

Water resources exist in paper-water and wet-water worlds. Both worlds must be in balance to ensure long-term sustainability.

CHAPTER FOUR

AVAILABLE WATER RESOURCES

Prior to the early 1990s, the Tucson community had relied almost exclusively on ground water to meet water demand. Due to rapidly growing demand associated with population increases following World War II, the regional ground-water system transitioned from one in approximate equilibrium, where a balance existed between ground-water withdrawals and natural recharge, to one of accelerating depletion. Despite implementation of demand management programs and the strong environmental ethic of Tucson residents, ground-water withdrawals continued to increase due to continuing growth through 2000. Rapidly declining water levels in the metropolitan area as well as in surrounding areas have resulted in measurable land subsidence, increased pumping costs, and the gradual loss of natural habitat along local riparian corridors.

The need to develop renewable water supplies in order to meet projected long-term water demand has long been recognized. *Tucson Water Resources Plan 1990-2100* concluded that Colorado River water and municipal effluent would need to be increasingly utilized in order to satisfy projected water demand. To achieve long-term sustainability, the use of available water sources must be prioritized so that utilization of renewable supplies is maximized and the use of ground water is limited to sustainable amounts. In *Tucson Water Resources Plan 1990-2100*, Tucson Water's various water resources were quantified based on a set of planning assumptions that were appropriate at that time. As discussed in Chapters Two and Three, some of these assumptions no longer apply and have been revised in this planning assessment.

This chapter briefly describes ADWR's Assured Water Supply (AWS) Program which places restrictions on how water providers utilize their water resources. In addition, the chapter quantifies the three water sources physically available and evaluates the constraints that may affect use of these water sources for potable and non-potable supply. Finally, this chapter discusses the potential opportunities to acquire additional volumes of each water resource. Detailed information on the AWS Program and potential water supply acquisitions is included in Appendix C: *Assured Water Supply Implementation*.

THE ASSURED WATER SUPPLY PROGRAM

To appreciate how Tucson Water will utilize its water resources, it is critical to understand the rationale underlying the AWS Program managed by ADWR. AWS is the regulatory paradigm for municipal water-resource management in Arizona's Active Management Areas. The program is designed to ensure that the water supplies that support developing communities are sustainable over the long term. In order to accomplish this, all new developments must demonstrate that their existing, committed, and reasonably foreseeable future water demands can be met using renewable water supplies over a 100-year period. Various water resources can be utilized to meet water demand but reducing and eventually eliminating reliance on "mined" ground water is the ultimate goal. This necessitates a shift toward increasing utilization of renewable water supplies. The program also embodies a credit accounting system that tracks all water usage and applies to all water supply sources available to the City of Tucson.

"Paper Water" versus "Wet Water"

In order to comprehend the importance of the AWS Program as a water management tool, the distinction between "paper water" and "wet water" must be understood. The world of paper water centers on the various rights and credit accounts that together provide Tucson Water with the authority to pump or use water. The world of wet water, on the other hand, is based on the availability and use of physical water. According to ADWR (2001):

"The process of calculating the basic allocation, the incidental recharge factor, and the extinguishment credits produces an amount of 'paper water.' It may be the case that an existing water provider is entitled to an amount of groundwater on paper that does not exist in the aquifer. It is important to remember that even though an applicant is entitled to a groundwater allocation, the physical availability of the water must be proven."

While paper water and wet water management strategies overlap, they emphasize different aspects of water-resource planning. A water provider may be able to demonstrate the physical availability of a water supply but must also have the legal right to use it. Conversely, while a water provider may have the legal right to use a certain quantity of water, hydrologic availability can place physical constraints on its use. The Utility has set a long-term planning goal of achieving hydrologic sustainability while working within the constraints of the laws and regulations governing water use.

Water Credit Accounting

Under the AWS Program, all ground-water withdrawals are debited from several potential sources of water credits. This program places a finite cap on the amount of ground water that can be pumped by Tucson Water without incurring a replenishment obligation. This is referred to as allowable ground water. When AWS accounting went into effect at Tucson Water in 2001, the Utility projected that it would have access to approximately four million acre-feet of allowable ground-water credits. Under current regulations, once this volume is

exhausted, all ground water that is subsequently withdrawn must be replenished with a renewable supply. Because future dependency on mined ground water is not consistent with the AWS Program, Tucson Water will become increasingly reliant on Colorado River water, municipal effluent, and other potentially available water supplies that may be delivered through the Central Arizona Project.

Tucson Water manages several paper-water credit accounts that can be credited and debited under the AWS Program. These credits include allowable ground water, remedial ground water, annual recharge, and long-term storage. Descriptions of each type of credit and information regarding their requirements and/or limitations are provided in Appendix C: *Assured Water Supply Implementation*. Tucson Water actively manages these water accounts to ensure its compliance with AWS regulations.

While paper-water accounting is a critically important aspect of water resource management, municipal water providers also are concerned with having access to physically available water of sufficient quantity and quality to meet current and projected service area demands. Tucson Water has three water sources of supply currently available: ground water, imported Colorado River water, and municipal wastewater effluent. The current and future availability of these water sources and other potential supplies are discussed in the following sections.

