for extinguishment to fulfill the state's water management objectives. The Department may adjust that recommendation upon further studies of projected groundwater overdraft.

For the second part of this program, the Department recommends that the AWBA, in concert with the Department, develop a process to quantify and locate where credit extinguishment should occur for water management purposes, and to offset groundwater overdraft that occurs in 2025 or beyond.

8.7.2 Underground Water Storage, Savings, and Replenishment Program

The expense and environmental concerns associated with constructing large surface water storage reservoirs, like those found on the Salt, Verde, and Agua Fria Rivers, supports underground water storage as an increasingly important tool for the storage of renewable water supplies for future use in the Phoenix AMA. Underground storage provides an additional benefit of restoring or preserving groundwater in areas where groundwater levels have declined. The Underground Water Storage, Savings, and Replenishment (UWS) Program is, therefore, an important component of the Augmentation and Recharge Program.

As has already been reviewed, Arizona's UWS Program provides regulations under which water may be stored and rights to recover that water may be accrued. The statutes and policies of the UWS or "recharge" program, when read together, can be seen to establish a number of objectives. These include:

- To protect the general economy and welfare of the state by encouraging the use of renewable water supplies, especially Colorado River water, instead of groundwater, through a flexible and effective regulatory program for the underground storage, savings, and replenishment of water;
- To allow for the efficient and cost-effective management of water supplies by allowing the use of storage facilities for filtration and distribution of surface water instead of constructing surface water treatment plants and pipeline distribution systems;
- To further the conjunctive management of the water resources of this state to reduce the overdraft and achieve the management goals of the AMAs;
- To store water underground for seasonal peak demand and for use during years of shortage; and
- To augment the water supply for future growth and development.

Since its inception in 1986, the Recharge Program has become increasingly flexible over time with regard to storage and recovery locations and the number and types of programs available. With the increased flexibility has come an increased complexity and the potential for recharge projects to aggravate, as well as mitigate, local water problems. High water tables, low water tables, water quality, physical availability, and third party impacts are all problems that can be affected positively or negatively by recharge facilities. Thus, the regulation of the program to maximize benefits and minimize harm is crucial to an effective program.

The following sections describe: (1) a brief overview of the UWS programs, (2) the definition of a storage facility, and (3) the storage and recovery location criteria that determine whether a recharge project is considered "consistent with the management plan and achievement of the management goal" of the AMA.

8.7.2.1 Overview of the Underground Water Storage, Savings, and Replenishment Program

Persons who want to undertake recharge activities are required to obtain permits from the Department. There are three types of permits: (1) storage facility permits, which may be constructed underground storage facility (USF) permits, managed USF permits, or groundwater savings facility (GSF) permits; (2) water storage permits; and (3) recovery well permits.

8.7.2.1.1 Storage Facility Permits

Storage facility permits allow the holder to construct, develop, and operate a storage facility. If storage is to occur at a facility that will use constructed basins or wells to add water to an aquifer, a constructed USF permit is required. If the storage will utilize the natural channel of a river or stream to add water to an aquifer, a managed USF permit is required. At a GSF, a groundwater user who would otherwise have pumped groundwater is provided an alternative supply of water by a water storer. The alternative supply is then used in lieu of the groundwater, thus preserving the groundwater.

8.7.2.1.2 Water Storage Permits

Water storage permits authorize the holder to store water at an affiliated storage facility. Rights to recover water under the UWS Program always accrue to the holder of the water storage permit, unless the water stored through the water storage permit is designated as non-recoverable.

8.7.2.1.3 Recovery Well Permits

Recovery well permits allow the holder to recover water stored pursuant to the UWS Program. The storer of the water may always recover the water stored within the area of impact of water storage, which is defined "as projected on the land surface, the area where the stored water has migrated or is stored." A.R.S. § 45-802.01(2). Under a number of conditions, some of which are discussed in detail later in this chapter, recovery may also occur outside the area of impact. Theoretically, if these conditions are met, storage could occur anywhere within the AMA. Under no circumstance, however, can water be recovered in the AMA if it was stored outside the AMA.

8.7.2.1.4 Key Program Components

The UWS Program has a number of key components. Rights to recover water may be exercised annually or over the long-term. Almost any water can be recovered within the same year in which it was stored. If a number of conditions are met, stored water will be credited to a long-term storage account allowing the account holder to recover the water at any point in the future. The conditions greatly assist the achievement of water management goals by preventing an entity from storing water and earning long-term storage credits if the water could be put to direct use. The statutes define what source water cannot be put to direct use and therefore, what may be eligible as long-term storage credits. In general, if an entity stores effluent it is determined that, until 2025, it cannot reasonably be put to direct use, and is therefore eligible to be stored as long-term storage credits. Additionally, CAP water is considered water that cannot be put to direct use if the storer is not simultaneously mining groundwater. A.R.S. § 45-802.01(21). In other words, if the storer continues to mine groundwater, then stored CAP water may only result in credits if the entity stores an additional amount of CAP water to offset the groundwater pumping. (A designated provider who pumps groundwater from its groundwater allowance account is not considered to be mining groundwater.) The obvious intent for this provision is to encourage direct use of CAP water. It should be

reemphasized that while water storage may not be eligible to accrue long-term storage credits, the water stored is eligible to be recovered on an annual basis, and is treated as a direct use for all intents and purposes.

No time limit exists on the right to recover long-term storage credits. Long-term storage credits may be assigned to another person if that person could meet the same provisions for earning credits as did the storer. In addition, once the water is recovered, it retains the same legal characteristics it had before storage. For example, if CAP water is stored, the recovered water may be used in any legal manner that CAP water can be used, even if the recovery occurs outside the area of impact of the stored water.

The UWS Program is also the mechanism by which the CAGRD replenishes water on behalf of its members. The CAGRD may store water and accrue long-term storage credits or obtain credits already accrued. At the CAGRD's request, the Department will transfer credits from CAGRD's long-term storage account to its replenishment account, termed a "conservation district account" by statute, to offset the CAGRD replenishment obligations. A.R.S. § 45-859.01. Once the credits are transferred to the replenishment account, they may not be recovered, assigned, or moved back to the long-term storage account.

8.7.2.2 Underground Water Storage, Savings, and Replenishment Program Issues

Arizona law generally prohibits artificial "bodies of water" constructed for landscape, scenic, or recreational purposes. However, one of the exceptions to this prohibition is if the body of water is "unsealed and an integral part of an underground storage facility." A.R.S. § 45-132(B)(6). One issue the Department considers carefully when permitting storage facilities is whether they are legitimate storage facilities that will meet the goals and intents of the program, including those facilities that "further the conjunctive management of the water resources of this state to reduce the overdraft and achieve the management goals of the AMAs," as stated in section 8.7.3.

