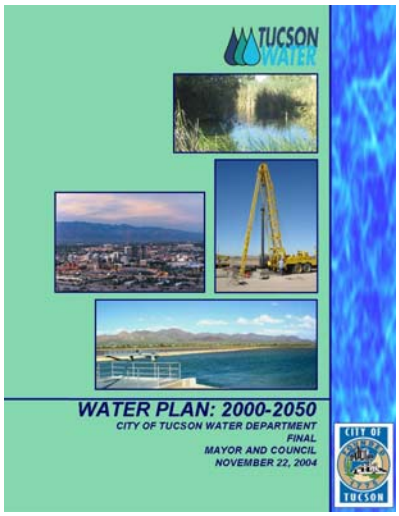
UPDATE TO *WATER PLAN: 2000-2050*

EXECUTIVE SUMMARY

This is the first update to *Water Plan: 2000-2050,* and it provides the City of Tucson's Mayor & Council with a renewed view of the community's water-resource future. The City of Tucson Water Department (Tucson Water) issued *Water Plan: 2000-2050* in 2004 to initiate a dialogue between the Utility and the community about the water-resource challenges which need to be addressed in the coming years. Although the substantive issues and challenges remain largely the same, the planning timeframes within which to address them have changed. The Update also accounts for revised population projections that have since been developed, an increase in the City's Central Arizona Project allocation, and changed planning assumptions and priorities which have evolved in the three years since *Water Plan: 2000-2050* was issued.



Both *Water Plan: 2000-2050* and this Update clearly demonstrate that the community served by Tucson Water has the water resources available to provide a long-term, sustainable water supply. This supply is sufficient not only for Tucson Water's current residents but also for those who are projected to come in the next several decades. Tucson Water's rate payers have already invested in developing the Utility's water-resource portfolio and its extensive water distribution systems. As a result, the community's remaining water-resource challenges primarily involve increasing system reliability and securing sustainable water supplies for new growth in the decades beyond.

The extent and timing of future growth in areas to be served by Tucson Water will be determined by land-use issues currently being addressed by planning authorities in the region. The recommendations in *Water Plan: 2000-2050* and this Update provide the Utility with the flexibility needed to accommodate future land-use decisions while ensuring a safe and sustainable water supply for Tucson Water's customers.

Both *Water Plan: 2000-2050* and this Update emphasize the need for the Utility to continue pursuing three general initiatives in order to ensure sustainable growth in the community:

1. Utilize fully the renewable water resources the City of Tucson currently has available;

2. Achieve more efficient water use through expanded conservation programming; and

3. Acquire additional water supplies to increase reliability and meet future demand.

Tucson Water has taken specific actions which directly support these initiatives. With regard to the first, Tucson Water plans to purchase the City's entire Central Arizona Project allocation in 2009. The Utility is also investing in additional reclaimed water production facilities to meet projected demand. Both of these actions will allow the Utility to further reduce its historical reliance on ground water and increasingly shift to renewable supplies.

Managing water demand is a critical component of any water-resource plan. Further reductions in per capita water demand will have a significant bearing on the water resources and system improvements that will be needed over time. Water conservation, improving the Utility's distribution system efficiency and drought preparedness are three areas where progressive steps have been taken with notable results.

Tucson Water has begun exploring opportunities to acquire additional water supplies to augment its already substantial water-resource portfolio. It is anticipated that acquiring additional resources will become increasingly competitive and costly both locally and statewide. Tucson Water is working with the Central Arizona Water Conservation District who is actively exploring ways to play the leading role in acquiring additional supplies for water interests in Maricopa, Pinal, and Pima Counties. If this effort proves successful, it could minimize in-state competition, reduce acquisition costs, and provide the physical means to convey additional renewable supplies to Tucson Water's service area.

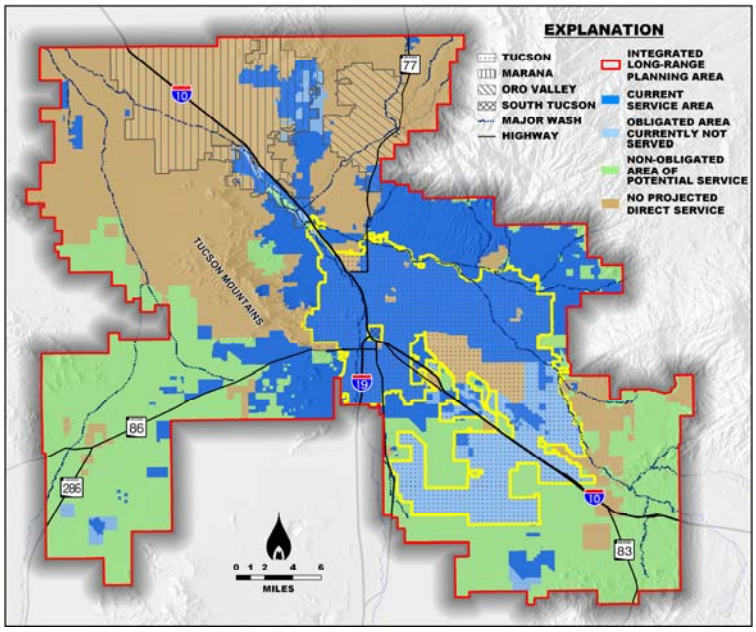
This Update also highlights several developments and changes which have occurred since *Water Plan: 2000-2050* was issued in 2004:

- New population projections through 2030 have been developed that directly influence projected water demand;
- The Utility has increased its annual Central Arizona Project allocation by 8,206 acre-feet with the finalization of the Arizona Water Settlements Act;
- Inclusion of a scenario analysis which assesses potential impacts to future water demand based on possible changes in the size of its ultimate service area and to the possible implementation of more aggressive demand-management measures;
- The possibility that the Secretary of the Interior may declare a shortage on the Colorado River sooner than previously projected;
- The need to further assess the community's preference regarding the long-term mineral content of the Colorado River water/ground-water blend to provide a final recommendation to Mayor & Council in 2008;
- Greater recognition of the potential long-term impact that climate change may have on the Utility's available water resources and the community's annual and seasonal demand for water.

Many of these and other changes and developments have been discussed over time with the City Manager's Office, the City of Tucson's Citizens' Water Advisory Committee, the Environment, Planning and Resource Management Subcommittee of the Mayor & Council, and the City of Tucson Mayor & Council. This Update summarizes the substance of these discussions and provides additional information about the evolving planning environment.

LONG-RANGE PLANNING AREA REVISITED

The Long Range Planning Area, shown on Figure ES-1, includes areas currently served by Tucson Water (dark blue) and undeveloped areas that the Utility is obligated to serve (light blue).



These two areas are collectively referred to as the "Obligated Area", and represent areas within the City limits or areas where the utility is currently contracted to serve. The remaining geographic areas (shown in green) are non-obligated areas of potential service. The Obligated Area and the non-obligated areas of potential service are collectively referred to as the Utility's "Potential Service Area." Areas shown in brown are those where Tucson Water has no plans to provide direct service.

Figure ES-1: Long Range Planning Area.

Regional Cooperation within the Long Range Planning Area

Even though Tucson Water has no plans to provide direct service to areas shown in brown on Figure ES-1, the Utility continues to evaluate local water management issues and to work cooperatively with water providers that serve these areas. Over the years, Tucson Water has been an active participant in many formal and informal local groups, such as the Southern Arizona Water Users Association (SAWUA), discussing various water management issues. In 2004 Tucson Water began discussions about regional cooperation on water resource issues with the largest water providers in the area. Those discussions resulted in a 2006 proposal from SAWUA for a cooperative water supply organization.

At approximately the same time, the Central Arizona Water Conservation District (CAWCD) Board developed a strategic plan that included the goal of acquiring additional water resources on the behalf of all water providers within its three-county service area. In effect, CAWCD proposed to perform the same functions as envisioned under the SAWUA proposal but on a much larger and far reaching scale. In addition, Pima County has proposed the establishment of a countywide water-and-wastewater authority which would include all public and private water and wastewater providers within the county.

As these alternative proposals have been discussed, local water providers have also continued to discuss potential cooperative projects related to water supply and management. The discussions

have included concepts such as joint projects for delivering renewable water supplies to areas of need, common issues and concerns for coordinated lobbying at the State level, and consideration of water credit transfers to reduce costs to ratepayers and meet water management goals.

POPULATION PROJECTIONS

Revised projections were used to develop population estimates for Tucson Water's Obligated Area and its Potential Service Area; these projections are graphically shown on Figure ES-2. The Obligated Area population is estimated to increase from 638,936 in 2000 to approximately 990,000 in 2030 and to just over 1.1 million by 2050. The Potential Service Area population is estimated to be about 1.1 million in 2030 and almost 1.3 million in 2050.