GROUND WATER

Physical Availability of Ground Water

The volume of physically available ground water within Tucson Water's projected service area can be estimated using a number of approaches. Two approaches were applied in developing *Water Plan: 2000-2050* with each addressing "physical availability" in different terms. The first approach provides an estimate of the volume of ground water currently in storage that could be potentially withdrawn (depletion model). The second approach provides an estimate of the volume of ground water that is naturally replenished each year (sustainability model).

The depletion model is based on a simple "tank" analysis. The estimate obtained through this analysis was calculated based on three parameters: aquifer area within the projected service area, the thickness of potentially accessible saturated sediments, and the estimated specific yield of these sediments. This analysis ignores natural recharge which seasonally replenishes local aquifers. The tank analysis also assumes that the entire specified thickness of saturated sediments can be dewatered. Using this approach, the volume of ground water potentially available within Tucson Water's projected service area may be about 18.5 million acre-feet. However, even if this total volume were physically recoverable, it is not legally available because withdrawing this water would be contrary to the Arizona Groundwater Management Act of 1980 and its declared goal of "safe yield" for the Tucson AMA. Under the AWS Program, there is a limit to the amount of allowable ground-water credits available for pumping. Arizona law does not allow physical water supplies in the Tucson AMA to be depleted by new growth in the long term.

The sustainability model estimates annually renewable ground water that is physically available for hydrologically sustainable pumping within Tucson Water’s projected service area. Under this approach, aquifer depletion is not considered a potentially available source of supply. The average annual volume of renewable ground water available within the projected service area can be approximated in a number of ways using published information and/or by utilizing estimating tools. Tucson Water estimates that renewable ground water may be as much as 50,000 acre-feet per year. For planning purposes, it is conservatively estimated that Tucson Water can withdraw 50,000 acre-feet of ground water each year without causing significant water-level declines within its projected service area. Under the AWS Program, however, the Utility has a finite quantity of ground water credits that it can legally pump to meet both current and future demand.

Ground-Water Use Constraints

Four potential constraints on the use of ground-water supplies are discussed in this section: ground-water quality concerns, competition for locally available ground water, aquifer stewardship, and legal rights to use ground water.

Ground-Water Quality Concerns

Ground-water contamination exists in a number of areas within the current Tucson Water service area as well as within the larger Long-Range Planning Area. The presence of contaminants has impacted Tucson Water’s ability to efficiently utilize its ground-water resources. Many production wells have been taken off-line over the years due to the presence of contaminant plumes. However, such operational impacts are relatively minor and do not place significant restrictions on the current use of ground water as long as the contaminated ground water is contained and treated. The Tucson Airport Remediation Project pumps contaminated ground water from the aquifer, treats it to drinking water standards, and uses it in the potable distribution system. The potable use of remediated ground water is not expected to grow significantly during the planning period. However, a potential incentive for future use is that such water is not debited from AWS ground-water accounts.

Competition for Locally Available Ground Water

Ground water that Tucson Water has historically relied upon for supply is in many ways a shared resource. The aquifer system has stresses placed on it not only by Tucson Water but also by other municipal and private water providers, industrial and agricultural operators, and numerous private well owners. For more information on other local ground-water users, refer to Appendix A: *Other Water Users in the Region*.

Tucson Water is currently the only local water provider that is not totally dependent on “wet” ground water as its sole source for potable supply. Management decisions that will be made by Tucson Water to balance its use of this resource must take into account the actions of other ground-water users. Some other municipal water providers in the region are developing plans to utilize Colorado River water in place of mined ground water. However, some small private water companies, agricultural interests, and industrial water users are not required

under the Groundwater Management Act of 1980 to cease mining ground water and shift to renewable supplies. A more regional approach in managing the common ground-water resource is needed to ensure that all entities take collective responsibility in managing the local aquifers in an equitable and sustainable manner.

Aquifer Stewardship

Over the past 60 years, the regional aquifers located in the Tucson basin and Avra Valley have been over pumped. This has caused significant water-level declines, associated land surface subsidence, and loss of riparian habitat. In order for ground water to remain a viable water resource for future use, water users must shift from strategies that rely on over pumping to those that use ground water at the rate it is replenished. This is referred to as sustainable pumping. Tucson Water is planning to curb its own ground-water use so that it does not exceed a hydrologically sustainable pumping rate. While Tucson Water is the largest regional water provider, it is only one of many ground-water users in the region. For the Utility's aquifer management efforts to be effective, all local ground-water users must work together as stewards of the Tucson AMA's regional aquifers. Such a coordinated effort would make it possible to stabilize water levels and reduce the potential for continued land subsidence and loss of riparian habitat.



Pinal County Subsidence Fissure - Settling or cracking of the land surface can result from over-pumping an aquifer.

Legal Rights to Use Ground Water

Tucson Water has a finite amount of ground water it can legally withdraw. The Utility was granted an initial volume of allowable ground-water credits when it obtained its AWS designation. There are additional ground-water credits that will be added to this account over time (see Appendix C: *Assured Water Supply Implementation*). Once these paper-water credits are exhausted, all ground water that is pumped must be replenished with a renewable water supply. It is projected that if Tucson Water utilizes ground water at a hydrologically sustainable rate, about 50,000 acre-feet per year, then the Utility will eventually deplete its allowable ground-water credit account. At some point in time beyond 2035, the remaining credit balance may not be sufficient to maintain the City of Tucson's AWS designation without acquiring additional renewable water supplies or reducing per capita demand.

