CHAPTER TWELVE: WATER MANAGEMENT STRATEGY

12.1 INTRODUCTION

The Tucson Active Management Area (TAMA) Fourth Management Plan (4MP) historical data analysis and projections indicate that it is possible for the TAMA to achieve safe-yield by 2025. In fact, the TAMA has achieved a safe-yield condition in some recent years. Achievement and maintenance of safe-yield requires that TAMA water users reduce groundwater pumping, increase underground storage of Central Arizona Project (CAP) and reclaimed water and continue to implement water conservation measures. How long the TAMA will be able to maintain a safe-yield condition will depend on additional water conservation and water augmentation measures, as well as natural water supply conditions and growth patterns.

12.2 WATER MANAGEMENT CHALLENGES

The TAMA has recently attained safe-yield for certain specific years, and could achieve long-term safe-yield by 2025 depending on choices made by holders of water rights and regional water management decisions as described below. Increased use of reclaimed water and full utilization of CAP supplies are fourth management period objectives. Maintaining safe-yield is a concern that will need to be addressed in the future, as municipal growth continues and renewable supplies are maximized. Management of conditions of drought and shortage, when CAP supplies are not available or experience reduced availability, is another important future consideration. Finally, although safe-yield is an AMA-wide calculation, the location where water is stored relative to the location where the stored water is recovered can be an important factor in addressing local water level declines, subsidence, earth fissures and reduced physical availability of groundwater for potential future development. Refer to Chapter 8, Figure 8-1, for the location of water storage relative to the location of recovery wells. Planning for proximity of the location of recovery in relation to the location of storage can help mitigate these challenges.

The following section describes in more detail the major water management challenges facing the TAMA during the fourth management period and beyond.

12.2.1 Allowable Groundwater Pumping

Several categories of water users, both existing and potential new users, may legally withdraw groundwater without replenishing or replacing that volume of water back into the aquifer. These uses contribute to overdraft and, under current regulatory framework, may increase and continue in perpetuity.

Agricultural Sector

As part of the adoption of the Code, Irrigation Grandfathered Groundwater Rights (IGFRs) were granted that allow farmers to withdraw groundwater for agricultural use. No new IGFRs may be created and the amount of land that may be irrigated is limited to that which was historically irrigated. However, an existing IGFR may be conveyed to a new owner, retired to a Type 1 Non-Irrigation Grandfathered Right (Type 1 GFR), or extinguished for credits that may be used to prove the Assured Water Supply (AWS) requirement of consistency with the TAMA management goal. The trend through 2013 in the TAMA has been a gradual reduction in IGFRs, either through conversion to Type 1 GFRs or through extinguishment for AWS credits. Of the 11,000+ reduction in irrigation acres in the TAMA since 1985 about 1,300 acres are associated with extinguishments.

IGFR groundwater use represents a perpetual authority to withdraw groundwater without a replenishment requirement. Agricultural users in general within the TAMA have always used significantly less water than their allotments. Despite this, agricultural demand in the TAMA, although fluctuating over time, shows no trend of decline.

Voluntary use of renewable supplies by currently active farms is limited by economics. Without subsidies or financial incentives, the cost to deliver and use renewable supplies is generally higher than the cost to pump and use groundwater. Although the Groundwater Code prohibits new land from being brought into agricultural irrigation in the TAMA, there has historically been some land associated with IGFRs that is not under irrigation; agricultural groundwater use could increase beyond current levels if more of the acreage associated with IGFRs is farmed. If these IGFRs continue to be farmed through 2025 and beyond, then the agricultural sector could help move the TAMA closer to safe-yield through further reductions in agricultural groundwater use and increased use of renewable water supplies, combined with enhanced on-farm irrigation water management practices.

Industrial Sector

Industrial groundwater use is less likely to contribute to reaching the TAMA safe-yield goal due to the potential for growth in industrial groundwater use and existing constraints on replacing groundwater use with renewable supplies. Industrial water users in some cases may acquire new groundwater withdrawal permits (e.g., general industrial use permits) and may obtain, through purchase or lease, currently unused non-irrigation grandfathered rights to pump groundwater. The available groundwater allotments of current industrial rights and withdrawal permits alone exceed the average annual volume of natural recharge that has occurred in the TAMA between 1985 and 2013. Of particular note in the TAMA is the long-term groundwater demand of the mining industry, which is projected to remain a major groundwater user for the foreseeable future. There is no regulatory or statutory authority at this time to require industrial water users to convert to renewable supplies; however, some users may choose to do so voluntarily.