With regard to USFs, A.R.S. § 45-815.01 specifically lists water systems that are categorically excluded as USFs. These include aqueducts, irrigation canals, and other man-made water conveyance systems. In addition, incidental recharge from any agricultural, municipal, mining, or industrial use is precluded from qualifying for a USF permit. Bodies of water, as defined in statute, do not qualify for USF permits unless they "have been designed, constructed or altered so that water storage is a principal purpose of the body of water." A.R.S. § 45-815.01(1). Thus, the law does allow for a body of water to be both a USF and a recreational lake. However, the Department guards against attempts by applicants to avoid the prohibition on recreational lakes by labeling a body of water a USF when its principal purpose is not underground storage. Thus, if the purpose of the facility is primarily recreational or aesthetic, it does not qualify as a USF. However, if the facility meets the goals, intents, and requirements of the USF Program while serving other uses as well, it may qualify for a USF permit.

Usually, the efficiency of a USF is related to its purpose. If a permit applicant's primary intent is to store water, achieving high efficiency at the facility is an important goal for the applicant. If the applicant's intent is to achieve multiple purposes, or if storage is not a primary purpose, efficiency is less important to the applicant.

Efficiency at USF's, however, is always a concern to the Department. As the AMA becomes more reliant on renewable supplies to meet a growing demand, as is required under the AWS Rules, efficiency of all surface water and groundwater use will be necessary. This program will serve to encourage efficient uses of water, and every effort will be made in the future to retain the integrity of the program and its intents and goals through maximizing the efficiency of recharge at permitted facilities. The Department examines projected efficiency of a USF as part of its review to determine whether a project is hydrologically feasible, which must be established before a USF permit will be issued. A.R.S. § 45-811.01(C)(2). The less

efficient a proposed project is, the more the Department will examine it to determine if it is a legitimate USF. The Department will consider a number of factors when evaluating a facility for efficiency as a component of hydrologic feasibility, including the following:

- Whether the facility has the *potential* to store water, and the quantity of that potential storage
- Whether the facility is designed, constructed, or altered so that water storage is a principal purpose
- Whether other regulatory agencies impart conflicting standards to a facility (e.g., Arizona Department of Environmental Quality containment standards in a treatment wetland)
- Whether and how the facility will be maintained (e.g., wet-dry cycles, scraping, etc.) to ensure and/or enhance infiltration
- If a facility serves multiple purposes, whether the purposes other than recharge would not be legal or regulated without being associated with a recharge facility
- Whether potential water storers at the facility are subject to conservation requirements and lost and unaccounted for water limits under the management plan

The Department is also concerned about potential abuses in GSF permits. The statutes clearly state that not every instance where groundwater use is replaced with a renewable water resource qualifies for a GSF permit. Only where the use of the renewable resource would not have occurred without the operation of the GSF and only where there is no other reasonably available alternative source should a GSF be permitted. A.R.S. § 45- 812.01(B).

While the groundwater savings program is an important tool in achieving the water management objectives by increasing the uses of Colorado River water and effluent and preserving groundwater supplies, it must be emphasized that 95 percent of the groundwater saved today will be pumped in the future through the use of long-term storage credits. The groundwater savings program is, in effect, a deferred groundwater pumping program and should not be confused with the conversion of an existing groundwater use to a renewable resource, which would provide a permanent savings of groundwater and a direct contribution to the achievement of safe-yield. For these reasons, the Department will not issue a GSF permit or storage credits unless a legitimate "groundwater savings" will occur or has occurred.

8.7.2.3 Storage and Recovery Siting Criteria

The benefits to water management through the Recharge Program depends on where the water is stored and recovered. Non-recoverable water storage is discussed in the next section.

For storage and recovery, unless stored water is recovered by the storer within the area of impact, the recovery is only allowed "if the director determines that recovery at the proposed location is consistent with the management plan and achievement of the management goal for the active management area." A.R.S. § 45-834.01(A). Recovery of stored water *within* the area of impact of the stored water is always considered consistent with the management plan.

Although the statute ties recovery outside the area of impact to the consistency requirements of the plan, the locations of storage and recovery of water are inherently linked. Both must be considered when determining whether the future recovery meets the consistency requirements and management goals of the AMA. Outside the area of impact, it cannot be determined whether recovery is consistent with water management objectives of the AMA unless the storage location is also considered. Water management benefits to the AMA would depend greatly on whether water recovered from an existing well was stored in a remote area of the AMA or in a large pumping center of the AMA. Therefore, the criteria to determine whether the recovery location is consistent with the management plan and goal for the AMA must also consider where water was stored.

The locations of storage and recovery are important factors in addressing local and regional supply problems, particularly in critical areas, and in attempting to balance the supplies in the AMAs during the third management period. For example, the future water supplies of the AMA may be diminished if water storage occurs in a remote location having no foreseeable future demand for the stored water and if recovery occurs outside the area of impact of storage. In this instance, the stored water would, in effect, be wasted if there was not a projected use of the aquifer either by existing groundwater users or through recovery. In addition, recovery outside the area of impact of water storage could aggravate problems if the area of recovery was experiencing rapidly dropping groundwater levels or if groundwater supplies were already fully committed under the AWS Program. On the other hand, if storage occurs in an area experiencing high water levels and recovery occurs away from the area of impact, the water storage will contribute to those high water levels. If dewatering is required as a *direct* result of water storage or savings, either the storage facility's operational plan should be adjusted to minimize impacts or the storer may not be issued credits.

The Second Management Plan siting criteria provided no protection of groundwater supplies already committed under the AWS Program. However, the new Third Management Plan criteria protect groundwater supplies already committed for an assured water supply from an entity who wishes to recover water *outside* the area of impact.

The Third Management Plan criteria also link future use benefits to determinations under the AWS Program. If storage occurs in an area that has a committed and projected demand through a Designation or Certificate of AWS, then it is deemed to contribute to groundwater supplies that will be used in the future. If the storage does not meet this criteria, such as if it were located in a remote area with no committed or projected demands per a Designation or Certificate of AWS, it must be determined by the director to otherwise be beneficial to the AMA if recovery is to occur outside the area of impact of storage. Permitted storage facilities to date, listed in Appendix 8A, are all in locations that provide benefits to the AMA. If a storage facility is found not to meet the criteria, it will be indicated as such in the permit as a notice to potential water storers that future recovery may only be allowed inside the area of impact until such time that there is a demand for groundwater in the area of impact of the storage.

Recovery from within the area of impact is not required to meet management plan consistency requirements. Recovery may occur *outside* the area of impact of the storage only if the director determines that the recovery location is consistent with the management plan. A.R.S. § 45-834.01(A). Therefore, recovery must continue to be consistent with management plan criteria, even after the recovery well permit has been issued. Thus, previously permitted recovery wells are subject to the criteria of the Third Management Plan and future management plans.