Potential Changes to Ground-Water Availability

The City of Tucson is a member of the Central Arizona Groundwater Replenishment District (CAGRDR). Under the terms of the CAGRDR contract, the CAGRDR has agreed to replenish up to 12,500 acre-feet per year of excess ground water pumped by Tucson Water. This could

extend the amount of ground water legally available to the Utility although at a significant cost. If the CAGR is utilized in this fashion, it will be important to ensure that replenishment occurs in a facility in which Tucson Water has direct recovery capability.

Several communities in Arizona have acquired ground water from less populated areas in the State and are developing plans to convey the water to the more highly developed urban areas. Substantial quantities of ground water might be available from undeveloped basins in western Arizona. Such transfers of ground water could yield an additional water supply in the future or they may be used to augment Colorado River water supplies in shortage years. These supplies could potentially be delivered to the Tucson area by utilizing existing excess capacity in the Central Arizona Project.

The AWS Program does not currently recognize annually renewable ground water that is derived from natural recharge. Without such recognition, Tucson Water's allowable ground-water credits will continue to be debited each year by the amount of ground water pumped. Tucson Water views renewable ground-water as a water resource that should be formally incorporated into ADWR's program. This would require legislative action and/or a regulatory-driven process that would quantify the volume of ground water that could be annually available for sustainable ground-water pumping. Tucson Water should pursue such a change in order to establish that in future years, the appropriate amount of ground water will not only be physically accessible but also legally available as a source of supply. However, *Water Plan: 2000-2050* is based on current law and does not assume that the law will be changed in the future to recognize "renewable ground water."

COLORADO RIVER WATER

Tucson is located in an arid region where very few stream reaches contain natural perennial flow. At one time, natural stream flow was a significant source of supply along certain channel reaches to historic populations in the Tucson area; however, given the ephemeral nature of most streams, local natural stream flows are no longer a viable source for municipal supply. Colorado River water is the only imported renewable surface-water source available in the Tucson AMA.

Availability of Colorado River Water

The State of Arizona currently has rights to 2.8 million acre-feet of Colorado River water per year. Water users in California have historically diverted portions of Arizona's allocation that went unused in any given year. In the past four years, however, the Arizona Water Banking Authority (Water Bank) has stored excess Colorado River water in long-term banking facilities to bring the State's full allocation into use.

As shown on Figure 4-1, Colorado River water is delivered to the area via the Central Arizona Project that conveys water from Lake Havasu to its terminus located southwest of Tucson. It is a 336-mile long system of canals, tunnels, pumping plants, and pipelines. The Central Arizona Project is the largest single source of renewable water supply available to the Tucson area.

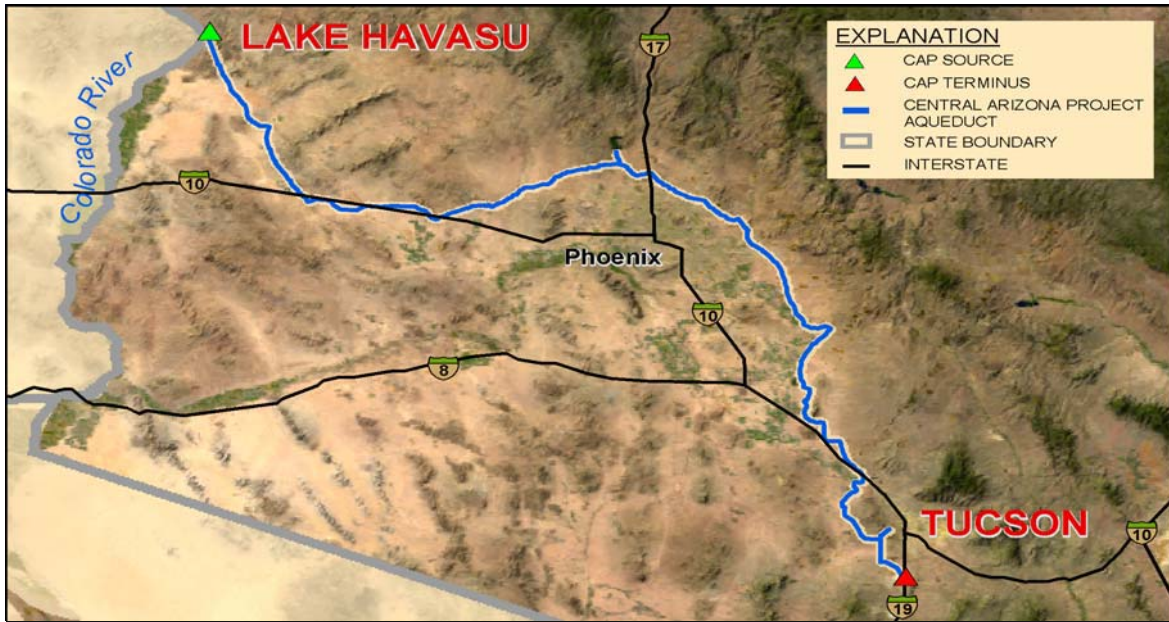


Figure 4-1: The Central Arizona Project Aqueduct.