Future industrial sector development in the TAMA will likely impact the achievement of safe-yield if currently unused Type 1 and Type 2 Grandfathered Groundwater Rights (GFRs) are used to meet water needs. However, in 2013, TAMA water used for industrial purposes was less than 30 percent of industrial GFR and permit allotments. Between 1985 and 2013, industrial users in the TAMA on average only used 28 percent of industrial GFR and permit allotments. Although the unused industrial GFR and permit allotments represent a significant potential groundwater demand, legal water management decisions and land use ordinances can reduce the groundwater impacts these allowable uses represent. For example, Pima County prohibits the use of groundwater on new golf courses[1].

The largest industrial subsector in the TAMA is for mining use, followed by water used by turf-related facilities including golf courses. Water use by mines in the TAMA fluctuates with the world commodities market. The expected lifetime of the existing mines in the TAMA extends well into the next century, but exactly how long will depend on the economic feasibility of the mining and extractive processes available to local operations. It is also possible that additional ore bodies may be developed, although most potential new sites are just outside the TAMA boundaries. Groundwater withdrawals within the TAMA to meet processing demand when these properties are developed will depend on the location of milling installations. To remain competitive, mines within the TAMA must consider, among other factors, the cost of the water supply needed to mine and process the ore. While a certain amount of the CAP allotment for the state was designated for mining operations, all subcontracts were declined by TAMA mining interests due to cost, contract terms and water quality considerations. However, at the completion of the 2014 Non-Indian Agricultural priority CAP water reallocation process, ADWR recommended to the US Secretary of the Interior that 6,802 ac-ft of CAP water be reallocated to Freeport-McMoRan-Sierrita and Rosemont Copper Company[2].

[1] See Title 18, Chapter 18.59.040 of the Pima County Zoning Code.
[2] See ADWR's January 16, 2014 letter to the US Secretary of the Interior.

Municipal Sector

The municipal sector is the dominant water use sector in the TAMA. Municipal demand in 2013 was approximately 161,916 ac-ft. Currently, of the agricultural, industrial and municipal sectors, only new municipal use is legally required to utilize renewable supplies (through direct use or storage and recovery). Municipal groundwater demand has reduced by more than 78 percent since it peaked in the year 2000, with most of the reduction occurring since 2005. Many municipal providers in the TAMA have experienced declines in overall water demand in recent years. Montgomery & Associates' residential demand study conducted in 2014 also indicated a trend in reduction in municipal residential demand for several providers in the TAMA. However, it is important for municipal provider to monitor their water demand and respond if the trend reverses. Since the adoption of the AWS Rules in 1995, new subdivisions in AMAs and providers with a Designation of Assured Water Supply (DAWS) are required to offset their groundwater use to meet the AWS criterion of consistency with the TAMA management goal. The AWS requirements only apply to designated providers and to new subdivisions served by non-designated providers. Subdivisions platted before the 1995 AWS Rules became effective and un-subdivided land within undesignated service areas can continue to use groundwater without replenishing it.

Exempt Wells

As of 2013, ADWR estimates that about 29,000 people within the TAMA are self-supplied water via exempt domestic wells. An exempt well is one equipped to pump less than 35 gallons per minute. ADWR does not impose any conservation requirements on exempt well water use, nor does ADWR collect any data, annually or otherwise, pertaining to water withdrawals by exempt wells. In the projected demands for the 4MP, ADWR assumed each exempt well served about 2.5 persons; and that each person self-supplied via an exempt well in the TAMA would use 45 gallons per capita per day for interior uses; and that exterior uses for each exempt well would be 60 gallons per day, based on recent information from the Central Arizona Groundwater Replenishment District (CAGRD), municipal provider Annual Water Withdrawal and Use Reports and recent studies conducted on residential water uses. Without the collection of additional data, the ability to determine the precise impact of exempt wells on achievement of the TAMA safe-yield goal remains limited.