8-101. Storage and Recovery Siting Criteria

During the third management period, for the purposes of A.R.S. § 45-834.01(A)(2)(b), recovery of stored water at a location is consistent with the management plan and achievement of the management goal for the active management area:

A. *If recovery will occur within the area of impact, regardless of whether the recovery well permit applicant was the storer of the water; or*

B. *If recovery will occur outside of the area of impact, all of the following three criteria are met:*

1. The water storage that resulted in the right to recover water:

a. Is contributing to groundwater supplies that are accessible to current groundwater users or that have been committed to establish a Designation, Certificate, or Analysis

of Assured Water Supply pursuant to A.R.S. § 45-576 or rules adopted thereunder so long as the areas in which water is stored are not experiencing problems associated with shallow depth to water; or

b. *Is a component of a remedial action project under Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) or Title 49, Arizona Revised Statutes, and the director has determined that the remedial action will contribute to the objectives of this chapter or the achievement of the management goal for the active management area; or*

c. *Is otherwise determined by the director to have contributed to the objectives of this chapter or the achievement of the management goal for the active management area.*

2. *Either:*

a. *At the time of the application, the maximum projected depth to water at the location of the recovery well after 100 years does not exceed the general 100-year depth-to-static water level for the AMA specified by A.A.C. R12-15-703 after considering: (1) the maximum proposed withdrawals from the recovery well; (2) withdrawals for current, committed, and projected demands associated with determinations made under A.R.S. § 45-576 that are reliant on the water which the recovery well will withdraw; and (3) withdrawals for other current or projected demands that are reliant on the water which the recovery well will withdraw; or*

b. *The recovery will be undertaken within the applicant's service area and the applicant is a municipal provider designated as having an assured water supply.*

3. *The recovery well is:*

a. *Located in an area experiencing an average annual rate of decline that is less than 4.0 feet per year; or*

b. *A component of a remedial action project under CERCLA or Title 49, Arizona Revised Statutes, and the director has determined that the remedial action will contribute to the objectives of this chapter or the achievement of the management goal for the active management area; or*

c. *Likely to contribute to the water management objectives of the geographic area in which the well is located, as determined by the director.*

8.7.2.4 Criteria for Storage of Non-Recoverable Water

Pursuant to A.R.S. § 45-833.01(A), "the director may designate a water storage permit as storing non-recoverable water. If the water storage occurs within an active management area, the water storage permit may be designated in this manner only if the storage is consistent with the active management area's augmentation program." The director may make this designation only upon application by a proposed water storer.

Only in few instances has this designation been applicable. In the second management period, non-recoverable storage occurred in association with certain augmentation grants that included storage of water to test the hydrologic feasibility of a recharge site. The Department has not allowed augmentation grant money to be used to purchase water supplies for storage and recovery for a grantee. Therefore, water

stored in association with certain grants has been designated as non-recoverable. Under the Third Management Plan, non-recoverable water storage may also occur as a result of an enforcement action associated with non-compliance of conservation requirements.

Water that is stored under a permit with this designation may not be recovered on an annual basis, may not be credited to a long-term storage account, and may not be used for replenishment purposes associated with the CAGRD. The same considerations discussed in the preceding section that shaped the criteria for recovery location have shaped the criteria for siting non-recoverable storage.

8-201. Criteria for Storage of Non-Recoverable Water

During the third management period, water storage that is designated as non-recoverable is consistent with the AMA's Augmentation Program if one of the following criterion is met:

The water storage:

1. *Is contributing to groundwater supplies that are accessible to current groundwater users or that have been committed to establish a Designation, Certificate, or Analysis of Assured Water Supply pursuant to A.R.S. § 45-576 or rules adopted thereunder so long as the areas in which water is stored are not experiencing problems associated with shallow depth to water; or*

2. *Is a component of a remedial action project under CERCLA or Title 49, Arizona Revised Statutes, and the director has determined that the remedial action will contribute to the objectives of this chapter or the achievement of the management goal for the active management area; or*

3. *Is otherwise determined by the director to contribute to the objectives of this chapter or the achievement of the management goal for the active management area.*

8.7.3. Regulatory Incentives

Provisions established in the Agricultural, Municipal, and Industrial Conservation Programs of this management plan provide incentives for water users to utilize renewable resources. The inclusion of renewable supply incentives is somewhat controversial due to the perception that encouraging the use of a renewable supply may result in an inefficient use of the supply. The program to increase the use of renewable water supplies should not be perceived as an alternative to conservation.

Arizona is not currently using its full Colorado River apportionment directly, and some municipal entities do not have enough annual demand or the infrastructure with which to deliver their allotments directly. However, these conditions are likely to change in the next 10 to 15 years, due primarily to the provisions of the AWS Rules. The Code (particularly through the assured water supply provisions) and the management plans require a long-term perspective on supply and demand. In the long term, efficient use of all water supplies will be necessary. The distinctions that are now being made among sources of water, including incentives that allow increased use of certain renewable sources, may seem ill-advised in hindsight. In fact, shortages are anticipated on the Colorado River system 35 out of the next 100 years. It would be inappropriate not to build a conservation ethic into the structure of the Phoenix AMA communities, even as they move towards the use of renewable supplies.

Some uses of water can be identified as "structural" and others as "discretionary." Structural uses are part of the base water use requirement; for example, once a swimming pool is built, it is likely to be filled with water. However, the decision to overseed a lawn or a golf course in a particular year is discretionary, or

non-structural. As incentives were designed for inclusion in this plan, the Department emphasized that increased utilization of renewable supplies should be for non-structural purposes, so that the use can be scaled back if available renewable supplies become scarce. Although it is unlikely, a renewable supply shortage may occur during the third management period. Therefore, promoting efficient use of all supplies now in anticipation of future shortages is responsible water management.

Achievement of the water management goals over the long term is only possible in the context of diligent, long-term conservation efforts and increased utilization of renewable supplies. The debate is not between conservation and augmentation, but rather, whether the concept of "efficient use" can be integrated into the regulatory system and the community ethic. Matching the resources to the most appropriate demand will require more sophisticated management, including conjunctive management of groundwater and surface water, than has been the norm in Arizona in the past. It is difficult to design incentives that are administratively workable without causing equity problems and weakening the conservation message which is crucial in protecting our resources for the future.

Table 8-6 lists the Third Management Plan incentives to use alternative supplies. Some of these incentives were established in the Second Management Plan. Because many of these incentives encourage use of alternative supplies at the expense of conservation, the incentives may need to be scaled back in the future to achieve safe-yield.

Although the need to include specialized incentives to address subregional conditions has been identified, the only regulatory tool to date for addressing localized areas of decline is the limitation on recovery of recharged water if it is recovered outside the area of hydrologic impact. The compliance approach described in Table 8-6 may result in encouraging recharge in specific locations to address local hydrologic concerns.

8.7.4 Purchase And Retirement of Grandfathered Rights

The Code specifies that the Third Management Plan may include a program for the purchase and retirement of grandfathered rights by the Department not to begin earlier than January 1, 2006. A.R.S. § 45-566(A)(9). An annual groundwater fee of up to $2.00 per acre-foot can be collected for the purchase and retirement of grandfathered rights beginning in 2006, although the fee cannot be levied until the management plan contains a program for such purposes. A.R.S. § 45-611(C)(4). The possibility of the Department developing such a program is being considered for inclusion in the Third Management Plan beginning in 2006. If the plan were to be modified to include such a program, it would provide the Phoenix AMA with another method for reducing groundwater overdraft and helping to achieve the management goal. The purpose of this section is to analyze those issues that need to be considered in determining the feasibility of developing and implementing a grandfathered right purchase and retirement program in the AMA.