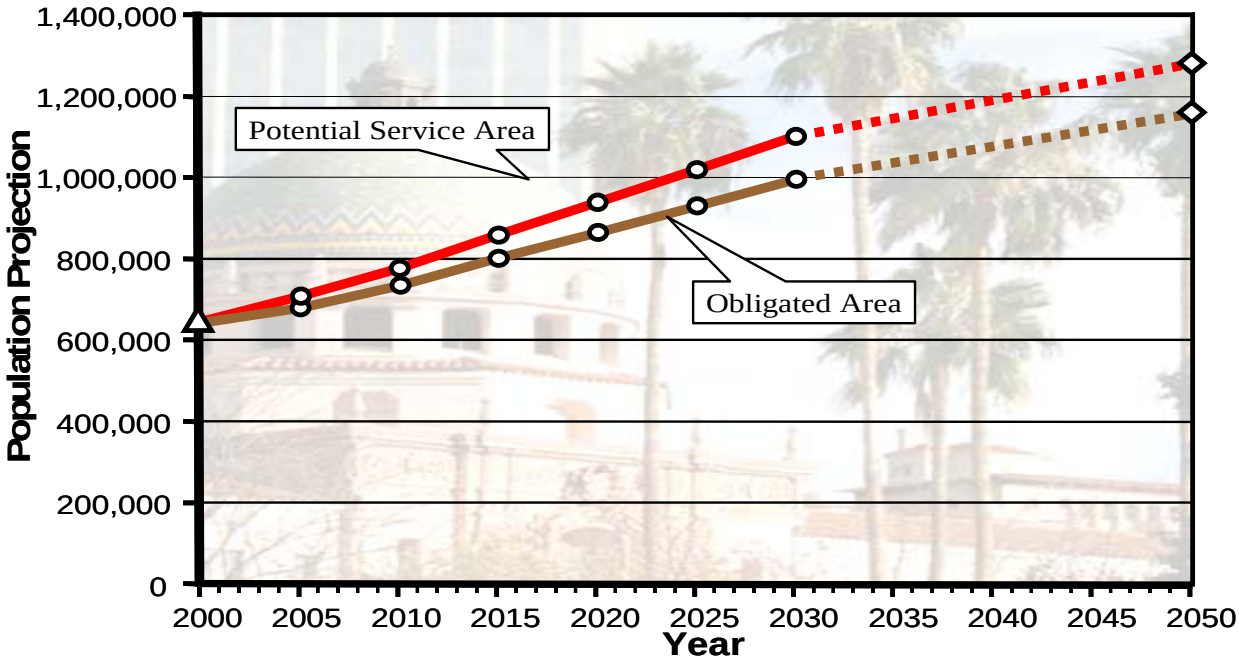


Figure ES-2: Population Projections.

PROJECTING WATER DEMAND

Two significant issues have arisen since the development of *Water Plan: 2000-2050* regarding the extent of the City's future water service area and the extent to which additional water demand-management (i.e., water conservation) measures are implemented. This Update addresses these emerging issues by presenting four future demand scenarios.

First, the City of Tucson historically has provided water service throughout the area characterized in this Update as the Potential Service Area; the City's willingness to serve within this area typically has been limited only by the availability of infrastructure to serve proposed new development. On December 11, 2007, the City Manager announced a new interim policy under which the City will not agree to serve any new developments outside its Obligated Area until such time as the Mayor & Council adopt a comprehensive policy regarding the City's future water service area. This new policy, if adopted by Mayor & Council, could significantly change demand projections and the timing of resource utilization for the Tucson Water service area.

Second, the Community Conservation Task Force recommendations have been developed but the extent to which these recommendations will be implemented has not yet been determined. Additional water conservation measures over and above what was recommended by the Community Conservation Task Force have also been recommended. However, expanding existing programs and implementing new, more aggressive conservation measures will require additional investment and community support. In combination with a potential new policy on service area expansion, decisions regarding the future level of water conservation efforts will also impact future demand and resource utilization in the Tucson Water service area.

As a result of these new developments, four water demand projections based on the combinations of two variables were developed for this Update. The two variables are service area size and level of demand management (see below). Demand management for this Update involves increased conservation measures and increased distribution system efficiencies that result in fewer system losses.

Variable #1: Service Area Size - Reduce (or increase) the size of the potential area that will be directly served by Tucson Water. In this analysis, the future service area size is projected to be either the Obligated Area or the Potential Projected Service Area.

Variable #2: Level of Demand Management - Invest (or not invest) in implementing additional, more aggressive water demand-management measures to reduce potable Gallons Per Capita Per Day. In this analysis, additional demand-management is assumed to be a ten percent reduction in potable demand by 2030. This reduction is based on information generated by the Community Conservation Task Force and by the Utility's Water Loss Control Program.

These two variables combine into four unique sets of assumptions each of which is represented in one of the demand scenarios shown in Figure ES-3. The results of a resource-demand analysis of the resultant four scenarios illustrate how changes in two planning variables could impact water resource utilization and the City's Assured Water Supply designation in future years.

	With Additional Demand Management	Without Additional Demand Management
Obligated Area	Scenario A	Scenario B
Potential Service Area	Scenario C	Scenario D

Figure ES-3: Matrix of Demand Scenarios.

Scenarios A and C approximate futures which assume additional investment in more aggressive programs will occur. For comparative purposes, *Scenarios B* and *D* represent futures which assume there would not be additional investment in such demand-management measures.

Review of Figure ES-4 indicates that projected water demand, as represented by each of the four scenarios, is highly sensitive to the size of the area to be served and whether the Utility invests in more aggressive demand-management measures.

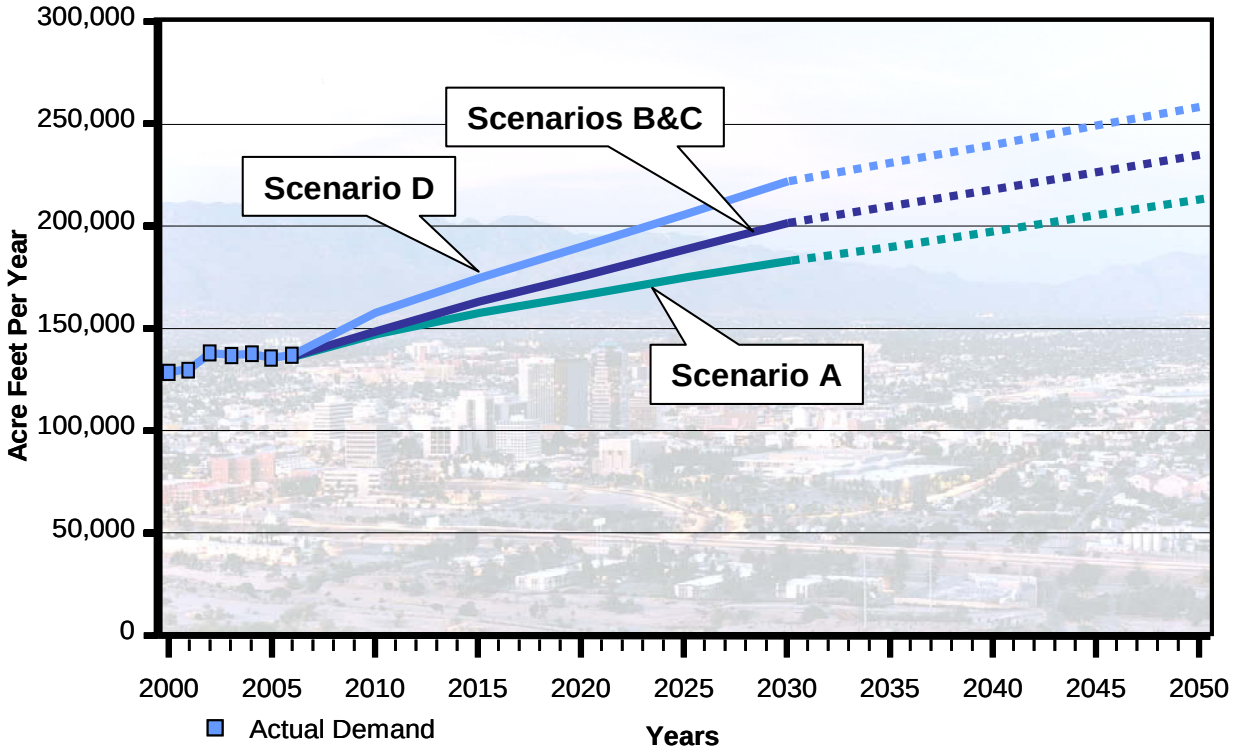


Figure ES-4: Projected Demand Scenarios.

Of the four, *Scenario A* has the smallest increase in projected water demand through 2050. This projection represents future water supply needs within the smaller Obligated Area and assumes that more aggressive demand-management strategies can be successfully implemented with the support of the community. Under this scenario, the Utility's total water demand is projected to increase from 128,141 acre-feet in 2000 to approximately 180,000 acre-feet in 2030 and to about 215,000 acre-feet by 2050.

The demand scenario which approximates the largest projected increase in demand is represented by *Scenario D*. This worst-case demand projection represents the most conservative portrayal of the Utility's future water supply needs. It assumes that the larger Potential Service Area would be served solely by Tucson Water and that additional demand-management programs would not be implemented above and beyond those already in place. Under this scenario, the Utility's total water demand is projected to increase to approximately 220,000 acre-feet per year by 2030 and about 255,000 acre-feet by 2050. *Scenarios B* and *C* are indistinguishable in terms of projected water demand and represent a mid-range increase in water demand through 2050.

IMPLEMENTING THE PLAN

The recommended resource utilization plan presented in *Water Plan: 2000-2050* consists of a schedule for implementing programs and projects common to many possible water-resource planning futures and specifies the scope and timing of critical water-management decision points within the planning horizon.

Balancing Projected Demand with Available Resources

Success in implementing the resource utilization plan and in addressing the critical water-management choices to be made in 2008 and later will help determine how the Utility's water-resources portfolio will be utilized in future years. These actions will determine to a considerable degree how quickly Tucson Water will use its available water supplies, when additional water supplies will need to be developed or acquired, and how demand may be managed in the future. For purposes of illustration, four demand-resource projections are presented which correspond to *Scenarios A, B, C,* and *D*. These demand-resource projections approximate potential resource utilization possibilities and demonstrate how future changes in the planning assumptions could impact resource planning decisions and the City's AWS designation. Only Scenarios A and D are summarized in this Executive Summary since they provide end-member perspectives on the two critical planning assumptions analyzed.

Scenario A – Increased Demand Management in the Obligated Area

In addition to decreasing future demand by limiting the Utility's service area expansion to the smaller Obligated Area, this scenario is predicated under the assumption that the Utility's potable Gallons Per Capita Per Day would gradually be reduced by ten percent by 2030. The latter would be achieved by implementing more aggressive demand-management measures beyond those already in place.

Figure ES-5 provides a view of how the Utility's resource utilization is projected to occur under *Scenario A*. The Utility's total water demand is projected to increase from 128,141 acre-feet in 2000 to approximately 180,000 acre-feet in 2030 and to about 215,000 acre-feet by 2050. This projected increase in water demand over time is the smallest of the four scenarios. Under this scenario, projected potable demand would exceed the sum of the City's annual Central Arizona Project allocation, its Incidental Ground-Water Recharge increment, and its annual Central Arizona Ground Water Replenishment District contracted volume by about year 2032. However, Tucson Water would still have available the balance of its renewable effluent resources not committed to the Utility's reclaimed water system and its reserve of non-renewable ground-water credits.