Groundwater Allowance and the Assured Water Supply Program

The AWS Rules, adopted in 1995, are a primary tool in achieving the TAMA's management goals and ensuring sufficient water supplies for new development. Pursuant to the AWS Rules, a certain declining volume of groundwater is allowed to be used and not replenished or offset. These groundwater allowances are designed to help municipal providers transition from groundwater to renewable supplies. Certain other temporary exemptions allow the pumping of groundwater during periods when renewable supplies are unavailable.

When a DAWS or Certificate of Assured Water Supply (CAWS) is issued, a groundwater allowance account is established. ADWR may credit additional allowable groundwater use to these accounts under certain conditions. The AWS Rules describe under what circumstances the groundwater allowance can increase.

The AWS Rules also allow credits to be added to the groundwater allowance of a DAWS or CAWS though extinguishment of grandfathered rights (IGFRs, Type 1, and Type 2 GFRs) within the same AMA. The methods of calculating these extinguishment credits are described in the AWS Rules and vary for each AMA. Groundwater use reported pursuant to a water provider's or subdivision's allowable groundwater volume is considered consistent with the management goal of the AMA and is not required to be replenished. However, this groundwater use contributes to overdraft.

Any groundwater use by a designated provider or by certificated land beyond the groundwater allowance must be replenished. If a CAWS or DAWS applicant does not have access to a renewable water supply, the subdivision or service area may be enrolled in the CAGRD to satisfy the AWS replenishment requirement. If a municipal provider is a member service area, or a subdivision is member land of the CAGRD, any groundwater withdrawn in excess of the groundwater allowance must be replenished within the AMA by the CAGRD. This volume is referred to as excess groundwater.

Municipal water use accounts for close to half of all water used in the TAMA. More than 90 percent of the TAMA population falls within service areas that have a DAWS. Once a provider has joined the CAGRD, the CAGRD is committed in perpetuity to replenish the excess groundwater demand associated with existing uses and with new developments within the provider's service area during the membership period. The AWS Program and CAGRD have significantly increased renewable water use in the TAMA.

Most private water companies have chosen not to be designated. As of 2014, there were only four private water companies in the TAMA with a DAWS: Sahuarita Water Company, Spanish Trail Water Company, Vail Water Company (formerly Del Lago), and Willow Springs Utilities. New developments in undesignated providers' service areas must have a CAWS. However, undesignated water providers are likely to continue to pump groundwater to serve their existing customers, as well as customers not associated with subdivision development. This ongoing groundwater use can affect the ability of the TAMA to reach and maintain safe-yield.

Table 12-1 shows the status of municipal provider DAWS. All of the designated providers listed below are or will be members of the CAGRD. As Metro – West and Willow Springs Utilities begin to add customers, they will complete their enrollment in the CAGRD as Member Service Areas. Nearly 86 percent of the TAMA population is within the service area of a provider with a DAWS.

The City of Tucson (Tucson Water), the largest municipal provider in the TAMA, is a designated provider. Pursuant to A.R.S. § 45-463, Tucson Water may, at a future date, request to have groundwater withdrawals associated with certain Type 1 Non-irrigation GFRs included in its designation. This represents a significant amount of groundwater, up to two million ac-ft (A.R.S. § 45-463(F)(3)). This amount is in addition to its AWS groundwater allocation of approximately 1.5 million ac-ft.

TABLE 12-1
TUCSON AMA AWS STATUS OF DESIGNATED PROVIDERS

Provider	2013 Water Service Area Population	2013 Water Demand (ac-ft)	Designation Volume (ac-ft)	2013 GW Allowance Balance (ac-ft)
Tucson Water	713,102	113,884	182,852	1,259,458
Metro - Main	44,102	7,670	8,975	120,237
Town of Oro Valley	42,903	9,734	15,049	13,473
Flowing Wells ID	15,820	2,404	2,863	43,865
Town of Marana	15,174	2,195	7,580	338
Sahuarita Water Co.	14,852	1,547	10,983	9,309
Vail Water Co.	11,039	1,197	3,749	559
Metro - Diablo	2,567	254	4,144	0
Spanish Trail Water Co.	866	183	4,388	487
Metro - West	0	0	1,014	0
Willow Springs Utilities	0	0	2,875	0
TOTAL	**857,858**	**139,068**	**244,472**	**1,447,726**

As of September 2014, there were 27 large providers (those serving more than 250 ac-ft) and approximately 113 small undesignated providers in the TAMA. Some undesignated providers may have the ability to participate in augmentation efforts. The 2013 groundwater demand by large providers in the TAMA that are not designated was 19,012 ac-ft. Large providers that do not have a DAWS served 91,242 people in 2013. Efforts to encourage use of renewable water supplies in this sector merit further attention as a component of the TAMA Underground Water Storage, Savings and Replenishment Program.