The current and pending Central Arizona Project allocations in the Tucson AMA are shown on Table 4-1. The pending reallocations are included in the Arizona Water Settlements Act which has cleared the relevant committees in both houses of Congress and is expected to be enacted soon. Tucson Water’s current Central Arizona Project allocation is 135,966 acre-feet per year. Once all pending reallocations are approved, the City’s allocation is expected to total 144,172 acre-feet per year. For planning purposes, however, the current annual allocation of 135,966 acre-feet is considered the available Colorado River water supply when making projections within the 50-year planning horizon. The other allocations in the Tucson AMA may be used directly by their holders, may be wheeled to the providers by Tucson Water through future agreements, or may be made available for lease or purchase.

Allocation Holder	Current Allocations	Pending Reallocations	Future Allocations
City of Tucson	135,966	8,206	144,172
Community Water Company (Green Valley)	1,337	1,521	2,858
Flowing Wells Irrigation District	4,354	0	4,354
Green Valley Domestic Water Improvement District	1,900	0	1,900
San Xavier District (Tohono O’odham Nation)	27,000	23,000	50,000
Schuk Toak District (Tohono O’odham Nation)	10,800	5,200	16,000
Pasqua Yaqui Tribe	500	0	500
Town of Marana	47	0	47
Metropolitan Domestic Water Improvement District	8,858	4,602	13,460
Town of Oro Valley	6,748	3,557	10,305
Spanish Trail Water Company	3,037	0	3,037
Arizona State Land Department	14,000	0	14,000
Vail Water Company	786	1,071	1,857
Total	215,333	47,157	262,490

Table 4-1: Central Arizona Project Allocations in the Tucson AMA (Acre-Feet).

Colorado River Water Use Within Existing Constraints

Clearwater Program and the Blend

To utilize Colorado River water in compliance with the constraints imposed by a citizens' initiative passed by voters in 1995 that prohibited its direct use, Tucson Water constructed CAVSARP, a large-scale recharge and recovery facility in central Avra Valley. This facility was built to recharge and recover up to 60,000 acre-feet of Colorado River water per year (54 million gallons per day, MGD). The facility consists of 330 acres of recharge basins, 27 recovery wells, a 54-MGD booster station, an 8 million-gallon reservoir, and approximately 25 miles of pipelines. Through the recharge and recovery process, Colorado River water mixes with native Avra Valley ground water to produce a blended water supply. CAVSARP, the Hayden-Udall Treatment Plant, and the 60-million gallon Clearwell Reservoir in the Tucson Mountains form the core infrastructure of the current Clearwater Renewable Resource Facility. These core facilities currently utilize about 45 percent of the City of Tucson's annual Central Arizona Project allocation and make it available for potable supply. The existing and proposed Clearwater Program facilities shown on Figure 4-2 would allow Tucson Water to make full use of its Central Arizona Project allocation. The Clearwater Program has gained wide community support. Regular deliveries of the blended water began in May 2001.



Basin Recharge of Colorado River Water – Tucson Water's Central Avra Valley Storage and Recovery Project went into operation in 2001.

Building upon the success of the Clearwater Program's recharge and recovery facility at CAVSARP, plans have been initiated to assess additional program elements to fully utilize the City's entire Central Arizona Project allocation as soon as possible. Proposed projects shown on Figure 4-2 and described in the following section include:

- Expanding the permitted recharge capacity of CAVSARP.
- Implementing the Southern Avra Valley Storage and Recovery Project (SAVSARP).
- Developing a new well field near Three Points in Avra Valley.
- Constructing the Spencer Interconnect pipeline.
- Augmenting existing pipeline infrastructure.
- Incorporating additional treatment processes at the Hayden-Udall Treatment Plant