The City could extend its Assured Water Supply (AWS) designation to about 2050 by depleting its reserve of ground-water credits; instead, Tucson Water recommends these credits be preserved as long as possible to provide planning flexibility for the future. It is more prudent to use these credits as short-term transitional supplies while additional renewable supplies are being acquired and/or developed.

Tucson Water recommends that the resource planning priority be placed on developing additional renewable resources such as the City's effluent supplies, additional imported supplies or a combination of both. In this manner, new growth after 2032 would become more hydrologically sustainable and the City's AWS designation could be extended well beyond 2050. Of the four future scenarios analyzed, *Scenario A* delays the need to develop or acquire additional renewable supplies furthest into the future and maximizes planning flexibility to deal with future uncertainties.

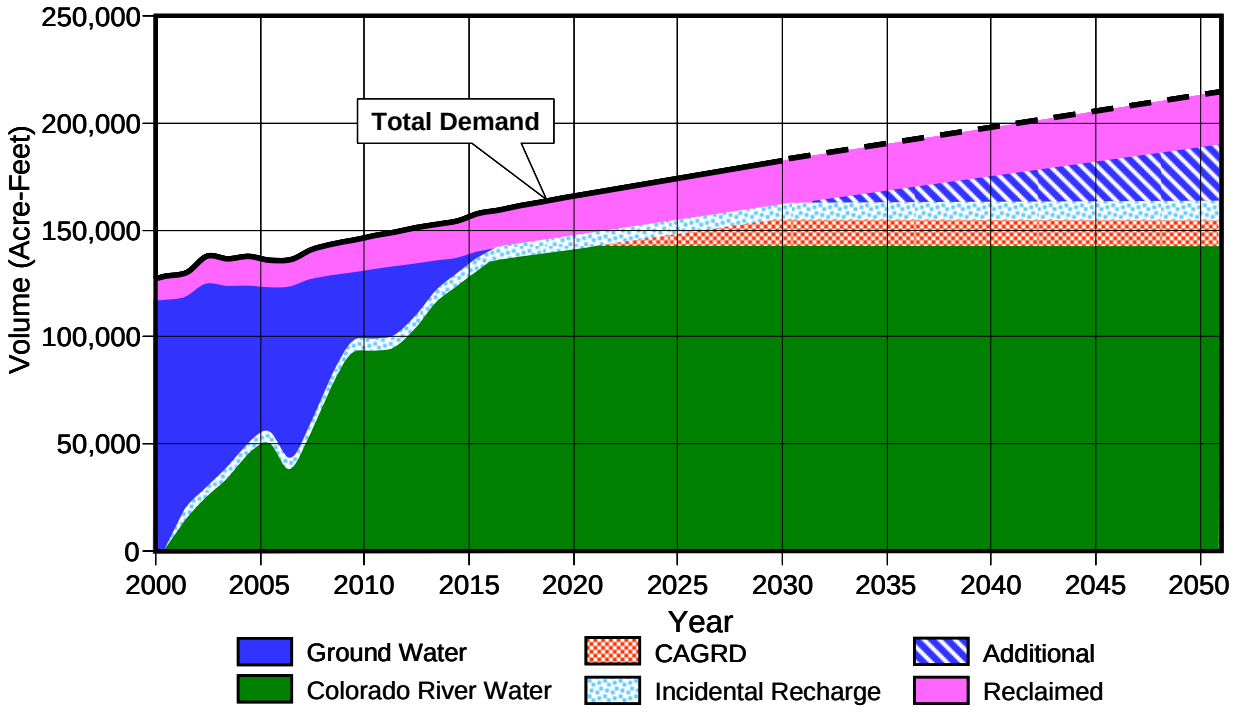


Figure ES-5: Scenario A, Projected Demand and Water Resource Utilization: 2000-2050.

Scenario D – Without Additional Demand Management in the Potential Service Area

Scenario D is based on the conservative demand assumptions used in *Water Plan: 2000-2050*. The Utility's total water demand is projected to increase to approximately 220,000 acre-feet per year by 2030 and about 255,000 acre-feet by 2050. It differs from *Scenario A* by assuming that the entire Potential Service Area would be served by Tucson Water (an area twice as large as the Obligated Area) and no additional demand-management measures would be implemented within the 50-year planning horizon.

Review of Figure ES-6 indicates that projected potable demand would exceed the sum of the City's annual Central Arizona Project allocation, its Incidental Ground-Water Recharge increment, and its annual Central Arizona Ground Water Replenishment District contracted volume by about 2017. Tucson Water would still have available beyond 2017 the balance of its renewable effluent resources and its reserve of non-renewable ground-water credits.

The City could extend its AWS designation to about 2025 by depleting its reserve of groundwater credits; as with *Scenario A*, Tucson Water recommends these credits be preserved as long as possible to provide planning flexibility for the future. Tucson Water recommends that the resource planning priority be placed on developing additional renewable resources such as the City's effluent supplies, additional imported supplies or a combination of both. In this manner, new growth after 2017 would become more hydrologically sustainable and the City's AWS designation could be extended further out in time. Of the four future scenarios analyzed, *Scenario D* is the least able to delay the need to develop or acquire additional renewable supplies and provides the least planning flexibility with which to deal with future uncertainties. The demand-resource projections associated with *Scenario B* and *Scenario C* are equivalent and would fall in between those shown for *Scenario A* and *Scenario D*.

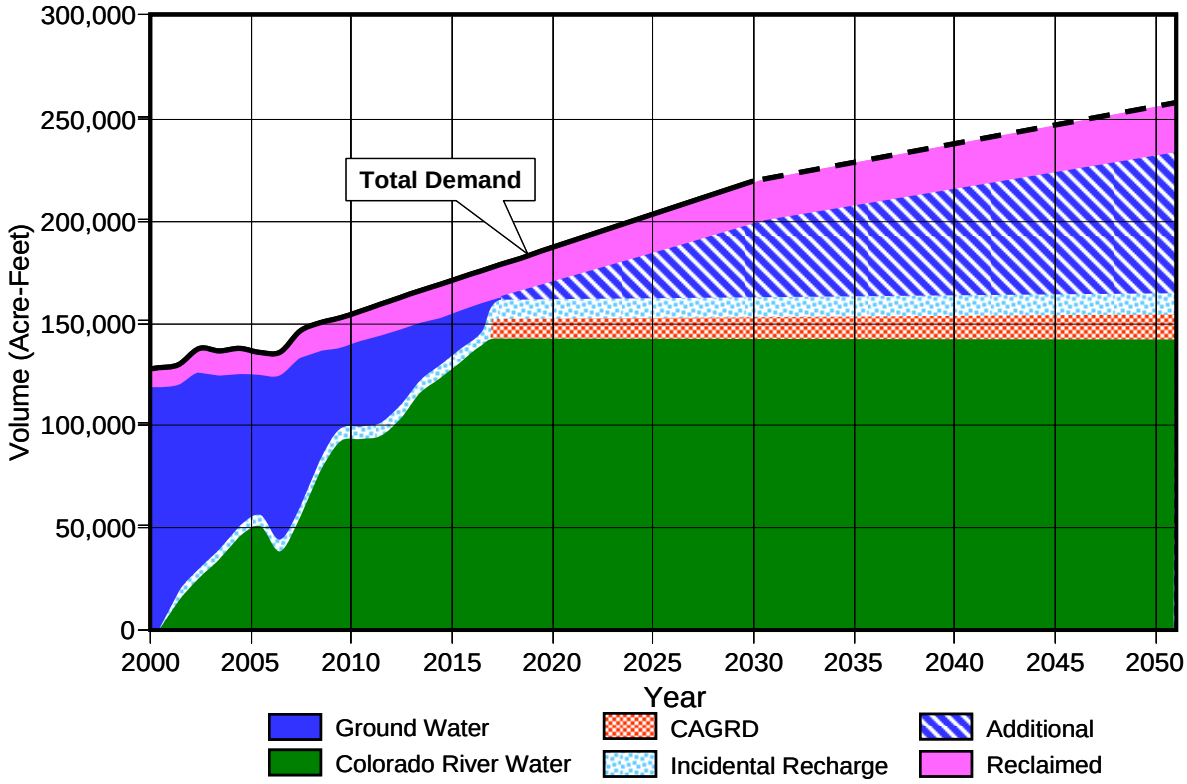


Figure ES-6: Scenario D Projected Demand and Water Resource Utilization: 2000-2050.

Decision Points

Water Plan: 2000-2050 outlined four critical decisions to be made at two key points in time: 2006 and 2014. In this Update, the key decision points have been revised. The first decision point is projected to occur in 2008 and the timing of the second decision point is dependent upon which of the four potential demand scenarios is relevant.

Decision Point 2008

In *Water Plan: 2000-2050*, the first two resource-management decisions pertaining to the use of Colorado River water were projected to be made in 2006. The first decision was concerned with

the long-term mineral content of the Clearwater blend of ground water and recharged Colorado River water. In the coming months, the Utility will provide Mayor & Council its recommendation regarding mineral content so that a final decision can be made in 2008.

The second decision focused on whether the Utility should consider bringing a surface (direct) water treatment plant into service for a portion of the City's current Central Arizona Project allocation. The results of recent analyses indicate that continuing to rely on recharge and recovery provides Tucson Water with greater operational performance and planning flexibility at less cost. Therefore, Tucson Water has implemented several projects to ensure sufficient facilities are in place to fully utilize the City's entire Central Arizona Project allocation as early as 2009.