12.2.2 Underground Storage and Recovery

Not all recovered water is considered the same under the AWS Rules. When an entity stores water in one location but recovers it some distance away, that stored water, is considered to be consistent with the AMA management goal; however, the water is not adding any physical availability in the location where the water is recovered. If instead water is stored and recovered from the same area, the stored water recharges the aquifer in the same location as the wells are pumping, and thus the stored water is adding physical availability to the wells that recover the water from within the area of impact of storage. Consideration of the recovery location will be more important in the TAMA in the future as groundwater levels in certain areas decline due to annual groundwater demand exceeding the volume of water that naturally or artificially recharges the aquifer each year.

A.R.S. 45-852.01(C) provides that reclaimed water stored in a managed underground storage facility (USF) incurs a 50 percent cut to the aquifer, meaning the storer would get credit for only 50 percent of the water stored. The cessation of reclaimed water storage at the managed USFs on the Santa Cruz River could affect riparian habitat that has benefited as a result of reclaimed water discharges to the river. However, reducing the cut to the aquifer to five percent or less would have an end-result contrary to the TAMA safe-yield management goal. Discussion of this topic may continue during the fourth management period.

12.2.3 Groundwater Savings Facilities

Groundwater Savings Facilities (GSFs) were used during the third management period to increase CAP water use and save groundwater supplies for future times of shortage. However, not all GSF permits have been put to use. For example, during the third management period Farmers Investment Company (FICO) secured a GSF permit for its irrigation rights in the Green Valley and Sahuarita areas. However, as of 2014 there was no infrastructure in place to bring a physical supply of CAP water to the GSF location. Plans are underway for construction of infrastructure to deliver CAP water to the GSF during the fourth management period.

12.2.4 Limitations on Availability of New Recharge Sites

Availability of suitable recharge sites affects direct recharge efforts in the TAMA. Physical factors affecting recharge feasibility include infiltration rates, permeability, geochemistry, available storage and the existence and extent of lower permeability or impermeable layers in the vadose zone. Although there are many locations within the TAMA suitable for recharge, there are limited sites capable of accepting large volumes of water.

Availability of sites for basin or in-channel recharge is also limited by areas of existing contamination and potential contaminant sources. Some reaches of stream channels in the TAMA are not suitable sites for developing surface recharge, because closed and active landfills, dumps and other land uses that could be sources of contaminants are located too close to stream channels.

Recharge using injection wells can be particularly useful in urban areas where there is insufficient space to develop a surface recharge site or land costs are too high for surface recharge to be economically viable.

The 1995 Water Consumer Protection Act (WCPA)[3] discourages use of injection of raw CAP water, but not injection of recovered CAP delivered through the drinking water distribution system. However, at this time it is cost prohibitive to use injection technologies on a large scale.

Proximity of a recharge project to the source of water that is to be stored is a significant economic feasibility factor for siting reclaimed water and CAP water projects because of the cost to construct and operate conveyance and distribution systems. Hydrogeologically suitable sites for recharge in some of the critical water level decline areas within the TAMA may be too far from existing reclaimed water delivery systems and the CAP canal to economically develop the sites. Use of the existing potable water supply system for delivery of recovered CAP water could improve the economic viability of some recharge sites.

Recovery considerations are another constraint on potential recharge site development. Concerns include where the facility is located with respect to the final use, whether the recovered water is determined to be groundwater under the influence of surface water and will therefore require filtering and disinfection and whether the proposed recovery will be feasible under recovery permit requirements in areas of severe groundwater overdraft and high subsidence risk *(See Chapter 7).*

12.2.5 Water Quality

Protecting and managing groundwater quality and matching water supplies of different quality to user needs maximizes the amount and utility of water available to the TAMA. Chapter 7 describes ADWR's Water Quality Management Program in detail. Most of the groundwater supplies in the TAMA meet all Environmental Protection Agency (EPA) and state drinking water standards. However, groundwater from some areas has contaminant levels that exceed the National Primary Drinking Water Regulation limits *(See Chapter 7).* Public education efforts are also needed to match water quality with intended uses and encourage the beneficial use of remediated groundwater.