The focus of this analysis is on the purchase and retirement of lands associated with irrigation grandfathered rights (IGFRs). Agricultural use is diminishing with the growth and development of our communities, and therefore, a purchase and retirement program will simply affect the rate at which agricultural water use is reduced. Although a purchase and retirement program could also legally include Type 1 and Type 2 non-irrigation grandfathered rights, these rights may be more expensive to retire. Purchase and retirement of these rights could possibly be offset by increases in General Industrial Use permits, thereby defeating the objective of reducing groundwater demand. At a minimum, the program should be limited to: (1) those IGFRs that use groundwater exclusively, and (2) do not lie in the path of urban development. In addition, IGFRs that would be targeted for purchase and retirement should be required to meet one or more of the following secondary criteria: high water duties, high percentage of annual groundwater use (if not exclusively groundwater), history of high consumptive use crops, history of high land utilization rates, and located in areas historically exhibiting high groundwater decline rates.

TABLE 8-6
RENEWABLE WATER SUPPLY UTILIZATION INCENTIVES
PHOENIX ACTIVE MANAGEMENT AREA

Municipal
Delivery of effluent by a municipal water provider does not count against the gallons per capita per day (GPCD) requirement, unless effluent is recharged in one location and recovered outside the area of impact. This is an incentive for municipal providers to invest in reclaimed water systems (Chapter 5, section 5.8). CAP water delivered by a municipal provider to a non-residential water user is excluded from the provider's total GPCD requirements for up to ten years if it is shown that the delivery will expedite the development of infrastructure to deliver reclaimed effluent to the user in the future (Chapter 5, section 5.8). The Alternative Conservation Program removes the non-residential portion of the GPCD requirement for providers who limit their groundwater use to the highest annual use between 1980-1989, utilize renewable supplies for their remaining demand, and implement specific conservation measures for non-residential customers. This program also includes an incentive to extinguish existing grandfathered rights to groundwater (Chapter 5, section 5.7.1.3.1). The Non-Per-Capita Program removes the GPCD rate as a regulatory tool entirely in exchange for implementation of specified conservation programs. A "best management practices" approach is designed to achieve the same level of efficiency as the GPCD, but the point of compliance is implementation of the programs, not the level of water use. To qualify, water providers must phase out groundwater use, or have a Designation of AWS (Chapter 5, section 5.7.1.2.3).
Industrial
Turf Effluent use is discounted when calculating compliance with the annual allotment for each facility. For the Third Management Plan, the incentive has been increased to a 40 percent discount (the Second Management Plan discount was a maximum of 20 percent) (Chapter 6, section 6.3.5.3). If 100 percent of the water used at a facility in a year is from a non-groundwater source, no compliance is required with the annual allotment for that year.
Cooling Towers Cooling towers that beneficially reuse 100 percent of their blowdown water are exempt from meeting the blowdown concentration requirements (Chapter 6, section 6-602.B.1). Cooling towers that convert to at least 50 percent effluent are exempt from the blowdown concentration requirements for one full year. If it is shown that they cannot meet the requirements, amended blowdown concentration levels may be applied (new incentive in the Third Management Plan) (Chapter 6, section 6-602.B.3).
Electric Power Electric power generating facilities are given a full year with no blowdown concentration requirements if they convert to at least 50 percent effluent. If it is shown that they cannot meet the requirements, amended blowdown concentration levels may be applied (new incentive in the Third Management Plan) (Chapter 6, section 6-505).

TABLE 8-6
RENEWABLE WATER SUPPLY UTILIZATION INCENTIVES
PHOENIX ACTIVE MANAGEMENT AREA

Dairies The reuse of dairy wastewater by a grandfathered groundwater right holder is not counted toward compliance with the dairy's maximum annual water allotment (Chapter 6, section 6-703).
Agricultural
Pursuant to A.R.S. § 45-467, effluent use cannot contribute to a farm exceeding its allotment in any year. In determining whether a farm exceeds its maximum annual groundwater allotment for a year, total water use, including groundwater, effluent, and surface water, is counted. Any effluent used that year is subtracted from the amount of groundwater that otherwise would have exceeded the farm's allotment.

8.7.4.1 Potential Groundwater Savings Under Purchase and Retirement

To analyze the potential groundwater savings that could be realized from an IGFR purchase and retirement program in the Phoenix AMA, an estimate was first made of the total withdrawal fees that could be collected by the Department in 2006 assuming: (1) use of a $2.00 per acre-foot withdrawal fee for purchase and retirement, and (2) groundwater and in-lieu water use by the IGFRs equivalent to the AMA's average annual groundwater and in-lieu water use from 1990 through 1996. An estimate was next made of the amount of farmland that could be purchased by the Department assuming: (1) use of all collected fees, and (2) a purchase cost for farmland equivalent to the representative 1996-97 price for an acre of farmland in those areas of the AMA that best meet the proposed minimum program criteria. The groundwater savings were then estimated by assuming: (1) a historic groundwater use for the retired farmland equivalent to the annual groundwater use per acre for those IGFRs in the AMA that grow high consumptive use crops and have high land utilization rates, and (2) a benefit period for the groundwater savings, beginning in 2006 or in the year in which the land was purchased, and lasting through the end of the fifth management period in 2025. These assumptions were used to calculate the potential groundwater savings that could be realized from a purchase and retirement program implemented for 1, 5, 10, 15, and 20 years. A program implemented for 5 years, for example, would mean that purchase and retirement fees would be collected for only 5 years (2006-2010) and used to purchase and retire irrigation grandfathered rights. However, the groundwater saved from such a short term program would continue each year beyond the program's duration. These savings and associated costs are shown in Table 8-7.

As shown in Table 8-7, assuming the same amount of purchase and retirement fees are collected each year from 2006 to 2010, the potential groundwater savings until 2025 would be 10,404 acre-feet per year on average (or a total of 208,080 acre-feet), and the purchase costs would be $41.66 per acre-foot. These costs assume a one-time purchase of the land in the year the funds were collected, with groundwater savings accruing annually through the year 2025. It should be noted that this cost reflects only the Department's cost for purchasing farmland and assumes that 578 acres of farmland would be purchased each year using $1,734,078 of withdrawal fees collected during that year. The 2,312 acre-feet of groundwater savings resulting from the purchase would continue to accrue on an annual basis from the year of purchase through 2025. Adding the accrued groundwater savings from each year's purchase of farmland results in total groundwater savings of 208,080 acre-feet by 2025. The total costs from 2006 to 2010 for purchasing the farmland equal $8,670,390 or (1,734,078 x 5). Therefore, the average cost of groundwater savings is $41.66 per acre-foot (or $8,670,390 ÷ 208,080 acre-feet).