The Next Decision Point

The Next Decision Point pertains to the development of additional renewable water supplies and is dependent upon which of the service area and demand-management options are adopted by the Mayor & Council. *Scenarios A, B, C and D* illustrate how these options impact the timing of the Next Decision Point and determine how far into the future the City's AWS designation can be extended with the City's currently available water resources. Depending on the direction from the Mayor & Council, the timing of the Next Decision Point may vary from as early as 2014 under *Scenario D* to as late as 2027 under *Scenario A*. The City's AWS designation may extend to 2025 or perhaps beyond 2050.

CONCLUSIONS

Many of the recommendations and conclusions noted in *Water Plan: 2000-2050* have already been implemented while others are currently in process or have been revised to reflect the changing planning environment. The updated recommendations are summarized below.

1. **Emphasize "Wet" Water Management Strategies**: The community's sustainable future ultimately depends on maintaining a physical hydrologic link between renewable water sources and the infrastructure needed to convey those waters to customers within the projected service area.

2. **Utilize Renewable Ground Water**: Tucson Water plans to limit its ground water withdrawals at or below this hydrologically sustainable level in order to ensure the long-term viability of the aquifer within the Utility's service area.

3. **Preserve City's Ground-Water Credits for Longer Term:** The City could extend its AWS designation under any future scenario by depleting its reserve of non-renewable ground-water credits in the near or mid terms. Instead, Tucson Water recommends that these credits be preserved as long as possible to provide planning flexibility for the future. It is more prudent to use these credits as short-term transitional supplies while additional renewable supplies are being acquired and/or developed. This would ensure that the water resources needed to support new growth will be hydrologically sustainable.

4. **Reassess the Water-Quality Target for Colorado River Water**: Customer preferences are being reassessed through the on-going *Decision H20* program by linking costs and environmental sustainability issues with potential mineral level targets. The goal is to finalize this aesthetic water-quality management decision in 2008.

5. **Fully Utilize Colorado River Water**: Between CAVSARP, SAVSARP, and the Pima Mine Road Recharge Project, the Utility will have sufficient recharge capacity in place to fully use its Central Arizona Project allocation as early as 2009.

6. **Fully Utilize Effluent for Future Supply**: Tucson Water recommends that the resource-management goal should be to maximize the future use of the City's effluent through additional treatment and recharge in order to augment the aquifer within Tucson Water's service area.

7. **Acquire Additional Water Supplies**: The City of Tucson is already exploring opportunities to acquire potentially available supplies to augment its water-resource portfolio. The availability of additional water resources will become increasingly competitive and costly both locally and statewide. The Utility is encouraged that the Central Arizona Water Conservation District is actively exploring ways to play the leading role in acquiring additional supplies for water interests in its three-county service area.

8. **Manage Water Demand**: Tucson Water is taking a number of actions to further manage demand including expanded conservation programming, reducing lost and unaccounted for water, encouraging the practice of water harvesting, and providing public information programs. Additional demand management efforts have been evaluated and recommended by the Community Conservation Task Force to further reduce per capita potable water use.

9. **Adjust Development Fees to Shift the Cost of Growth to New Customers**: Tucson Water has developed a financial plan that continues to shift the cost burden of growth to new customers as they are added to the system. The Utility recommends that in the future, development fees be adjusted to ensure that existing customers do not inordinately bear the cost of growth.

10. **Continue to Expand Regional Cooperation**: Tucson Water has taken steps to initiate new cooperative efforts and expand existing ones with local providers. These cooperative actions focus on acquiring additional sources of water supply, developing resource credit banking agreements, and exploring potential win-win arrangements to wheel renewable resources within the region.

The resource utilization plan will periodically be reassessed and revised as planning assumptions and circumstances change over time. This is the first Update to *Water Plan: 2000-2050,* and there will be others in the years to come. As the present unfolds into the future, the primary necessity is to prepare for change since it is the only certainty. This recognition reinforces the need for continuous planning and wise water management.

WATER PLAN: 2000-2050

2008 Update

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SECTION ONE

INTRODUCTION

This is the first update to *Water Plan: 2000-2050*, and it provides the City of Tucson's Mayor & Council with a renewed view of the community's water-resource future. The City of Tucson Water Department (Tucson Water) issued *Water Plan: 2000-2050* in 2004 to initiate a dialogue between the Utility and the community about the water-resource challenges which needed to be addressed in the coming years. Since that time, the substantive issues and challenges remain largely the same; however, the planning timeframes within which to address them have changed. In addition, planning assumptions and priorities have evolved and revised population and water demand projections have been developed.

Both *Water Plan: 2000-2050* and this update clearly demonstrate that the community served by Tucson Water has the water resources available to provide a long-term, sustainable water supply. This supply is sufficient not only for Tucson Water's current residents but also for those who are projected to come in the next few decades. Tucson Water's rate payers have already invested in developing the Utility's water-resource portfolio and its extensive water distribution systems. Many of the community's water-resource challenges involve increasing system reliability and securing sustainable water supplies for additional growth in the decades beyond.

The extent and timing of future growth in areas to be served by Tucson Water directly relate to land-use issues currently being discussed by planning authorities in the region. The recommendations in *Water Plan: 2000-2050* and this update provide the Utility with the necessary flexibility to accommodate future land-use decisions while ensuring a safe and sustainable water supply for Tucson Water's existing and future customers.

This update relies on *Water Plan: 2000-2050* as its primary source document; it serves as Tucson Water's most recent comprehensive revision to its long-range water resources plan. *Water Plan: 2000-2050* has received wide recognition as a significant accomplishment in water-resources planning and has become a resource document and model for others. It was predicated on a Scenario Planning approach which addresses the critical uncertainties that can affect the community's water future; the result is greater program viability and planning flexibility. *Water Plan: 2000-2050* was developed with the following resource-management goals:

- Meet Projected Total Water Demand.
- Maximize Use of Renewable Water Resources.

- Meet Water-Quality Targets.
- Achieve Sustainable Ground-Water Pumpage.
- Manage Costs and Water Rate Impacts.
- Comply with Assured Water Supply (AWS) Program.

Both *Water Plan: 2000-2050* and this update emphasize the need for Tucson Water to continue pursuing three general initiatives in order to effectively address the growing community's water-resource issues and challenges:

1. Utilize fully the renewable water resources it currently has available;
2. Achieve more efficient water use through expanded conservation programming or demand management;
3. Acquire additional water supplies to increase reliability and meet future demand.

The Utility's ability to implement these initiatives requires decision makers to address critical decisions at key points in time. These decisions will in turn ensure the timely implementation of projects and programs which will guarantee the long-term sustainability of the community's water resources.

This update highlights several developments and changes which have occurred since *Water Plan: 2000-2050* was issued in 2004. One significant change is that new population projections through 2030 have been developed that directly influence projected water demand and resource utilization. Another is the inclusion of an analysis which assesses the sensitivity of projected water demand to potential changes in the size of the area to be served and to the potential implementation of more aggressive demand management measures. The third is the possibility that the Secretary of the Interior may declare a shortage on the Colorado River sooner than previously projected. The fourth is the need to further assess the community's preference regarding the long-term mineral content of the Colorado River water/ground-water blend to provide a final recommendation to Mayor & Council in 2008. Fifth and finally, greater recognition is given to the potential long-term impact that climate change may have on the Utility's available water resources and the community's demand for water.

Many of these and other developments have been discussed over time with the City Manager's Office, the City of Tucson's Citizens' Water Advisory Committee (CWAC), the Environment, Planning and Resource Management (EPRM) Subcommittee of Mayor & Council, and the City of Tucson Mayor & Council. This update summarizes the substance of these previous communications and provides additional information about the evolving resource planning environment.

The update consists of seven sections. The first five sections document the support information used to update the recommended resource-utilization plan. Section Two

summarizes revised projections of Tucson Water's potential service area populations through 2050. Section Three discusses the impact that these revised population projections and potential demand-management initiatives can have on projected water demand. Section Four reviews Tucson Water's available water resources with emphasis given to the future availability of the City of Tucson's Central Arizona Project (CAP) allocation and the current status of the City of Tucson's Assured Water Supply (AWS) designation. Section Five reviews the needs of Tucson Water's potable and reclaimed water systems to convey water supplies within its service area to meet demand as well as potential cooperative opportunities to wheel the water resources of other local water providers.

The last two sections present the latest revisions to the recommended resource-utilization plan and update the conclusions provided in *Water Plan: 2000-2050*. Section Six refocuses Tucson Water's resource-utilization and system plan noting progress in implementing many of the previously identified common project/program elements and the results of the expanded public outreach regarding *Water Plan: 2000-2050*. Special emphasis is given to outreach efforts conducted to elicit customer preference regarding the long-term mineral content of the Colorado River water/ground-water blend. Section Seven provides an update on the key recommendations of the plan, summarizes the substantive conclusions of this update, and discusses what may lie beyond the fifty-year planning horizon. The Appendices (A through E) present more detailed information on specific issues discussed in this Update.

SECTION TWO

PROJECTIONS OF POPULATION

Tucson Water revised its aggregate and spatial population projections based on updated information generated by the Pima Association of Governments (2005a). In addition, an analysis was conducted to assess the sensitivity of population projections to variations in the ultimate size of the Utility's service area.

LONG-RANGE PLANNING AREA REVISTITED

Tucson Water's Long-Range Planning Area is outlined by the red boundary on Figures 2-1 and 2-2. The overall planning boundary has been revised in order to be more spatially contiguous with bounding jurisdictions, preserved lands, and census polygons. The Long-Range Planning Area is generally consistent with the planning areas utilized in *Water Plan: 2000-2050* and in *Tucson Water Resources Plan 1990-2100* (CH2M Hill, 1989).

As shown on Figure 2-1, the Long-Range Planning Area includes areas currently served by Tucson Water (dark blue) and those undeveloped areas that the Utility is obligated to serve (light blue). The Utility's obligation is limited by the terms of legal contracts and by the availability of its assured water supplies. These dark and light blue areas are collectively referred to as the "Obligated Area" which has a combined area of about 410 square miles. The color-coded areas shown on Figure 2-1 are portrayed with limited resolution and should not be construed to be a detailed, parcel-based determination of status. Tucson Water currently provides direct service both within and outside the City limits. The light blue areas include undeveloped lands within the existing City boundaries and a limited number of contracted areas outside the City where Tucson Water is legally required to provide service. The Obligated Area can potentially be expanded through the approval of future water-service contracts, City annexations, or by the direction of the City Manager. The City Manager recently directed Tucson Water not to provide new services outside the Obligated Area unless directed to do so.