Tucson's 1995 Water Consumer Protection Act prohibits delivery of groundwater that has been treated by Tucson Water to remove contaminants, even if the resulting water quality meets all federal and state drinking water standards. Within the Tucson Water service area, use of treated groundwater supplies and achievement of maximum beneficial use of treated groundwater produced by mandated clean-ups are complicated by this provision.

Water quality considerations regarding recharge are site-specific. They are related to the ambient groundwater quality (which varies across the TAMA), the soil chemistry, the quantity of water to be recharged, the degree of mixing with the ambient groundwater, past land-use practices, percolation rates and the period of time the recharged water remains in the aquifer. The location, volume and timing of recovery activities also impact water quality.

Water withdrawn in the vicinity of a recharge site is often a mixture of the recharged water and ambient groundwater. In some areas of the TAMA, recharge of CAP water would improve the quality of the ambient groundwater; in other areas, CAP recharge may lead to increases in the concentration of total dissolved solids (TDS). TDS concentration is one of several parameters that affect the aesthetic qualities of drinking water. The typical concentration of TDS in CAP water is higher than the concentrations of TDS found in the groundwater currently being withdrawn from many areas of the TAMA. Generally, artificial recharge processes, including percolation of water from surface basins through vadose zone soils, do not remove TDS from recharging water. Additionally, older groundwater supplies in the vicinity of recharge site which are located in deeper parts of the aquifer than those layers that are currently being tapped are also likely to

[3] See *https://www.tucsonaz.gov/water/water-consumer-protection-act*.

have higher concentrations of TDS and other inorganic parameters than the groundwater currently being supplied.

Beginning in 1992, Tucson Water initiated the direct delivery of CAP water. Due to significant water chemistry differences in the new CAP supply versus the historical supply, public perception of the water quality was degraded due to aesthetics primarily resulting from higher TDS. As a result of the impact of the implementation problems Tucson Water experienced, direct delivery has affected CAP water use plans beyond the City of Tucson. Public perception of CAP water quality, in conjunction with infrastructure costs, has made other communities in the TAMA reluctant to consider direct delivery of CAP water in the short term. However, there is support for the use of CAP water through annual storage and recovery.

Augmentation funds have been used to assess potential water quality impacts of recharge activities. ADWR funded a study of selected disinfection by-product issues related to the recharge and recovery of CAP water. ADWR also funded a water quality impacts evaluation as part of a study to assess the feasibility of delivering CAP water to water users in the Sahuarita-Green Valley area. These projects are described further in Chapters 7 and 9.

12.2.6 Conservation Alone is Insufficient to Achieve Safe-yield

Efficient use of all water supplies is prudent, especially in the arid southwest. ADWR conservation programs encourage efficient use of all water supplies. However, conservation alone is not sufficient to result in the achievement of safe-yield in the TAMA nor in any AMA, because replenishment is not required for most water demand sectors, certain types of groundwater rights are perpetual and certain segments of municipal demand can continue to develop using groundwater.

12.2.7 Reclaimed Water Use

The TAMA has a long history of using reclaimed water for turf-related watering. To encourage reclaimed water in particular for turf watering, ADWR has provided an incentive for the use of reclaimed water. The Turf Program in the industrial sector allows turf facilities to receive a discount on every acre-foot of reclaimed water used. This incentive was originally included in the management plans to encourage the replacement of groundwater with reclaimed water in the turf sector, which can help outweigh the additional cost of delivering and treating reclaimed water. However, this incentive may result in irrigation managers becoming less concerned about the volume of water being applied to the turf, and hence result in the application of more water than the minimum amount the turf actually needs, which might otherwise be stored underground and used to meet demand at a future date. However, the increased costs of reclaimed water versus groundwater may mitigate the concern for economic reasons.

Septic systems tend to be located in rural areas where no regional wastewater infrastructure exists. They require adequate percolation rates and densities greater than one residence per acre for approval. Use of septic systems reduces the amount of wastewater that may be reclaimed and re-used. Further, septic systems leachate cannot be directed to areas where water levels are declining as can wastewater collected through a centralized sewer system, which can be treated and stored underground under a water management strategy that addresses sub-regional areas within the TAMA.