It is unlikely that the Department would terminate a purchase and retirement program at the end of the third management period. A more realistic assumption is that the program would continue through the fourth and fifth management periods. Assuming no change in the price for farmland, the potential groundwater savings for a 20-year purchase and retirement program are estimated to average 24,276 acre-feet per year, with purchase costs averaging $71.43 (or $34,681,560 ÷ 485,520 acre-feet). Should agricultural land prices double, however, the average annual groundwater savings after 20 years would only be 12,138 acre-feet and the resulting costs would be $142 per acre-foot.

TABLE 8-7
POTENTIAL GROUNDWATER SAVINGS AND ASSOCIATED IMPACTS[1]
IRRIGATION GRANDFATHERED RIGHT PURCHASE AND RETIREMENT PROGRAM
PHOENIX ACTIVE MANAGEMENT AREA

Program Duration (Years)	Total Purchase and Retirement Fees Collected[1] ($)	Total Farmland Purchased and Retired[2] (Acres)	Total Groundwater Savings[3] Through 2025 (Acre-Feet)	Average Groundwater Savings[4] (Acre-feet per year)	Cost of Groundwater Savings[5] ($/Acre-Foot)
2006 (1)	$1,734,078	578	46,240	2,312	$37.50
2006-2010 (5)	$8,670,390	2,890	208,080	10,404	$41.66
2006-2015 (10)	$17,340,780	5,780	358,360	17,918	$48.39
2006-2020 (15)	$26,011,170	8,670	450,840	22,542	$57.69
2006-2025 (20)	$34,681,560	11,560	485,520	24,276	$71.43

[1] Assumes a purchase and retirement fee of $2.00 per acre-foot and 867,039 acre-feet of groundwater pumping and in-lieu water use in the Phoenix AMA annually.
[2] Assumes use of all of the fees collected and land purchase costs of $3,000 per acre annually.
[3] Assumes previous use of groundwater on farmland was 4.0 acre-feet per acre and groundwater savings accruing annually through 2025. Assumes a benefit period from the year in which farmland was purchased and retired to 2025.
[4] Annual savings equals total benefit divided by 20 years.
[5] Reflects land purchase costs only.

It should also be noted that the potential groundwater savings assume that the retired farmland would not be offset by inactive farmland being brought back into production in another location in the AMA. A "rebound effect" such as this is possible in the Phoenix AMA because much fallow farmland already exists.

8.7.4.2 Land Management and Maintenance Issues

Before a purchase and retirement program could be developed and implemented in the Phoenix AMA, land management and maintenance issues would need to be addressed. These issues include, but are not limited to, the following:

- Funding for staff and other resources needed to manage the retired farmland
- Liability claims
- Impacts of removing the land from the county and local property tax base
- Control of noxious weeds and dust on the land

8.7.4.3 Future Directions for Purchase and Retirement Program

For the Phoenix AMA to meet its management goal, as quantified in this management plan, an IGFR purchase and retirement program could have limited success in reducing the excess overdraft, especially if the program included the purchase of the land associated with the IGFR. However, the program does not necessarily have to include the purchase of the land. Instead, another option may be to purchase and retire the grandfathered rights only, but not the land. If the Department decides to modify the Third Management Plan to include such a program in the AMA, the rebound effect and land management and maintenance issues need to be fully addressed before the program is implemented.

8.7.5 Technical Assistance, Coordination, and Facilitation

The Department will continue to support augmentation project construction, planning, and research activities during the third management period. Technical assistance will be provided to entities in assessing the need for augmentation projects (especially in critical areas), determining project feasibility, and reviewing project impacts. Department staff will participate on oversight committees, provide data, and review planning and feasibility study reports. To facilitate research projects, the Department will assist entities by conducting research activities, assisting in study design, providing data, reviewing results, and disseminating information.

Many augmentation activities during the third management period will require the participation of water users, government agencies, and a variety of interest groups. Cooperative efforts among the participants will allow the development of more effective projects and studies. The Department will work with organizations to coordinate and facilitate augmentation activities. Examples of these activities include: (1) developing a critical management area strategy, (2) reviewing the second plan of operation for the CAGRD and facilities plan for the AWBA, (3) promoting the efficient use of the CAP delivery system, (4) facilitating Indian water rights settlements and leases, (5) further assessing the feasibility of other augmentation measures, and (6) working with organizations such as the West Valley Central Arizona Project Subcontractors (WESTCAPS) and other local groups to find solutions to water management problems.

8.7.5.1 Critical Area Strategy Planning

As described in Chapter 2 and summarized in the physical assessment section of this chapter, certain areas within the AMA are experiencing water management problems that are more serious than in other portions of the AMA. Two areas in the AMA, the northwest portion of the West SRV Subbasin and the Carefree Subbasin, need particular attention. These areas could continue to experience severe water management problems even if safe yield is achieved on an AMA-wide basis unless a more localized approach to water management is implemented.

Without an increased water management emphasis in these areas, existing problems such as drawdown, subsidence, earth fissures, etc., are anticipated to become worse. Therefore, the Phoenix AMA will place more emphasis on these areas through the third management period to develop a strategy to address these problems.

In conjunction with critical area strategy planning, many things can be done to help reduce future subsidence, earth fissuring, and associated damage in critical areas. One of the most important steps which

must be taken is to create an awareness among groundwater users, land developers, urban planners, and regulatory agencies about the potential problems which may be caused by future subsidence. One step which has been taken to promote this needed awareness is the formation of an internal Department subsidence group which will examine various subsidence issues and make recommendations concerning future rule modifications, regulatory approaches, and public education. Externally, the Department, the Arizona Geological Survey, the United States Geological Survey, and the intergovernmental Steering Committee on Land Subsidence and Earth Fissures will play an important role in providing education, information, and recommendations on subsidence-related issues.

Other planning efforts may include: (1) developing local/state partnerships, (2) identifying stakeholders, (3) identifying problems, (4) identifying groundwater pumping issues, (5) conducting hydrogeologic investigations as necessary, (6) examining new legislation and or local ordinances to remove barriers to problem mitigation, (7) providing recommendations for the AWBA regarding storage locations, (8) developing programs, and (9) creating incentives that contribute to a solution.

8.7.5.2 West Valley Central Arizona Project Subcontractors

A coalition of west valley water providers has been formed to establish a coordinated water resources planning effort to determine how renewable resources may be used to accommodate future urbanization. This coalition, known as WESTCAPS, is conducting a study to develop regional water strategies to optimize the efficient use of CAP allocations in the West SRV.

The Department is providing WESTCAPS with technical and planning assistance. In addition, financial support has been provided from the conservation assistance and augmentation grants fund.

8.7.5.3 Salt River Valley Model

The Department has developed a regional groundwater flow model of the Salt River Valley to provide an analytical tool capable of quantifying the effects of various groundwater management and conservation scenarios on the groundwater supplies within the study area. This model is currently used in the analysis of applications for Certificates and Designations of AWS within the Phoenix AMA.