The Long-Range Planning Area extends well beyond Tucson Water's Obligated Area. The geographic areas shown in green on Figure 2-2 are non-obligated areas which may be served by Tucson Water and/or other water providers in the future. For the purposes of this Update, the dark blue, light blue, and green areas shown on Figure 2-2 are collectively referred to as Tucson Water's "Potential Service Area" which has a combined area of approximately 780 square miles. The Potential Service Area is almost twice as large as the Obligated Area and therefore contains a significantly larger projected population. As with Figure 2-1, the color-coded areas shown on

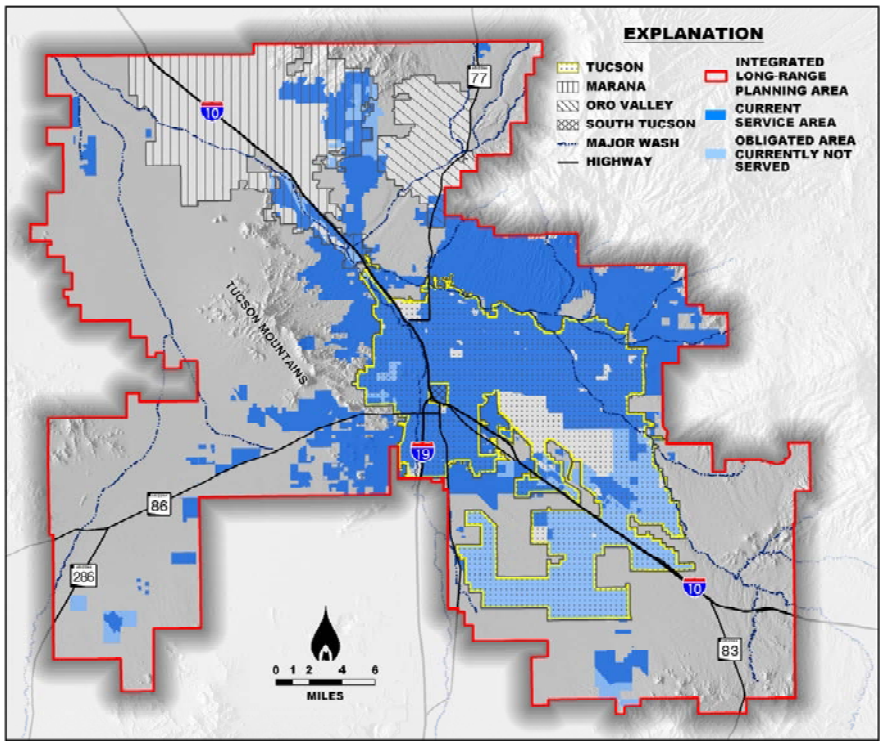


Figure 2-1: Tucson Water's Long Range Planning Boundary, Current Service Area, and Obligated Areas Currently Not Served.

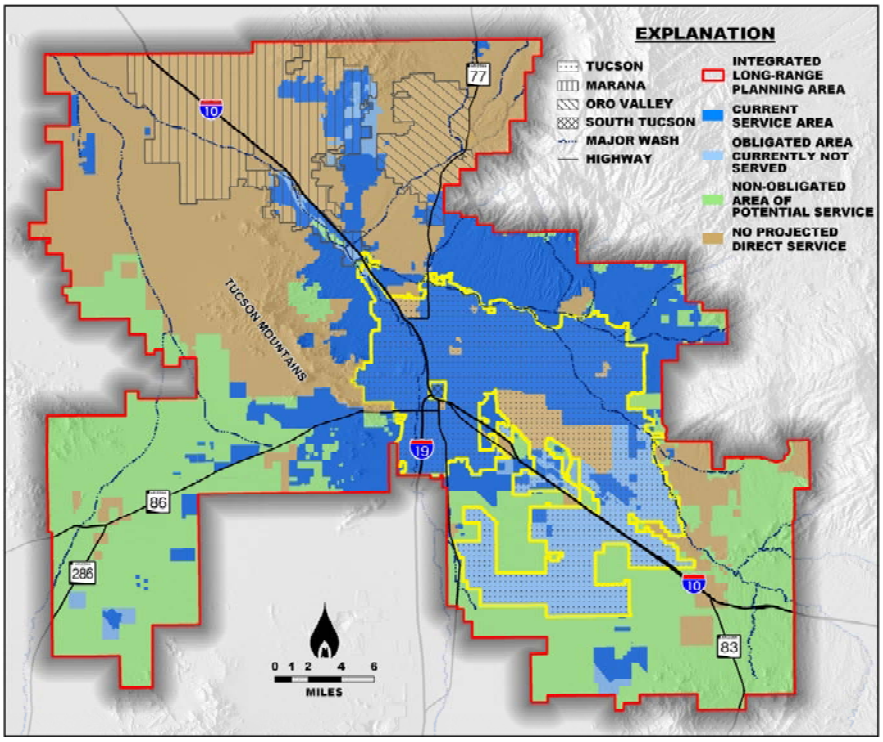


Figure 2-2: Tucson Water's Long-Range Planning Boundary and Potential Service Area.

Figure 2-2 are portrayed with limited resolution and therefore should not be considered to be a detailed, parcel-based determination of status. As per the City Manager's direction, Tucson Water will only commit to providing new services in areas shown in green when directed to do so.

Areas where Tucson Water has no plans to provide direct service are shown in brown on Figure 2-2. This area includes the many other local water providers who have chosen to pursue their own water-management objectives. The projected population contained within the brown areas is not included in Tucson Water's resource-planning projections. Nonetheless, the Utility has common interests with these providers and is already providing various forms of indirect service to many of them. Tucson Water also works with local water interests to identify and assess possible resource and water-supply arrangements that would be mutually beneficial. More details regarding more recent regional cooperative discussions and initiatives are in Section Seven.

POPULATION COUNTS AND PROJECTIONS

In *Water Plan: 2000-2050*, data sets provided by federal, state, and local governmental agencies were used to project population in the Potential Service Area through 2050. Such population data sets provide a common basis for conducting regional planning efforts. The U.S. Census Bureau provided a count of the local population in *Census 2000* which continues to serve as the decadal baseline. This baseline will be reset after *Census 2010*.

Aggregate Population Counts and Projections

In 2005, Pima Association of Governments (2005a) updated projections for Pima County and worked with local planning entities such as Tucson Water and the Pima County Regional Wastewater Reclamation Department to provide revised aggregate and spatial population estimates. The updated population projections have since been used to develop annual population estimates for Tucson Water's Obligated Area as well as revised estimates for the larger Potential Service Area. The original 2050 spatial projection provided by PAG did not have the same resolution as that shown for 2030 since the former was developed at the coarser census tract level. PAG plans to provide an updated 2050 projection with finer resolution in 2008.

Annual population projections for Tucson Water's Obligated Area and its Potential Service Area are graphically shown on Figure 2-3. The annual projections for the 30 years between 2000 and 2030 were based on traffic analysis zone assessments at five-year increments; the 20 years between 2030 and 2050 were linearly interpolated and are dashed indicating greater uncertainty. The population for the Obligated Area is estimated to increase from 638,936 in 2000 to approximately 990,000 in 2030 and to just over 1.1 million by 2050. The Potential Service Area population is estimated to be approximately 1.1 million in 2030 and almost 1.3 million in 2050.

From 2000 through 2030, significant population growth is projected to occur on the fringes of urban Tucson. This may entail further service area expansion in undeveloped obligated areas and possibly in unobligated areas if so directed. The population in the Tucson Water service area

continues to increase but at a slower rate than what was originally projected in *Water Plan: 2000-2050*. Nonetheless, the increasing number of people will create a growing need for water.

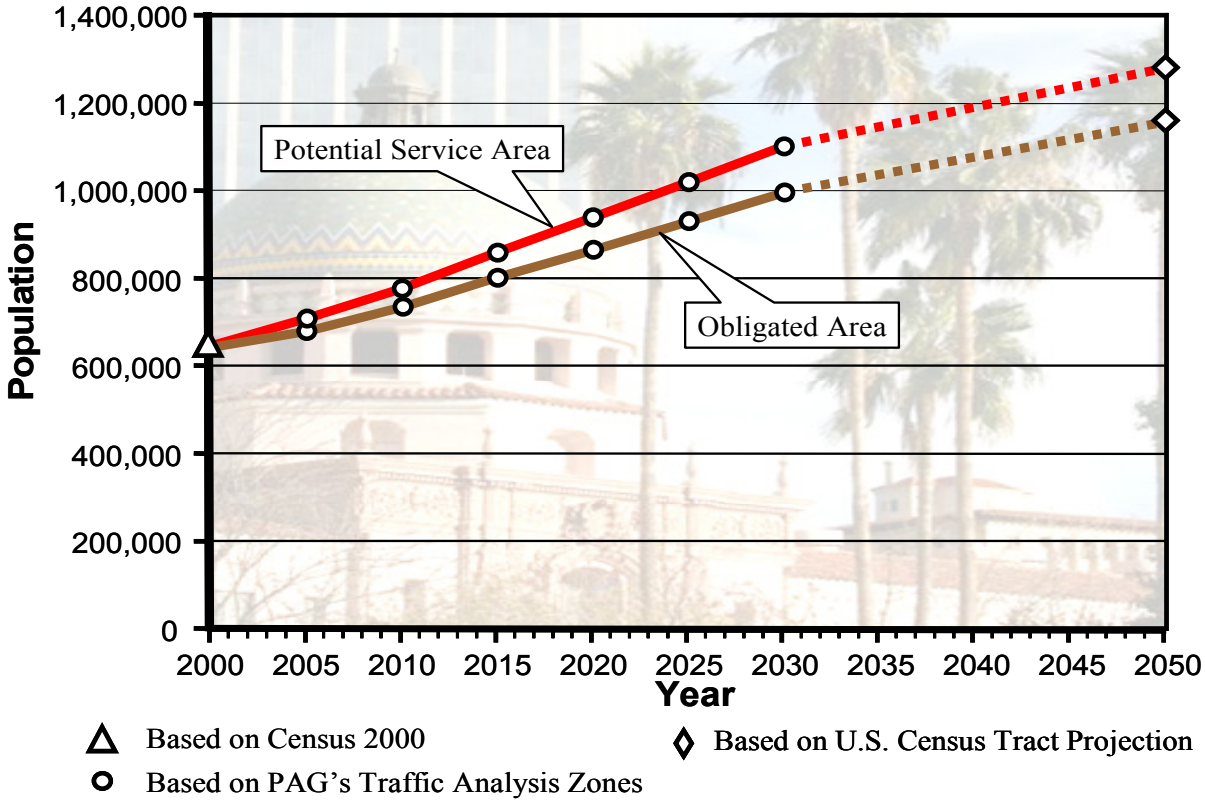


Figure 2-3: Population Projections for Tucson Water's Obligated Area and its Potential Service Area.