In calculating the amount of long term storage credits (LTSCs) earned by a storer, there is currently no cut to the aquifer for reclaimed water stored at a constructed underground storage facility. This means that 100 percent of the water sent to store, minus evaporative losses and other debits, is recoverable.

12.2.8 Susceptibility of CAP Supplies to Shortage

The TAMA has taken significant strides in reducing its reliance on groundwater, most notably in the

municipal sector, primarily by increasing the use of CAP water. However, there are indications that CAP may experience shortages in the coming years which could increase the use of groundwater in the future and affect the TAMA's progress on decreasing overdraft. However, this will be mitigated by the storage of water by the Arizona Water Banking Authority (AWBA) and others that has already occurred for later recovery during times of shortage.

12.2.9 Infrastructure

The 4MP has identified at least two areas of infrastructure need in the TAMA. The first is the ability to continue to enhance storage and recovery of stored water from within the area of impact of storage near recharge projects in the Avra Valley Sub-basin, rather than continuing to recover water in areas of the Upper Santa Cruz Sub-basin that are experiencing water level declines. To reverse this trend, Metro Water has been developing a cooperative regional recharge and recovery project. The second is the extension of the CAP canal to the Green Valley/FICO area, which is also experiencing reduced groundwater levels due to continued and historical pumpage.

12.2.10 Limitation on Renewable Supplies

The 4MP projects that CAP water will be fully utilized within the three AMA CAP water service area by the year 2025. Further, CAP water may experience a reduction due to shortage prior to that. The AWS Rules require future growth to use renewable water supplies. After 2025, no additional groundwater allowance for AWS determinations is granted in the AWS Rules. Reclaimed water use will become more important, and eventually the need to develop additional alternative supplies to groundwater will come.

The AWBA has not yet met its goal of firming CAP supplies in the TAMA; however, it has plans to be more aggressive in storing water in the TAMA in the future to work towards meeting the firming goal.

12.3 POSSIBLE SOLUTIONS

During the fourth management period, ADWR will continue to develop long-term water management solutions to address the challenges described in section 12.2 and work with the regulated community as well as other stakeholders within the TAMA to identify challenges and develop and implement solutions to water management challenges.

12.3.1 Agricultural Solutions

Although IGFR holders will continue to hold the right to pump and use groundwater in perpetuity, reductions in agricultural groundwater use are beneficial in achieving and maintaining the goal of safe-yield in the TAMA. The increased utilization of renewable water supplies to replace groundwater use, combined with demand reduction efforts to enhance on-farm irrigation water management practices, are key factors in meeting this water resource management goal.

ADWR will continue to work cooperatively with the agricultural community to ensure that existing conservation requirements are effective and appropriate. In addition, ADWR also will work closely with the agricultural community throughout the fourth management period to ensure that the BMP Program is an effective and efficient agricultural water conservation program that helps move the TAMA closer to the achievement of its safe-yield goal. ADWR, in conjunction with the BMP Advisory Committee, will monitor and analyze both existing and newly implemented BMPs.

ADWR will continue to monitor crop and water use patterns during the fourth management period to assess agriculture's impact on achieving the goal for the TAMA and to evaluate the effects of ADWR programs on farming operations. The impacts of the agricultural market on water use trends will also be evaluated

for future planning needs. ADWR will also encourage and evaluate incentives for the increased use of reclaimed water by the agricultural sector.

To completely eliminate overdraft in the agricultural sector, agricultural users would need to rely almost exclusively on renewable supplies or be required to replenish groundwater pumping.

12.3.2 Industrial Solutions

The future of industrial use in relation to the safe-yield goal for the TAMA is largely shaped by the potential for growth in groundwater use and existing constraints on replacing groundwater use with renewable supplies.

In order for the industrial sector to contribute more to the achievement of the TAMA goal, there must be continuing and enhanced water use efficiency, meaningful incentives for the use of renewable water supplies and viable administrative and physical renewable resource use mechanisms in place. The majority of reclaimed water use during the fourth management period is projected to continue to be used by municipally-served turf facilities through the Tucson Water regional reclaimed system. However, there may be potential for CAP and reclaimed water use by sand and gravel facilities and CAP use by mines or other facilities in the future. In order for this to occur, there would need to be either regional infrastructure cost sharing for direct use to make it economically viable to use a renewable supply, or low-cost replenishment mechanisms whereby pumped groundwater would be replenished by a renewable supply elsewhere in the TAMA under certain conditions. For mining use, CAP water would likely require additional treatment.