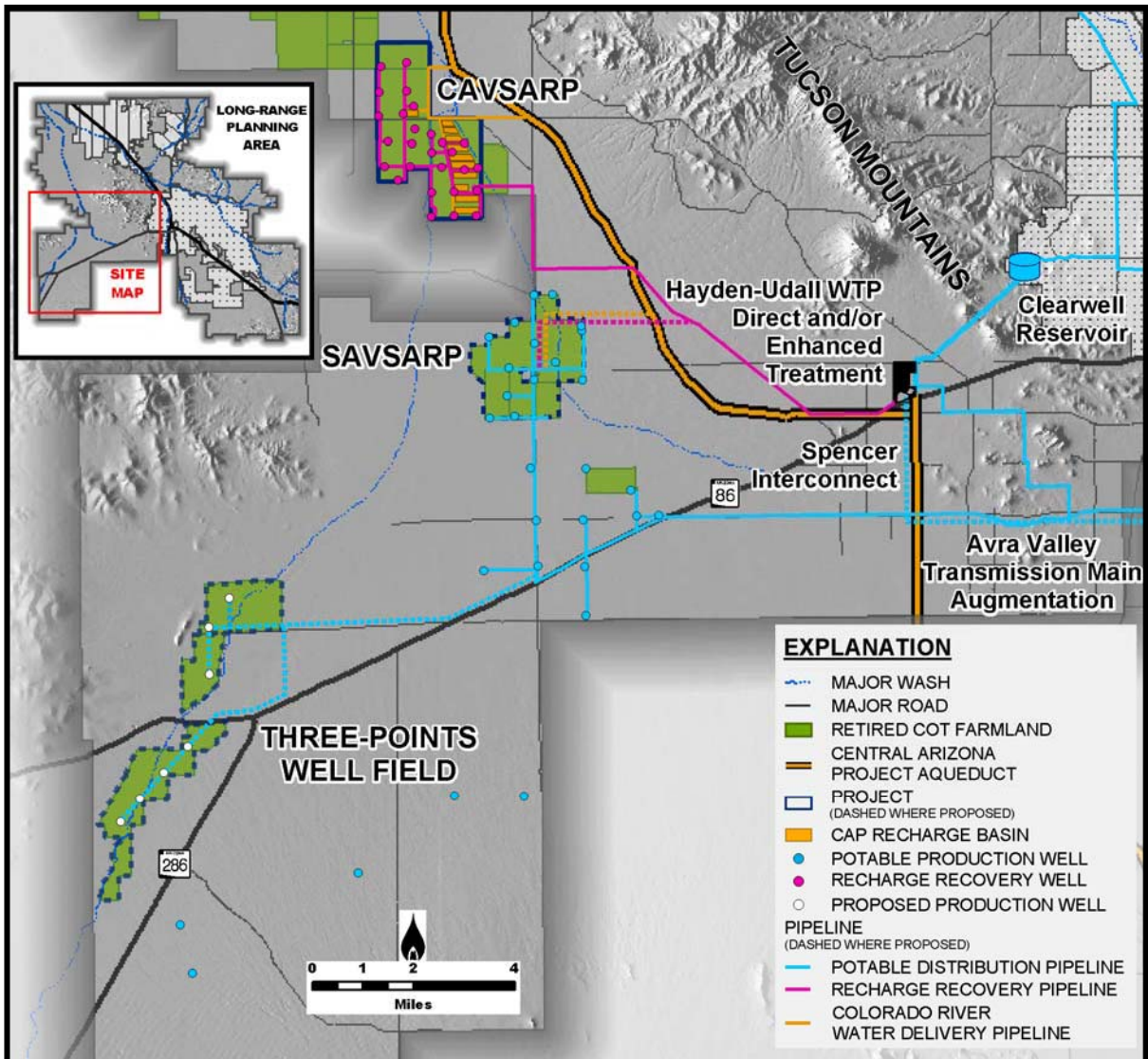


Figure 4-2: Existing and Proposed Clearwater Program Facilities.

The CAVSARP facility is currently permitted to recharge and recover up to 60,000 acre-feet of Colorado River water per year. The existing recharge facilities, however, are physically capable of recharging up to 80,000 acre-feet per year. An application to expand the annual permitted recharge capacity to 80,000 acre-feet has been submitted to ADWR to allow additional annual recharge at CAVSARP by 2005.

SAVSARP, another CAVSARP-type facility that may be located several miles to the south, may have sufficient annual capacity to recharge and recover 45,000 to 100,000 acre-feet of Colorado River water. The upper end of this range could provide Tucson Water with the physical ability to fully utilize its annual Central Arizona Project allocation. In addition, it could provide storage capacity to the Water Bank to store excess Colorado River water for use in future years. If this project were implemented, construction efforts would include 200 to 400 acres of recharge basins, 20 to 40 recovery wells, a reservoir/booster station, and

many miles of pipelines to convey this additional blended supply to the Hayden-Udall Treatment Plant.

A proposed Three Points Well Field could be constructed in southwestern Avra Valley. This well field may be designed to produce approximately 2,000 to 6,000 acre-feet of ground water per year by adding six to eight new supply wells. This additional ground-water supply would be used to maintain the desired water quality of the Clearwater Program's blend of local ground water and Colorado River water. Ground water from the proposed Three Points Well Field and from an existing southern Avra Valley well field would be conveyed to the Hayden-Udall Treatment Plant for blending via the proposed Spencer Interconnect pipeline.

Modifications to the Hayden-Udall Treatment Plant could include rehabilitation of the existing filtration process, alternative primary and secondary disinfection equipment, and the potential for enhanced treatment of surface water and/or recharged and recovered Colorado River water through membrane filtration. The purpose of enhanced treatment would be to satisfy the water-quality preferences of Tucson Water customers for the Clearwater blend. For any alternative that would include an enhanced treatment component, a method of brine disposal would have to be incorporated. It is currently envisioned that brine disposal would require the construction of many miles of pipeline to convey the waste stream from the Hayden-Udall Treatment Plant to lined evaporation ponds to be located on City-owned property.

Expanding the Clearwater Program to include the proposed projects will allow Tucson Water to fully utilize its Central Arizona Project allocation and will be a key element in Tucson Water's critical path over the next 10 years. Full utilization will be implemented as soon as possible to conserve ground water. When the proposed projects become fully operational, they will bring the Tucson Water service area onto a largely renewable water supply within 10 years. In addition, the expanded Clearwater Program could provide the Water Bank with recharge capacity to store excess Colorado River water at Tucson Water facilities. This would place excess Colorado River water in locations that can provide a direct wet-water input into the Tucson Water distribution system when such supplies are needed.