SECTION THREE

PROJECTED WATER DEMAND

The projections of aggregate water demand for the Obligated Area and the Potential Service Area provide supply targets that need to be met in the years to come. These projections depend in part on the size of the area (i.e. the number of people) to be served and on per capita water usage. To meet these demand targets, Tucson Water will ensure that sufficient water resources will be available when needed and that effective demand-management measures will be implemented.

PER CAPITA WATER USAGE RATES

In order to derive projected total water demand from population projections, average per capita water use of Tucson Water customers is determined. Such water usage is commonly measured in gallons per capita per day (GPCD).

The total GPCD water usage rate for Tucson Water's customer base has annually averaged about 177 GPCD for many years. The components of total GPCD include about 14 GPCD to meet reclaimed water demand and approximately 163 GPCD for all potable deliveries. Per capita potable water usage can be further broken down into total residential use at 110 GPCD, commercial and industrial water use at 35 GPCD, and water loss at 18 GPCD. Except for the past few years (which may be exceptional), the Utility's total GPCD has been relatively consistent for almost 25 years although the relative contributions of reclaimed and potable demand have changed over time. As longer-term per capita use trends change, water usage measures will similarly be revised.

PROJECTIONS OF TOTAL WATER DEMAND

Four projections of water demand were developed for this update to assess the potential impact of two variables over the 50-year planning period:

Variable #1: Reduce (or increase) the size of the potential area that will be directly served by Tucson Water; and

Variable #2: Invest (or not invest) in implementing additional, more aggressive demand-management measures to reduce potable GPCD.

The ultimate size of Tucson Water's potential future service area and its impact on projected demand was evaluated by assessing the two differently-sized areas introduced in Section Two—the Utility's Obligated Area and the larger Potential Service Area. The potential impact of additional demand-management on future water demand was assessed by assuming potable GPCD will remain constant by not investing in additional demand management measures ("without" condition) or it will gradually decrease ten percent from 163 to 147 by 2030 by making such investment ("with" condition). These two variables combine into four unique sets of assumptions each of which is represented in one of the demand scenarios shown in Figure 3-1.

Figure 3-1 indicates that *Scenarios A* and *B* focus on the smaller Obligated Area while *Scenarios C* and *D* are concerned with the larger Potential Service Area. Similarly, *Scenarios A* and *C* depict futures which assume investment in additional demand-management measures while *Scenarios B* and *D* represent futures without such investment.

	With Additional Demand Management	Without Additional Demand Management
Obligated Area	Scenario A	Scenario B
Potential Service Area	Scenario C	Scenario D

Figure 3-1: The Four Demand Scenarios and Associated Planning Assumptions.

The potential for achieving a ten percent reduction is based on analyses performed by Tucson Water's Community Conservation Task Force (2006) and the Utility's internal water-loss reduction program. The Task Force concluded that its recommended projects could reduce customers' potable demand by about 7.5% over the proposed program's implementation period. Further reductions will also be achieved through the Utility's internal water-loss reduction program which seeks to improve system efficiencies. Taking into account both of these initiatives, a water-demand reduction of at least ten percent could be realized by 2030 and beyond. For such water-use improvements to occur, Tucson Water will need both community support and greater financial investment to develop and implement more aggressive demand-management programs.

For all scenarios, the projected annual demand for reclaimed water use was increased from the eight percent assumed in *Water Plan: 2000-2050* to at least nine percent over the planning period. This increase is due to recent changes in customer usage and anticipated increases in demand in the near and mid terms.

Results of Scenario Analysis

Scenario A projects water demand in the Obligated Area through 2050 and assumes potable GPCD will gradually decrease ten percent by 2030. Under this demand projection, Tucson

Water's total water demand over the 50-year planning period would increase from 128,141 acre-feet in 2000 to about 180,000 acre-feet in 2030 and approximately 215,000 acre-feet by 2050. Of the four scenarios, *Scenario A* has the smallest increase in projected water demand as shown on Figure 3-2.

Under *Scenario B*, water demand is projected for the Obligated Area but differs from *Scenario A* by conservatively assuming that potable GPCD would remain constant throughout the 50-year planning period. Under *Scenario B*, the Utility's total water demand would increase from 128,141 acre-feet in 2000 to approximately 200,000 acre-feet in 2030 and about 235,000 acre-feet by 2050. *Scenario C* projects water demand for the larger Potential Service Area but assumes that potable GPCD will gradually decrease ten percent by 2030. Under this demand projection, Tucson Water's total water demand through 2050 would be essentially the same as in *Scenario B*. Both *Scenarios B* and *C* would result in a relatively moderate increase in water demand as shown on Figure 3-2.

Scenario D, like *Scenario C*, also projects water demand in the larger Potential Service Area but assumes potable GPCD would remain constant through 2050. Under this projection, the Utility's total water demand would increase from 128,141 acre-feet in 2000 to approximately 220,000 acre-feet in 2030 and about 255,000 acre-feet by 2050. This projection is consistent with the 50-year water demand projection in *Water Plan: 2000-2050*. *Scenario D* has the largest projected increase in water demand.

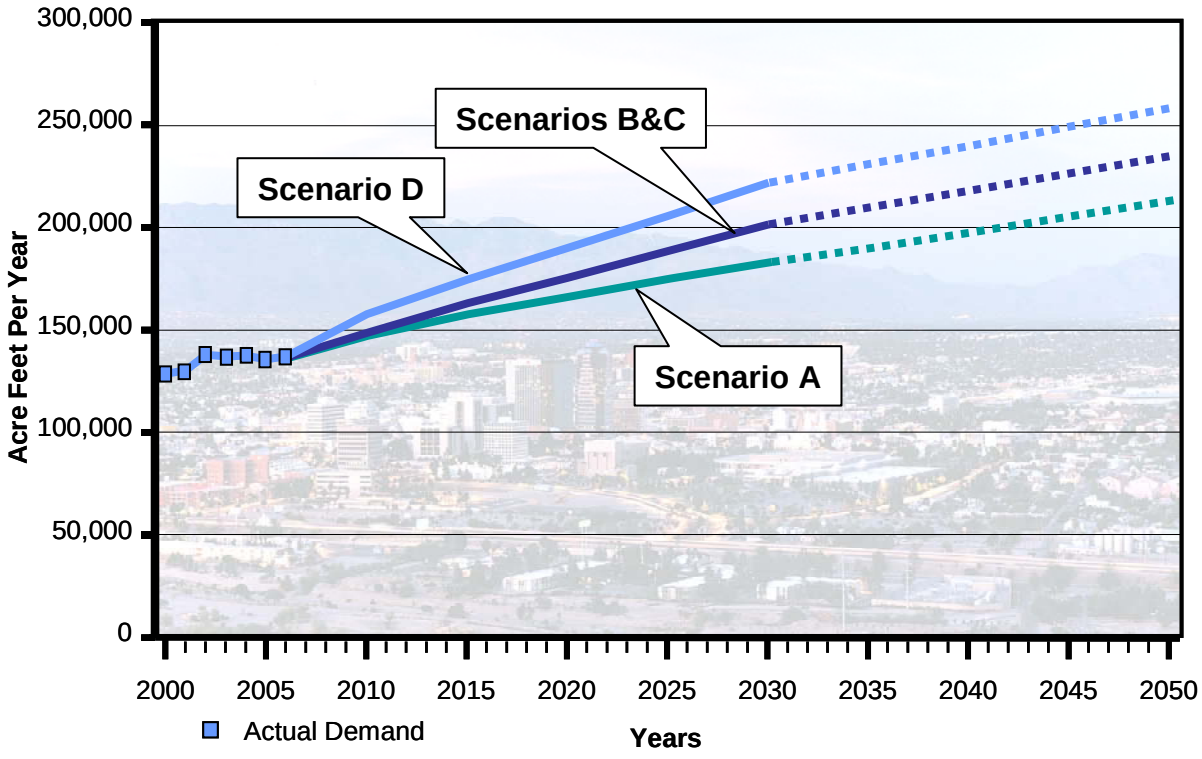


Figure 3-2: Projected Demand Scenarios: 2000-2050.

Review of Figure 3-2 indicates that future water demand is highly sensitive to the size of the area to be served and per capita water usage rate. *Scenario A* represents future water supply

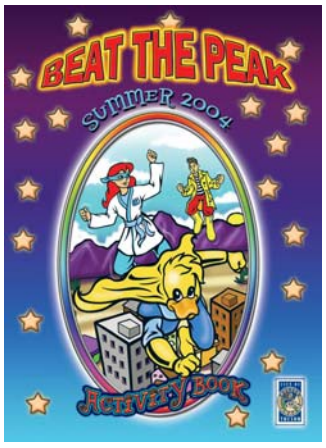
needs within the smaller Obligated Area and assumes that more aggressive demand-management strategies would be successfully implemented with the support of the community. Conversely, *Scenario D* represents a demand future which assumes that the larger Potential Service Area would be served solely by Tucson Water and that additional demand-management programs would not be implemented above and beyond those already in place. Of the four scenarios, *Scenario A* would offer the Utility the greatest resource planning flexibility while *Scenario D* would offer the least. The water-resource planning ramifications of the four scenarios are discussed in Section Six.