Apart from the groundwater right retirement provision in the Code and the groundwater right extinguishment provisions in the AWS Rules, there is currently no regulatory authority that could reduce grandfathered groundwater rights. ADWR has decided not to include a grandfathered right purchase and retirement program in the TAMA 4MP. The extent to which the extinguishment provisions in the AWS Rules will limit industrial use is impossible to predict. It may be necessary to explore groundwater replenishment approaches to offset a portion of industrial pumpage. Approaches such as expanding the authority of the CAGRD to recharge excess CAP water outside of the AWS Program or establishing a separate replenishment authority for industrial users are possible mechanisms. Statutory change would be necessary to implement either mechanism.

Industrial water uses may change as new technologies are developed. Research may need to be conducted during the fourth management period to investigate water conservation opportunities associated with use of these technologies by certain industrial users. This research could be used to develop conservation requirements for the Fifth Management Plan (5MP).

Turf Program

Groundwater use by turf facilities in the TAMA has reduced over time; however, groundwater remains a large component of the water supply for turf-related facilities. ADWR's focus on increasing the direct use of reclaimed water during the fourth management period, the continuation of incentives to use reclaimed water and aquifer management techniques to bring the location of recovered water closer to the area where the water is stored can assist the turf sector in further reducing its reliance on groundwater.

Mining Program

The potential for additional groundwater conservation is limited at mines due to the current level of conservation and recycling being practiced and the need to continue to transport and dispose of tailings. Reducing groundwater dependency is the most viable method for the mining sub-sector to contribute to the achievement of the TAMA goal. During the fourth management period, ADWR will continue to explore

opportunities for the mining sector to reduce groundwater dependency and incorporate use of renewable water supplies.

12.3.3 Municipal Solutions

The municipal sector is expected to continue to reduce its reliance on groundwater during the fourth management period by increasing use of CAP and reclaimed water. While municipal providers have expressed a strong commitment to maximizing the use of renewable supplies, the municipal sector is growing and is projected to be responsible for 50 percent of the TAMA water demand by 2025.

To promote renewable supply use, ADWR will continue to work with the municipal sector and others to develop additional meaningful and equitable incentives that are consistent with overall water management objectives. ADWR will continue to assist in regional planning activities and technical studies that result in direct use of renewable supplies by the municipal sector.

The development of sub-regional water management policies within AMAs will help protect against aquifer degradation such as land subsidence. This may include the development of water management strategies to promote withdrawals from areas experiencing recharge rather than areas experiencing severe declines.

During the third management period, modeling projections showed projected areas of water level decline in several areas within the TAMA, including in the Oro Valley and Vail areas. Several providers within the TAMA have entered into wheeling agreements to allow use of Tucson Water's distribution infrastructure as a method of physically conveying recovered CAP water from recharge sites near the CAP canal to other providers' service areas. Such wheeling arrangements take advantage of existing infrastructure to address the challenge of groundwater pumpage and related groundwater level declines in areas not located near recharge sites.

Local, multi-jurisdictional partnerships have proved to be beneficial in the TAMA. Examples of these groups include the Southern Arizona Water Users Association (SAWUA) *(See http://www.sawua.org/)*, the Upper Santa Cruz Providers and Users Group (USC/PUG) *(See http://uscpug.org/)* and the TAMA Safe Yield Task Force (SYTF). Progress in addressing water management challenges in the TAMA will take coordination, cooperation and consensus among different jurisdictions at the federal, state, county and local level and support from TAMA water users. Continued cooperation among these groups to find long-term solutions may require compromise and costs.

The AWS Program has partially addressed the utilization of renewable water supplies by municipal providers by limiting the amount of groundwater that can be used. However, there is still a certain amount of groundwater pumping allowed under the AWS Rules that could be evaluated in the context of its impact on safe-yield. In addition, the water use associated with existing customers of undesignated providers and municipal uses that are not subject to the AWS Rules represent a continuing demand on the aquifer. During the fourth management period, ADWR will assist water-users in investigating mechanisms, including possible legislative changes, to address this residual overdraft.