This model provides a cumulative source of hydrologic and geologic data for the Phoenix AMA and is intended for use by interested parties and as a framework for other models in the Salt River Valley. The model may be restructured in the future to incorporate water quality data, data regarding seasonal hydrologic stresses, a subsidence package, new water level data, and improved geologic data.

8.7.5.4 Gravity Surveys, Subsidence Monitoring, and Development of a Predictive Model

The Department is conducting a gravity survey and subsidence monitoring program in the Phoenix, Tucson, and Pinal AMAs to provide data that can be used to evaluate water level trends, groundwater storage changes, aquifer system compaction, and land subsidence conditions. The results of these analyses will then aid the Department in formulating future groundwater management policies. Gravity surveys can provide accurate information regarding changes in aquifer storage. Land subsidence monitoring provides a means to detect ongoing and potential future damage to the land surface. It is proposed that data gathered through this program will enhance the existing information on subsidence and determine if subsidence has occurred in other areas of the Phoenix AMA. The Department will make this information available to the public and will be available to discuss and present the results with local advisory groups or committees that have an interest in the topic.

In addition to the subsidence monitoring, the Department will also develop a subsidence predictive modeling component that will be used in conjunction with the Hydrology Division's Salt River Valley

Groundwater Flow Model. This tool will be used for educational and planning purposes and for estimating the level of subsidence likely to occur, if any, under various groundwater withdrawal scenarios. In particular, this information will be useful in determining whether the depth-to-water limitations under A.A.C. R12-15-703 will contribute to additional subsidence in certain areas of the AMA. For the Phoenix AMA, A.A.C. R12-15-703 prohibits pumping below 1,000 feet below land surface. Therefore, if the modeling scenarios were to show that water levels at 1,000 feet below land surface caused additional subsidence in areas which resulted in substantial unreasonable harm, then it may provide the evidence that a depth-to-water limitation under the AWS Rules should be reevaluated.

8.7.6 Financial Assistance

The Department's Augmentation Assistance Program is described fully in Chapter 9. This program provides funding for augmentation, reuse, and recharge projects to enhance the region's water supply through grants, contracts, and intergovernmental agreements.

8.7.7 Resolution of Legal and Institutional Barriers

The Department will continue to work with interested parties in the AMAs and around the state to draft rules and propose legislation that will resolve legal and institutional barriers to augmentation activities. Among the barriers are difficulties with the recharge permitting process and conflicting objectives of various regulatory programs. Some problems the Department can address with its existing resources, tools, and authorities, such as revising the well spacing and impact rules. The Department can also indirectly influence progress in some areas through support of legislation. For some issues, new or revised statutory authorities may be necessary.

8.7.7.1 Colorado River Issues

The Colorado River is a very important source of water for the State of Arizona, both for the agricultural interests and towns along its banks and for the central valleys of the state served by the CAP. The supply is managed by a series of reservoirs controlled by the Secretary through the United States Bureau of Reclamation (USBR). In Arizona, the two principal reservoirs are Lake Powell (Glen Canyon Dam) and Lake Mead (Hoover Dam).

In 1964, the United States Supreme Court issued a final decree in the case of Arizona v. California, 376 U.S. 340 (1964), granting Arizona permanent rights to 2.8 million acre-feet of mainstream Colorado River water for use within the state, to the extent that the water was available within the system. The Court also provided the division of the water in years of surplus and shortage. In 1968, Congress passed the Colorado River Basin Project Act, which authorized the construction of the CAP and also altered the priority system on the mainstream. The Act directed the Secretary to adopt operating plans for the Colorado River system, including criteria for determining surplus and shortage conditions, and to operate the system in years of shortage so that California would receive its full entitlement of 4.4 million acre-feet before any water was available to the CAP. This latter political compromise, which was necessary to gain approval of the CAP over the objections of California, has effectively made the CAP the last priority water right among the states of the Lower Division in the Colorado River basin.

In 1983, once the CAP was under construction, the Secretary completed the National Environmental Policy Act analysis of the allocation of CAP water by publishing the Record of Decision in the federal register. This final determination made initial allocations of CAP water and provided guidelines for future allocations. It also included criteria for reducing CAP deliveries in years of shortage on the Colorado River. Thus, there are two separate shortage criteria that govern deliveries through the CAP–the shortage criteria and priorities on the river system and the shortage criteria and priorities within the CAP.

The Department is the state successor to the Arizona Interstate Stream Commission, and has been granted authority to represent the state in all matters concerning the rights to waters of interstate streams, most notably the Colorado River. In this role, the Department has the responsibility of monitoring the Secretary's operation of the Colorado River system, and of working with the USBR to insure that the system is operated in a manner consistent with Arizona's interests. In recent years, this has become a greater challenge as increasing demand on the system has forced the Secretary to make difficult choices on a variety of issues ranging from the development of surplus and shortage criteria to formal consultation with the United States Fish and Wildlife Service (USFWS) on the needs of endangered species under the Endangered Species Act.

The Department has been active in all of these decision-making processes. Primarily, these have involved interstate negotiations to resolve the competing demands on the river. Arizona has finally reached a point where it is using most, if not all, of its 2.8 million acre-feet entitlement. This use prevents the Secretary from delivering Arizona's unused water to California, which has occurred every year since the 1964 decree. The California demand is approximately 5.3 million acre-feet per year, with no indication of a meaningful plan for reduction yet announced. Nevada is also rapidly approaching full utilization of its .3 million acre-feet apportionment and is actively looking for new sources of water on the river. The Secretary may attempt to meet all demands on the river without requiring California to curtail its use to 4.4 million acre-feet (its full entitlement) by "borrowing" from the system by declaring surplus conditions. This borrowing impacts Arizona because of the low priority of the CAP. If the reservoirs are drawn down to accommodate excess demand, shortages may occur earlier, and they may be more severe than if the demand were limited.

The Department has spent considerable effort modeling the river system and working with the USBR to develop surplus and shortage criteria that would base surplus declarations on excess supply, rather than excess demand. This would result in a series of small shortages on the system, rather than a few very large shortages. This strategy would protect the M&I users of the CAP in most years by not exceeding the cushion of shortage protection created by non-Indian agricultural CAP contractors, who would be required to forego their right to use CAP water before any M&I shortage occurs. Also, the Department has been active in negotiating with the Secretary on resolving ambiguities and conflicts over the priorities within the CAP system, particularly those shortage decisions between M&I users and Indian contractors. While hydrologic predictions do not indicate shortages on the river system for many years to come, significant historical analysis shows that such shortages are almost a certainty. The Department is very interested in settling shortage criteria and correcting ambiguous or conflicting regulations before any shortage occurs.