MANAGING DEMAND

Managing current and projected water demand is a critical component of any integrated water-resource and system plan. The extent to which future water demand can be further reduced could have a significant bearing on the water resources and system improvements that will be needed over time. Water conservation, improving the Utility's distribution system efficiency, and drought preparedness are the three demand-management programs discussed in this update.

Water Conservation

Conservation programming has been a critical component of Tucson Water's planning process for several decades. During this time, many programs have been implemented encouraging greater water-use efficiency, and they have collectively been instrumental in maintaining a low per capita potable water usage rate. This low rate has largely been maintained through extensive educational outreach efforts and ordinance-based requirements which have resonated with and contributed to the community's conservation ethic. The Utility will continue to evaluate existing programs and develop additional ones based on their effectiveness, reliability, and cost to implement.



When developing more aggressive conservation measures, proposed initiatives need to be evaluated by assessing their demonstrated effectiveness as seen in other communities and by determining their potential applicability in Tucson given the unique characteristics of the local community. If these measures are appropriate, they could yield quantifiable decreases in the community's potable GPCD and a corresponding decrease in the projected growth of water demand in future years as shown by *Scenarios A* and *C*.

Conservation Initiatives Currently Underway

Tucson Water has been moving forward with several on-going programmatic activities to further widen the reach of its conservation program. These activities include the following:

- Develop a voluntary Incentive Program for commercial water customers;

- Implement the Enhanced Water Waste Enforcement Program;
- Demonstrate community leadership by providing technical support to City General Services who will coordinate the implementation of water audits for departments within the City;
- Review the conservation measures developed by other jurisdictions;
- Complete the Irrigation Design Standards by finalizing performance targets and developing procedures to implement those standards; and
- Investigate options to reduce water waste associated with hot water distribution systems in the residential sector.

Community Conservation Task Force

In addition to developing the above measures, Tucson Water also established the *Community Conservation Task Force* in 2005 to ensure that new conservation strategies selected for implementation would be both effective and broadly supported by the community (Community Conservation Task Force, 2006). In order to achieve the latter, the members of the Task Force Committee represented a wide range of community stakeholders.

The Task Force Committee recommended 22 conservation measures that offer the greatest potential water savings and all were given the same implementation priority. The measures targeted five programmatic areas:

- Rebates and Incentives
- Ordinances Requiring Retrofits on Resale
- New Construction Ordinances
- Demonstration Programs
- Other

These measures targeted single-family residential, multi-family residential, and the commercial/industrial water-use sectors; the recommended measures are listed in Appendix A of this update. The Task Force Committee recognized that its final recommendations more heavily emphasized the multi-family residential sector over the others noting that Tucson Water's past conservation efforts and its block-rate pricing structure primarily targeted single-family residential users.

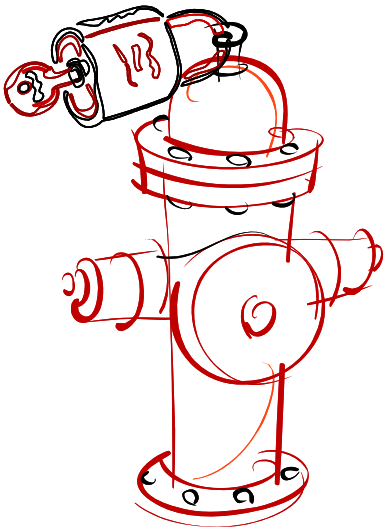
The recommended projects may potentially reduce demand by up to 7.5% over the life of the proposed program (Community Conservation Task Force, 2006). Consistent with the Task

Force Committee's recommendations, projected water demand associated with *Scenarios A* and *C* assume that such demand-management efforts would be successful in producing significant potable GPCD reductions. Further study is currently being performed by Tucson Water to assess the potential rate impacts associated with implementing the recommended measures.

Conservation is a vitally important demand-management tool. Effective conservation allows the community to maximize the use of the water it has available by optimizing efficiencies. Like any demand-management strategy, an aggressively managed conservation program can have a significant impact on when critical decisions must be made and when water-resources and system-planning projects need to be implemented to meet Utility goals.

Improving Water System Efficiency

A comprehensive Water Loss Control Program was initiated in October 2006 to better track and reduce the amount of "lost and unaccounted for" water in Tucson Water's potable system. This program integrates on-going programs and has initiated new ones to identify, control, and track system water losses. This information is used to increase water-use efficiency, reduce water losses to comply with regulations, and recover lost revenue. In essence, the Water Loss Control Program is the Utility's "internal" water conservation and product control program.



The overall purpose of the Water Loss Control Program is to control and track lost water by calculating the Utility's water balance; establishing goals, metrics, and milestones; and assessing the Utility's water-use efficiency performance. The total annual potable deliveries considered lost were 11.2, 11.9, and 12.5 percent in years 2004, 2005, and 2006, respectively.

The Water Loss Control Program will accomplish several specific objectives:

- Reduce water loss to seven percent of total annual potable deliveries within the next five years and to four percent in the longer term;
- Ensure to the degree possible that all water delivered through the potable system is accounted for;
- Increase billing accuracy;
- Comply with the conservation requirements in ADWR's Third Management Plan; and

- Establish the Infrastructure Leak Index to measure how efficiently the Utility manages and controls leaks on an annual basis.

To achieve these objectives, the specific projects managed under the Water Loss Control Program must involve all of the administrative divisions within the Utility. Tucson Water has taken steps which have reduced the potential for additional water losses in the potable system. The Water Loss Control Program integrates the Source Water Flow Meter Replacement Program, the Production Well Maintenance Program, and the Meter Replacement Program. The latter is particularly noteworthy since in the last three years, Tucson Water has replaced over 31,000 aged customer meters. Such meters tend to under-report the volume of water that passes through them which in turn results in a loss in revenue. In addition, the Utility's Water Loss Control Program has already initiated activities with the following objectives:

- Capture all non-revenue water losses in the potable system by developing a centralized water-tracking database;

- Quantify discharge volumes from pipeline breaks, leaks, and planned or unplanned distribution system releases by using standardized water discharge estimating and measurement procedures;

- Recover lost water revenue from stuck water meters by implementing a back-billing process;

- Implement the Large Reclaimed Meter Inspection and Replacement Program;

- Implement the Potable Meter Inspection and Replacement Program;

- Calculate and record water loss by updating well purging procedures; and

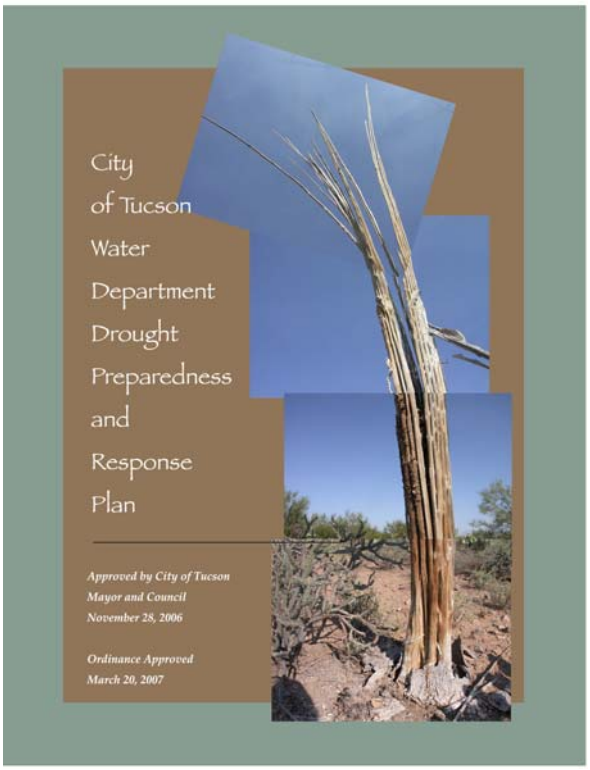
- Ensure production well meter accuracy by implementing a meter testing, calibration, and replacement program.

Plans are also in place to initiate a water system audit process to conduct an overall system water balance. The results will identify and prioritize sub-areas within the system where additional water control measures and Utility resources need to be focused. In addition, the main replacement program will focus on areas demonstrating the greatest need by considering historical outages, pipeline materials and age, and locations where mains will be relocated by road projects.

Decreases in the amount of water that is lost will help offset increasing total water demand. Tucson Water will provide the City of Tucson Mayor & Council with annual updates on the continuing development and findings of the Water Loss Control Program.

Drought Preparedness and Management

Drought preparedness and management are inextricably linked with water-resources planning. The impacts associated with drought are caused not only by dryer than normal weather patterns but also by the water demands the community places on its available supplies. The effects of drought can be worsened by managing available water resources inefficiently or through inadequate resource and/or system planning. Conversely, effective drought planning can serve as a "buffer" which can minimize the severity of drought impacts when they occur (Arizona Department of Water Resources, 2007). The *City of Tucson Water Department Drought Preparedness and Response Plan* (Drought Plan) was developed to conform with recently enacted state law and to further reinforce the Utility's existing drought management and water resource/system buffers already in place.



In response to recommendations developed by the Governor's Drought Task Force (2004), drought-related legislation became state law in 2005 and required all Arizona water systems to submit a drought preparedness and response plan to the State by January 1, 2007. The City of Tucson Mayor & Council approved the Drought Plan in November 2006 and subsequently amended the Tucson Code in March 2007 by adopting an ordinance which enforces the drought response stages and response measures embodied in the Drought Plan.