ADWR will continue to work with the Arizona Corporation Commission in the development of policies related to water conservation and supply acquisition and on conditions for appropriate recovery of costs for private utilities associated with ADWR's regulatory programs.

There are ongoing discussions about the effectiveness of the existing water conservation programs. Although the existing mandatory water conservation programs have been effective in reducing the overall water demands, during the fourth management period, ADWR will continue to evaluate the effectiveness

of existing water conservation programs. Some have suggested that Gallons Per Capita Per Day (GPCD) rates could be reduced even further, while others feel that BMP type programs are not effective in achieving water conservation. Others believe that water conservation occurs passively – without the implementation of water conservation measures by a provider or other entity, such as the county or the state. Further evaluation could include ADWR assisting in designing follow-up studies and analyses to evaluate program effectiveness. This could include exploration of Water Management Assistance Program projects on municipal research.

Throughout the fourth management period, ADWR will work to improve water use data collection to support both planning and conservation program evaluation efforts. ADWR will also continue to provide direct conservation assistance to water providers to assist them in meeting their regulatory requirements.

12.3.4 Augmentation Solutions

During the fourth management period and beyond, ADWR, working with the local jurisdictions, could consider potential solutions such as the following to increase the use of renewable water supplies in the TAMA, thereby further reducing groundwater dependency:

- Consider requiring replenishment of groundwater withdrawals by the agricultural and industrial demand sectors, minus incidental recharge by these sectors.
- Adopt a special increase in withdrawal fees to create a fund for augmentation projects.
- Further incentivize the achievement of full utilization of renewable supplies, either directly or through underground storage and recovery within the area of impact of storage of CAP and reclaimed water.
- Mitigate, through local water management incentives and regulations, the occurrence of subsidence, land fissuring, decreases in well productivity, water level declines and decreases in water quality due to water withdrawals. One possible avenue would be through encouragement of the storage of water in areas experiencing declines (where appropriate hydrologically) and recovering water where the water is stored. TAMA stakeholders have indicated support for the analysis and discussion of potential solutions addressing local areas within the AMA.
- Develop and adopt economic incentives to achieve water management objectives on the TAMA and local level.
- Resolve infrastructure challenges hindering efficient use and distribution of all water supplies.
- Address residual groundwater pumping and allowable groundwater pumping in the municipal sector.
- Consider the cost effectiveness of reclaiming brackish, high TDS or other poor quality water not previously considered for beneficial use.

12.4 SUMMARY

The key to effective water management is to anticipate change and to develop systems that are flexible enough to respond to conditions that are unlike those we experience today. As has been noted many times, the one aspect of the future that is certain is that it will be unlike the past. The ability to identify and understand trends in water use and supply is central to the functions of ADWR. It will be helpful to expand basic monitoring programs, improve data management and improve hydrologic modeling and advanced planning capabilities in order to effectively manage the state's water supplies in the future. Doing so will allow ADWR to better serve the State of Arizona and the AMAs in the next management periods.

This chapter has set the stage for activities within the TAMA that could contribute to the TAMA's goals and objectives. To ensure safe, dependable water supplies for existing and future residents of the TAMA

we must efficiently use available renewable water supplies. Achieving safe-yield and adopting management techniques to address sub-regional areas within the TAMA will continue to be challenges. The ability to meet these challenges is dependent to a substantial degree on community and legislative support. New strategies and tools for water management may be required in the Tucson area in order to achieve the TAMA goals. A combination of education, cooperative efforts, and legislative changes may be required to address water challenges in the future. ADWR will continue to work with the TAMA community to develop innovative and cooperative solutions to respond to the area's changing needs.

12.5 FINAL THOUGHTS

Safe-yield is defined as a long-term balance that is both achieved by 2025, and maintained thereafter. On the horizon are additional water management questions and challenges which include, but are not limited to, the following:

- What happens after 2025?
- How can economic growth continue given finite water resources?
- What other options exist for long-term water management solutions to ensure the economic viability of the state and the TAMA?

The programs that were developed for the third management period focused on elements of water-supply management problems and strategies within the authority of ADWR which were feasible with the available agency resources. The program discussion and future directions sections of the TAMA 4MP highlight some of the potential opportunities for ADWR to utilize additional tools and acquire additional statutory authority or to contribute indirectly to the efforts of others to address the water management challenges facing the TAMA.