Indirect Use of Colorado River Water

While the community gradually increases its use of Colorado River water for potable supply, Tucson Water has the ability to accrue recharge (paper-water) credits while preserving ground water at two ground-water savings facilities (GSF) in Avra Valley. In addition, Colorado River water can be stored at the Pima Mine Road Recharge Project located immediately north of Sahuarita.

The GSF projects are farming operations that use Colorado River water to irrigate crops instead of pumping ground water. Recharge credits are granted by ADWR commensurate with the volume of ground water that is saved (not pumped) due to the use of Colorado River water for local farming. However, the ability to ever recover this water from the area where it is stored is uncertain. Without the ability to recover the wet water, the Utility would need to further deplete ground water within its service area in order to gain any direct benefit.

Tucson Water and the Central Arizona Water Conservation District jointly own the Pima Mine Road Recharge Project. The facility, which can recharge up to 30,000 acre-feet of Colorado River water per year, does not have a wet-water recovery component at this time. The facility is, however, adjacent to Tucson Water's Santa Cruz Well Field. This project is currently used to store Colorado River water for use in the future.

Potential Changes to Colorado River Water Availability

Central Arizona Project Outages and Shortages

Tucson Water is more vulnerable to Central Arizona Project reliability issues than many other subcontractors because it has the largest Central Arizona Project subcontract and it is located at the terminus of the aqueduct. If the Central Arizona Project were to go temporarily off line or if extended drought conditions cause shortages on the Colorado River in future years, Tucson Water's Colorado River water supplies could be significantly reduced for indeterminate periods of time.

Model projections performed by ADWR suggest that in future years, there is an increasing likelihood of periodic shortages on the Colorado River due to significant droughts. Such events would affect the reliability of Tucson Water's supply of Colorado River water since the Central Arizona Project has the most junior right. ADWR (2003a) prepared a Central Arizona Project supply analysis for Tucson Water to assess the potential impacts on the Utility's Central Arizona Project allocation under a variety of reservoir operating assumptions and reservoir levels in 2003. The results of the analysis suggest that shortages could reduce the availability of Colorado River water for Municipal and Industrial (M&I) use between 2015 and 2020. The potential severity of these shortages in any year will depend upon future shortage criteria to be adopted by the Secretary of the Interior.



Central Arizona Project – This aqueduct brings Colorado River water from Lake Havasu to the Tucson area.

Beyond 2020, the probability of a shortage in any given year can range from approximately 20 to 60 percent depending on operational assumptions. Many of these assumptions may vary as weather patterns change and the reservoir levels behind dams on the Colorado River fluctuate (ADWR, 2003a). Tucson Water will continue to collaborate with ADWR to obtain updated reliability projections as conditions change over time.

A terminal storage reservoir near Tucson was originally planned to provide the local area with continued access to Colorado River water during short-term operational outages, but it has not been constructed to date. However, recharge projects such as CAVSARP provide storage that can not only be relied upon to accommodate such events but would also provide long-term drought resistance.

Another strategy to help buffer Tucson Water's Colorado River water supplies against canal outages and shortages on the Colorado River is to increase the amount of Colorado River water which Tucson Water controls. Increasing the City of Tucson's annual Central Arizona Project allocation where possible and leasing the allocations of others would provide additional Colorado River water supplies in normal years while ensuring greater source and system reliability in shortage years.

The Water Bank is charged with storing excess Colorado River water to firm Central Arizona Project allocations in future years of shortage. It has set a goal of completing these state-wide activities by 2017. The local firming goal is to store approximately 810,000 acre-feet of Colorado River water within the Tucson AMA. However, the Water Bank might not have sufficient funding to meet this goal. In addition, questions have arisen regarding how this stored water will be delivered to the various water systems. The Utility is working with the Water Bank to provide storage capacity at facilities that have wet-water recovery capabilities. Implementing SAVSARP would further expand Tucson Water's ability to provide the Water Bank with recharge and recovery sites to store excess Colorado River water.

Acquiring Additional Sources of Colorado River Water

The City of Tucson will seek to increase its Central Arizona Project allocation and to access additional Colorado River water over the 50-year planning period. This may be accomplished through reallocation, lease, and transfer.

In the near future, a fixed volume of Colorado River water has been identified for reallocation to Arizona communities, and the City of Tucson has been recommended to receive an additional 8,206 acre-feet per year through this process. This reallocation will occur when the Arizona Water Settlements Act, now pending before Congress, is enacted and becomes enforceable. In addition, as State land is sold and developed in Tucson Water's projected service area, portions of the State's allocation could be transferred to the City. However, there is a discernable risk that the Colorado River water held by the State might in fact be transferred to other entities rather than to the City of Tucson.

The Tohono O'odham Nation currently has a contract for 37,800 acre-feet per year of Central Arizona Project water. The Arizona Water Settlements Act will provide an additional 28,200 acre-feet to the Nation. The U.S. Secretary of the Interior currently administers these

allocations. The Tucson area will have first right of refusal to any of the Nation’s Central Arizona Project water that may be leased in the future. However, if this option is not exercised, this water could be made available to other water users or providers in the three-county Central Arizona Project service area. In addition, a large volume of Colorado River water has been allocated to the Native American communities located in other areas of Arizona. Over time, Tucson Water could pursue lease agreements to access this potential water supply as well.