The Endangered Species Act has become a much greater component of water management and planning in recent years. This is particularly true on the Colorado River because the entire system is managed by the federal government. Each federal agency has the duty to consult with the USFWS over any federal action that may affect endangered species or habitat, and the USFWS has the authority to require reasonable and prudent alternatives and remedial measures as a condition to continued federal action. Because Colorado River operations are so important to Arizona, the Department became a founder of a group of state agencies and utilities dedicated to finding a cooperative solution to the restrictions of the Endangered Species Act. This group, known as the Lower Colorado River Multi Species Conservation Plan Steering Committee, is actively planning a long-term habitat conservation plan and programmatic consultation program with USBR and the USFWS. This plan is designed to accommodate current water and power production on the river while protecting and enhancing habitat for all species determined to be threatened by river operations. By supporting this program, the Department hopes to avoid any alteration of the water delivery system which would negatively impact Arizona's water supply.

8.8 ADDITIONAL WATER MANAGEMENT TOOLS

Beyond the third management plan programs, the following sections describe other management tools that assist water users in achieving water management objectives.

8.8.1 Assured Water Supply Rules

The Assured and Adequate Water Supply Rules are a primary tool in achieving the AMA's management goals and ensuring sufficient water supplies for new development. This program provides the largest impetus for water providers to develop Augmentation and Recharge Programs through the need to have a safe, secure water supply to meet demands for 100 years. To be consistent with the Rules, water providers or developers either acquire renewable supplies for direct use or underground storage to meet future demand, or they join the CAGRD who will replenish the aquifer with renewable supplies on their behalf to replace groundwater that is pumped to meet their demand.

8.8.2 Water Exchanges

Water exchanges are water-for-water trades between two or more parties that improve the management of limited water supplies. Water exchanges can reduce the cost of water deliveries and allow the quality of water to be matched with the requirements of the user. Entities in the Phoenix AMA have engaged in water exchanges to satisfy Indian water settlements, to overcome distribution system limitations, and to obtain cheaper sources of water. Water exchanges are governed by A.R.S. §§ 45-1001, *et seq.*

8.8.3 Well Spacing Rules

The Code states that the director shall adopt rules governing well locations (A.R.S. § 45-598(A)) and may adopt rules governing pumping patterns (A.R.S. § 45-601) to minimize damage to adjacent land and water users. The Department is currently evaluating existing draft well spacing and well impact rules pursuant to the criteria specified by A.A.C. R12-15-830; however, the Department also is considering new rules. New rules in this area could better address the statutory requirements of protection, including criteria with which potential subsidence-related impacts and damage may be quantitatively evaluated. New rules could also assist in the goals of this Augmentation Program by allowing greater scrutiny of localized aquifer conditions.

8.8.4 Indian Water Rights Settlements

Settlement of long-standing disputes over the water rights claims by Indian communities in the state would assist water management by providing certainty over the legal rights to water of both tribal and non-Indian entities. The Department participates in and encourages settlement discussions, offering technical assistance and ensuring that state water laws and policies are considered by the parties. To help in settlement discussions, the state has created the Office of Indian Water Rights Settlement Facilitation. The parties may utilize the facilitator for information, facilitation, and mediation purposes.

8.8.5 Water Protection Fund Grants

Legislation establishing the AWPF Commission was passed in 1994. The purpose of the AWPF is to provide grant monies to water users for implementing projects to protect or restore the state's rivers and streams, including the purchase of CAP water or effluent for riparian enhancement. The Legislature appropriated $4 million for the AWPF from the state general fund in 1994, $6 million in 1995, $1.6 million in 1996, $5 million in 1997, and $1.6 million in 1998.

AWPF grants could impact future augmentation activities in the Phoenix AMA by providing funds to develop riparian enhancement projects which would utilize excess CAP water or effluent. While the amount of incidental recharge occurring due to these activities would increase, new or enhanced riparian areas also create an additional demand for water supplies.

8.9 FUTURE DIRECTIONS

Many issues must be addressed in order to achieve safe-yield and the other objectives discussed in this chapter. There is a growing recognition that the regulatory and non-regulatory tools available may not be sufficient to meet the AMA water management objectives. As has been discussed, numerous factors affect water use patterns, many of which are not affected by the Department's programs. Although some Code provisions are directly linked to achievement of the management goal, water management tools could be improved in many ways.

Critical area management strategies need to be formulated during the third management period to attempt to move beyond the AMA-wide goal and address water management problems in specific geographic areas of the AMA. The critical area strategy program will focus on problems associated with groundwater pumping, such as large cones of depression, subsidence, earth fissures, reduction in aquifer storage capacity, and the reduced physical availability of supplies. In addition, developing programs that promote the beneficial use of groundwater from waterlogged areas to replace groundwater pumped elsewhere serves multiple purposes. These efforts will require partnerships with entities from the areas in question who are willing to make necessary changes and support more stringent requirements to improve groundwater conditions.

It may be necessary to reexamine the AWS Rules provision that deems groundwater up to 1,000 feet below the land surface to be physically available. Allowing groundwater levels to fall this low will exacerbate subsidence and earth fissures, water quality problems, and problems with well productivity. Results from the subsidence monitoring and gravity survey conducted by the Department and its subsequent incorporation into the groundwater flow model will provide information that can be used to amend the Rules if changes are warranted.

Further examination of the purchase and retirement of IGFRs will be conducted. Issues such as whether the current withdrawal fee would be sufficient to successfully carry out this program and whether the Department will consider the purchase and retirement of the lands associated with the rights will be evaluated.

The Third Management Plan storage and recovery criteria relating to the decline rate remained consistent with the Second Management Plan. However, further evaluation will be conducted in the third management period to determine whether more stringent criteria is warranted, especially in relation to developing a critical management strategy.

Through the third management period, continued evaluation of meeting water management objectives through AWBA activities will be conducted, including researching where water storage and credit extinguishment could provide the most benefit to the AMA.

REFERENCES

AWBA, 1997. Storage Facility Inventory. p. 11.

CAP Agricultural Water Supply Available Under Restructured Plan, Revised January 17, 1994.

CAP Annual Operations Summaries, 1990-1997.

CAP Subcontracting Status Report, March 20, 1998.

Halpenny, L.C., 1984. Waterlogging within the Buckeye Water Conservation and Drainage District, Buckeye Valley, Arizona. p. 3-1.

Hoff, T.M., 1998. Maricopa County Flood Control District. Letter to S. Ehlers.

Kinshella, P., 1997. City of Phoenix. Personal Communication.

Larson, M.K. and Pewe, T.L., 1986. *Origin of Land Subsidence and Earth Fissuring, Northeast Phoenix*, Arizona. Bulletin of the Association of Engineering Geologists, Vol. XXIII, No. 2, pp.139-165.

Maricopa Association of Governments, 1993. 208 Water Quality Management Plan. p. 3-5.

Montgomery, E.L. and Desert Agricultural and Technology Systems, Inc., 1988. *Study of Waterlogging Problems in the West Salt River and Hassayampa Sub-basins of the Phoenix Active Management Area*. Desert Agricultural and Technology Systems, Inc.

Pewe, T.L., 1990. *Land subsidence and earth-fissure formation caused by groundwater withdrawal in Arizona; A review*, in Higgins, C. G., and Coates, D.R., eds., Groundwater geomorphology; *The role of subsurface water in Earth-surface processes and landforms; Boulder, Colorado.* Geological Society of America Special Paper 252, pp.219-233.