Tucson Water can also pursue Colorado River water currently used to support agricultural activities. Agricultural districts on the Arizona side of the Colorado River have higher-priority entitlements than the Central Arizona Project. If this water becomes available, it would be less subject to curtailment during declared shortages on the Colorado River. In addition, there are approximately 80,000 acre-feet of lower-priority agricultural Central Arizona Project water that may be annually available to municipal and industrial users in 10 to 15 years.

EFFLUENT

Municipal wastewater effluent is a renewable water supply that steadily grows along with population. This recycled water supply can provide an alternative to ground water for urban irrigation and industrial uses through Tucson Water’s reclaimed water system. In addition, this water source will be used to augment Tucson Water’s ground-water supplies and help meet the area’s increasing demand for potable water.

Availability of Effluent

In 2003, 68,061 acre-feet of effluent were produced from the metropolitan wastewater treatment plants in the Tucson area. As shown on Table 4-2, the City of Tucson had entitlement to a total of 30,739 acre-feet of this effluent. Of this total, 13,121 acre-feet were reused as reclaimed water while the remainder was discharged to the Santa Cruz River. As the population of the Tucson community grows, so will the volume of effluent it generates.

Entity	Acre-Feet per Year
Tucson	30,739
Secretary of Interior	28,200
Pima County	3,986
Metropolitan Domestic Water Improvement District	3,074
Oro Valley	2,062
TOTAL	68,061

Table 4-2: Local Effluent Entitlements in 2003.

Annual effluent availability within the Long-Range Planning Area could approach 121,000 acre-feet by 2030 and 128,000 acre-feet by 2050 based on population growth projections and assumptions regarding per capita water usage, sewer return flow rates, and septic tank usage. Of these totals, it is projected that the City of Tucson would have annual entitlement to approximately 62,000 acre-feet by 2030 and about 66,000 acre-feet by 2050.

assumption is that the reclaimed water system will supply at least eight percent of the projected total demand through 2050. Accordingly, reclaimed water demand is projected to increase from 10,897 acre-feet per year in 2000 to approximately 20,200 acre-feet per year in 2050.

Effluent to Augment the Ground-Water Supply for Indirect Reuse

While treatment technologies exist to achieve potable standards with treated effluent, direct potable use of effluent is not a viable alternative at this time. However, as the population grows and other available potable water supplies become fully utilized, the need for reusing effluent as a critical supply source will grow. Treated effluent will most likely be reused indirectly through a sequenced program of enhanced treatment, recharge, recovery, and blending with other supply sources prior to delivery. Although this concept may not be exercised for many years, preparing for effluent reuse has already begun. Tucson Water considers effluent to be a vital renewable water resource that will be needed to ensure supply sustainability and drought resistance in the long term.

Potential Changes to Effluent Availability

Tucson Water has entitlement to a large volume of municipal effluent and the Utility may be able to increase its entitlement in the future. This could include agreements to lease or purchase the Secretary of the Interior's effluent entitlement potentially available through SAWRSA as well as others. This would result in greater utilization of the only locally generated renewable supply that grows with the community.

SUMMARY

The AWS Program is the regulatory paradigm that governs use of the water resources available to Tucson Water. The Utility must, within the legal constraints of the AWS Program, manage its available resources as wet water to ensure supply sustainability over the long term. To achieve hydrologic sustainability within Tucson Water's projected service area, the Utility will seek to limit its ground-water pumping to about 50,000 acre-feet per year. Barring changes in state water law, this rate of pumping will reduce Tucson Water's AWS portfolio of available ground-water credits of approximately four million acre-feet. Once this portfolio is exhausted, additional ground-water withdrawals would need to be replenished with renewable water supplies.

The City of Tucson's current Central Arizona Project allocation is 135,966 acre-feet per year with a pending reallocation of 8,206 acre-feet per year. In addition, the City of Tucson has annual access to 12,500 acre-feet of CAGR D replenishment water. The City of Tucson may be able to further augment its available Colorado River water supplies by implementing an aggressive resource acquisition program.

Tucson Water will also have entitlement to about 66,000 acre-feet per year of effluent by the year 2050. The Utility may purchase additional effluent entitlements within the 50-year planning period to further augment supplies.

In order to meet projected water demand within the 50-year planning period, projects and programs will have to be implemented in the near and mid terms to store (bank) physically available but unused wet-water resources for use beyond 2050. This volume of excess available supply, shown as an uplifted wedge on Figure 4-3, consists of unused Colorado River water and effluent. This volume of excess water availability occurs because potential annual supply exceeds projected annual demand through much of the 50-year planning period. Review of Figure 4-3 indicates that most of the projected excess supply is available in the near and mid terms and that it tapers off later in time. Any unused annual volumes will continue to be irretrievably lost and the excess supply available in the near and mid terms will be unavailable for use beyond 2050 when water demand may exceed available renewable supplies.

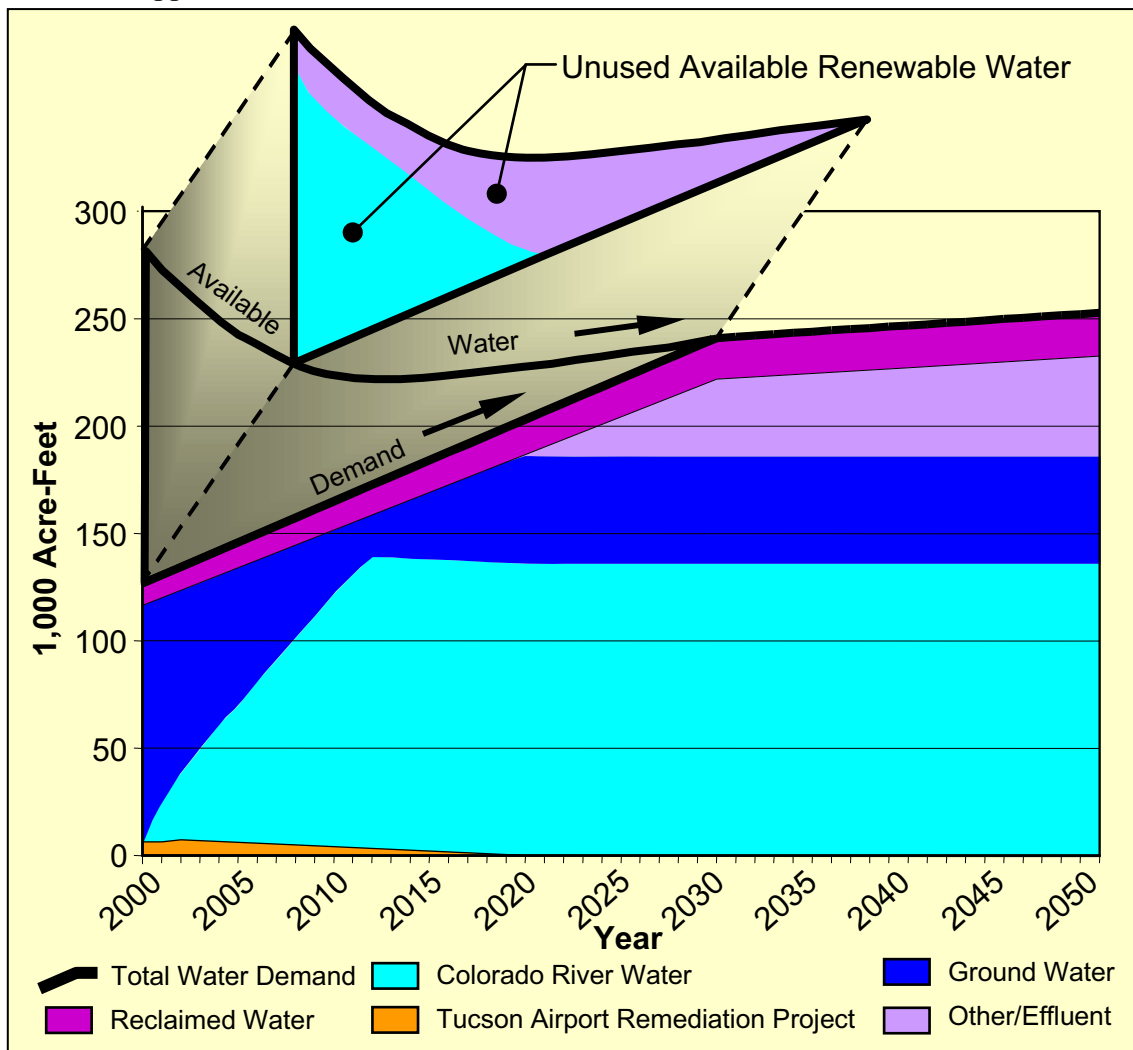


Figure 4-3: Projected Demand and Available Sustainable Water Resources, 2000-2050.

The projected availability of unutilized Colorado River water and effluent provides an opportunity to store readily available and relatively inexpensive renewable supplies for later use. This may provide incentive to more fully utilize existing facilities such as the Pima Mine Road Recharge Project and to construct additional underground storage facilities to accommodate excess supply within Tucson Water’s projected service area while it is

available. What is certain is that acquiring additional water supplies later in time when excess supply is no longer available will be subject to statewide competition. Because of market forces, the cost of acquiring additional supplies in later years will become increasingly expensive. For these reasons, the Utility will seek to secure additional supplies as early as possible.

The Utility's available wet-water resources, if fully utilized, will provide Tucson Water with sufficient supplies to meet demand throughout the 50-year planning period. In order to maintain the City of Tucson's AWS designation beyond 2035, it will be necessary to acquire additional renewable supplies and/or reduce per capita demand by implementing a more aggressive demand management program. Maintaining a diverse water-resource portfolio will provide Tucson Water with greater drought resistance, higher source reliability, and the ability to blend a variety of source waters to provide consistent water quality to customers.

Water source availability is only one piece of the long-term water-resource puzzle. How Tucson Water will access its available water sources and convey sufficient supply to where demands and services are located within its projected service area is another piece and the focus of Chapter Five, *Water Delivery Systems*.