Schumann, H.H., 1992. *Land subsidence and earth-fissure hazards near Luke Air Force Base, Arizona.* 18 USGS Subsidence Interest Group Conference, Edwards AFB, Antelope Valley, Nov. 18-19, 1992; Abstracts and Summary.

Slaff, S., 1993. Land Subsidence and Earth Fissures in Arizona. Arizona Geological Survey Down-To-Earth Series 3, 24 p.

Wachter, J., 1997. Luke Air Force Base Memorandum for CES/CEVC.

APPENDIX 8A
PERMITTED STORAGE FACILITIES FROM MAY 1988 THROUGH MARCH 1998
PHOENIX ACTIVE MANAGEMENT AREA

Facility	Type	Pilot/ Full-Scale	Source	Annual Volume (AF)	Subbasin Location	*Total Stored (AF)
Surprise/South WWTP	USF	Pilot	effluent	313	West SRV	61
Surprise/South WWTP	USF	Full-scale	effluent	3,584	West SRV	0
Goodyear WWTP	USF	Pilot	effluent	3,360	West SRV	0
Chandler/Regional Park	USF	Pilot	effluent	250	East SRV	0
Chandler/Regional Park	USF	Full-scale	effluent	5,600	East SRV	0
Chandler/Intel	USF	Full-scale	effluent	3,100	East SRV	0
Del E. Webb/ Sun City West	USF	Full-scale	effluent	3,042	West SRV	5,775
Peoria/Beardsley	USF	Full-scale	effluent	2,470	West SRV	0
Ocotillo	USF	Full-scale	effluent	2,500	East SRV	3,476
Gilbert	USF	Full-scale	effluent	3,314	East SRV	14,530
Pima Utilities	USF	Full-scale	effluent	628	East SRV	0
Mesa Northwest Wastewater Reclamation Plant	USF	Full-scale	effluent	8,963	East SRV	21,034
Goodyear/ White Tanks	USF	Pilot	CAP	120	West SRV	0
Surprise/McMicken	USF	Pilot	CAP	2,000	West SRV	200
Scottsdale/ East Pima	USF	Pilot	CAP	5,000	East SRV	246
Scottsdale /Water Campus	USF	Pilot	CAP	5,000	East SRV	1,481
Avondale	USF	Pilot	CAP, Salt &Verde	10,000	West SRV	0
Del Webb Home Construction/ Sun City Grand	USF	Pilot	Surface water from MWD	150	West SRV	0
Tempe /Kyrene	USF	Pilot	CAP, effluent	1,000	East SRV	113
Peoria/ Skunk Creek	USF	Pilot	CAP, Salt & Verde	10,000	West SRV	0
Phoenix /Injection	USF	Full-scale	CAP	600	West SRV	305

APPENDIX 8A
PERMITTED STORAGE FACILITIES FROM MAY 1988 THROUGH MARCH 1998
PHOENIX ACTIVE MANAGEMENT AREA

Facility	Type	Pilot/ Full-Scale	Source	Annual Volume (AF)	Subbasin Location	*Total Stored (AF)
Mesa/ Red Mountain	USF	Full-scale	CAP	2,000	East SRV	0
Granite Reef Underground Storage Project	USF	Full-scale	CAP, Salt & Verde, Plan 6	200,000	East SRV	165,782
Litchfield Park Service Company/ Sun Cor Farms	GSF	N/A	effluent	840	West SRV	679
San Tan Irrigation District	GSF	N/A	CAP	5,000	East SRV	7,660
Salt River Project	GSF	N/A	CAP	200,000	East SRV& West SRV	49,422
Pima Utilities/ Sun Lakes	GSF	N/A	effluent	1,500	East SRV	2,008
Queen Creek Irrigation District	GSF	N/A	CAP	28,000	East SRV	57,357
Chandler Heights Citrus Irrigation District	GSF	N/A	CAP	3,000	East SRV	3,662
Roosevelt Water Conservation District	GSF	N/A	CAP, effluent	100,000	East SRV	58,996
Maricopa Water District	GSF	N/A	CAP	18,000	West SRV	0
Tonopah Irrigation District	GSF	N/A	CAP	15,000	Hassayampa	29,032
New Magma Irrigation District	GSF	N/A	CAP	54,000	East SRV	141,935
TOTAL				**698,334**		**563,754**

* Total water stored through 1996.
WWTP = Wastewater Treatment Plant
MWD = Maricopa Water District
AF = acre-feet
CAP = Central Arizona Project
East SRV = East Salt River Valley
West SRV = West Salt River Valley
USF = Underground Storage Facility
GSF = Groundwater Savings Facility
N/A = Not applicable

APPENDIX 8B
DECLINE RATE METHODOLOGY

In evaluating an application for a proposed recovery well permit, the Department considers many factors in determining consistency with the average water level decline rate siting criteria. The time frame for which the average is calculated may vary based on data availability and the hydrologic characteristics of the area. Major trends in precipitation, water supply utilization over time, hydrogeologic data, and the modeling of projected impacts may be factors in evaluating this rate. Other considerations may also be appropriate depending on the location of the proposed recovery well.

Typically, the Department examines the historic static water level data for the period of record for wells located in the section in which the proposed recovery well is located and in the adjacent eight sections. The specific area examined depends on the availability and quality of water level data and the hydrogeology of the area. Bedrock outcrops, large pumping centers, and other features may affect the determination of pertinent data. Generally, wells that are screened in the aquifer of concern and are regularly monitored using consistent methods for static water level data are good reference points (such as the Department's statewide monitoring or index wells). The Department examines the well hydrographs (graphs of static water levels over time), and evaluates the slope of the curve for the period of interest. The slope indicates whether the static water level in the monitoring well has risen or fallen over time. A horizontal line on the hydrograph indicates that water levels remained stable over time. The Department identifies what activities may have caused the groundwater changes over time to see whether the activity still exists or has been reduced, eliminated, or increased over time.

This approach provides more flexibility and protection of the groundwater resource than would be provided by a simplistic evaluation of decline rates calculated for all water level data within a set radius and during the entire period of record. For example, if a recovery well is proposed for an area which historically had a rapid decline in groundwater levels due to activities that no longer exist (e.g., retirement of agriculture after heavy agricultural use in the 1940s and 1950s), and if the proposed area is not at high risk for subsidence, the proposed recovery well might be deemed consistent with the average decline rate criteria by looking at the period of time after the historic change in use. Similarly, if water levels in the vicinity of the proposed recovery well were stable for decades but a relatively new use caused rapid rates of decline, the proposed recovery well may be deemed inconsistent with the criteria.

The Department's groundwater models may be used to project future water levels and decline rates on a regional basis. Modeling may assist the permittee in evaluating recovery options. Where there are sufficient data, a model may give an indication of how long recovery within a region may remain permitted based on the current average decline rate criteria.

The most current procedures for establishing the average groundwater level decline rate in the vicinity of a proposed recovery well will be published in the Department's Recovery Well Application Packet.