The City's Drought Plan addresses the inherent uncertainties associated with drought events such as their potential duration and severity. It was developed with the understanding that drought impacts can potentially occur more locally or regionally. For instance, drought can be only local involving the Santa Cruz River Watershed and nearby basins, or it can be more regional encompassing all or part of the Colorado River Watershed thus impacting water users in several states. It is now common knowledge that drought can occur both locally and regionally at the same time.

Tucson Water's Drought Plan consists of four drought response stages ranging from the mild to the most stringent. These stages and the associated response measures account for the unique attributes of the Utility's water system which is configured and operated to maximize reliability in both its available resources and supply infrastructure. Tucson Water's system is less vulnerable to the effects of local or regional drought because the Utility has diversified its water-resources portfolio. This means that the Utility is not fully reliant on either surface water or ground water for potable supply. In addition, Tucson Water also operates a large

reclaimed water system which meets a significant portion of the Utility's total water demand. This system also serves as a drought buffer since it reduces the magnitude of peak demand on the potable system thereby minimizing the potential impact of local or regional drought. The Utility's conjunctive use of ground water and Colorado River water for potable supply and its utilization of reclaimed water to meet non-potable demand collectively provide Tucson Water and its customers greater supply resiliency in both wet and dry years.

For more detailed information on the stages, drought indicators, and response actions, the *City of Tucson Water Department Drought Preparedness and Response Plan* can be viewed on the City of Tucson Water Department's web site at *http://www.ci.tucson.az.us/water*. Answers to frequently asked questions regarding the City's Drought Plan and a summary of the staged response actions are provided in Appendix B.

SECTION FOUR

AVAILABLE WATER RESOURCES

This section provides an update on the three water sources physically available to Tucson Water and evaluates the constraints that may affect their use for supply. In addition, it includes a summary of ADWR's Assured Water Supply (AWS) Program which places restrictions on how water providers utilize their water resources to meet growing demand. Finally, this section discusses the potential opportunities to acquire or develop additional water resources. Supplemental information on the Utility's water resources portfolio and the AWS Program are provided in Chapter Four of *Water Plan: 2000-2050* and in Appendices C and D of this update.

GROUND WATER

Tucson Water will continue to rely on local ground-water resources and its well fields throughout and beyond the 50-year planning period. Ground water will remain an important supply source for the following reasons:

- To meet peak water demand during the hottest months;
- To meet projected annual potable demand when it exceeds the City of Tucson's annual Central Arizona Project allocation and if additional renewable supplies are not available;
- To provide emergency backup supply should there be a disruption in Colorado River water supply due to problems with the Central Arizona Project infrastructure or due to supply disruptions caused by system outages in Tucson Water's own system;
- To provide backup potable supply should a temporary shortage be declared on the Colorado River; and
- To provide longer-term back-up supply to help offset potential climate change impacts on Colorado River water availability.

Potential constraints on the use of ground water were discussed in *Water Plan: 2000-2050*. In general, the regional aquifer systems have stresses placed on them not only by Tucson Water but also by other water providers, industrial and agricultural operators, and numerous private well owners. Tucson Water remains 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 will take into account the current and projected actions of other ground-water users in the Long-Range Planning Area. One recent positive development is the passage of legislation that places constraints on the ability of private interests to drill "exempt" wells within the service area of a water provider that holds an AWS designation. This was an important step toward managing the proliferation of new "unregulated" demands on the local aquifers.

Over-pumping of these aquifers over many decades has resulted in significant water-level declines, measureable land surface subsidence, and loss of riparian habitat. In order for ground water to remain a viable resource for future use, Tucson Water has continued its efforts to reduce its ground-water use to approximate a hydrologically sustainable pumping rate. For the Utility's efforts to be beneficial in the longer-term, other local ground-water users will also need to work cooperatively to ensure that the local regional aquifers will be able to provide sustainable supply to meet the water needs of the greater community.

The Utility has a finite volume of ground-water credits that it can pump over time under the AWS Program; this is referred to as "allowable" ground water. The Utility also has access to a small volume of annually accruing ground-water credits from "incidental" recharge (defined as aquifer recharge which occurs after the Utility accesses its water sources for supply) constituting four percent of Tucson Water's annual total demand. In addition, Tucson Water has the ability to utilize up to 12,500 acre-feet of ground water per year that would be replenished through its contract with the Central Arizona Groundwater Replenishment District (CAGRD). However, the bulk of Tucson Water's ground-water pumping will debit against its allowable ground water account. Once these paper-water credits are exhausted, all ground water that is pumped in excess of incidental recharge must be replenished with a renewable water supply. Even if Tucson Water reduces its annual pumping and utilizes ground water at the hydrologically sustainable rate, the Utility will eventually deplete its allowable ground-water credit account. At some point in time, the credits remaining in this account will not be sufficient to renew the City of Tucson's AWS designation. Despite these concerns, these credits will continue to be valuable because they provide planning flexibility and the legal means to transition to fully renewable water supplies.

Tucson Water's use of its CAGRD contract adds legal authority to pump ground water. Under current state law, the replenishment (i.e. recharge) activities of the CAGRD are not required to occur in the same area as the ground-water pumping it seeks to offset. Thus CAGRD replenishment does not necessarily address local ground water declines. Tucson Water will perform CAGRD replenishment at its recharge and recovery facilities in order to maintain aquifer water levels within its projected service area and assist in achieving long term sustainability.

Potential Additional Sources of Ground Water

Substantial quantities of ground water might be available from less developed basins in western Arizona such as the Harquahala basin, McMullen Valley, and Butler Valley. Transfers of ground water from less populated areas of Arizona could yield additional water

supply in the future. These supplies could potentially be delivered to the Tucson area by utilizing existing excess capacity in the Central Arizona Project.

EFFLUENT

Municipal wastewater effluent is a renewable water supply that steadily grows along with the population. This recycled water supply is delivered through Tucson Water's reclaimed water system and provides a sustainable alternative to mining ground water to satisfy irrigation demand. In addition, this water source will continue to be recharged thereby augmenting local aquifers.

In 2006, 69,067 acre-feet of effluent were produced from the metropolitan wastewater treatment plants in the Tucson area. As shown on Table 4-1, the City of Tucson had entitlement to a total of 31,536 acre-feet (46 percent) of this effluent. Of this total, 11,983 acre-feet were reused as reclaimed water within the Tucson Water service area while the remainder (19,553 acre-feet) was discharged to the Santa Cruz River. In contrast, all of the effluent annually entitled to the Secretary of the Interior (28,200 acre-feet) was discharged to the river and constitutes the majority of the perennial effluent flow observed in the Santa Cruz River.

Entity	AF/Year
Tucson	31,536
Secretary of the Interior	28,200
Pima County	4,087
Metropolitan Domestic Water Improvement District	2,890
Oro Valley	2,354
TOTAL (rounded)	**69,067**

Table 4-1: Local Effluent Entitlements in 2006.

Updated projections of wastewater generation through 2030 were developed in consultation with the Pima County Regional Wastewater Reclamation Department. These projections indicate that annual effluent availability within the Long-Range Planning Area could approach 118,900 acre-feet by 2030. Looking beyond, *Water Plan: 2000-2050* indicated wastewater availability could approach 128,000 acre-feet by 2050. The updated wastewater volumes were based on population growth projections and assumptions regarding per capita potable water usage, sewer return flow rates, and septic tank usage and are summarized in Appendix C. Of these totals, it is projected that the City of Tucson would have annual entitlement to approximately 61,000 acre-feet by 2030 and about 66,000 acre-feet by 2050.

The City's reclaimed water system provides water of a quality appropriate for turf and ornamental landscaping, firefighting, toilet flushing, orchards, and the irrigation of some edible food crops. Tucson Water will continue to develop projects that will provide sufficient capacity to meet reclaimed water demand as the community continues to grow. A key long-term planning assumption is that the reclaimed water system will supply at least nine percent of Tucson Water's projected total demand through 2050. Accordingly, reclaimed water

demand in the Tucson Water service area is projected to increase from 11,983 acre-feet per year in 2006 to approximately 24,000 acre-feet per year in 2050. In addition to serving customers in the Tucson Water service area, the reclaimed water system provides a regional service by treating and wheeling effluent supplies owned by other regional entities. In 2006, 2,186 acre-feet of reclaimed water were wheeled to Pima County facilities and to the Town of Oro Valley for distribution and use.

As the population increases and all other available potable water supplies become fully utilized, the need for reusing effluent as a critical supply source will also grow. Treated effluent will most likely be banked in local aquifers through a sequenced program of enhanced treatment and aquifer recharge. Tucson Water considers effluent to be a vital renewable water resource that will 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 usable share in the future. This could include agreements to lease or purchase the Secretary of the Interior's effluent entitlement as well as those of others. This would result in greater utilization of the only locally generated renewable supply that grows with the community.

The effluent that Tucson Water further treats for use in the Reclaimed Water System comes from the local wastewater treatment works owned and operated by Pima County. This arrangement is unique to this region; elsewhere in the State, municipalities provide both potable water delivery and municipal wastewater treatment.

Pima County is presently engaged in its Regional Optimization Master Plan (ROMP) which will define the effluent quality and quantities that will be produced at the Roger Road Wastewater Treatment Plant and the Ina Road Water Pollution Control Facility. The outcome of the ROMP is critical to the future direction of the City's Reclaimed Water System since at the present time, most of the reclaimed supply is derived from the County's Roger Road Plant. Changes in where the effluent is produced as well as its resultant water quality may impact Tucson Water's ability to produce additional reclaimed water to meet increasing non-potable water demand. For a more detailed discussion of effluent ownership in the Tucson region and the near-term future of the Reclaimed Water System, refer to the *Reclaimed Water System – Status Report 2007* (City of Tucson Water Department, 2007a).

COLORADO RIVER WATER

The Colorado River is a major source of water supply, power generation, recreation, and environmental habitat in the western United States. It is a major part of Arizona's water supply portfolio providing more than one-third of all water used in the State (Central Arizona Project, 2007a). More than half of Arizona's annual water supply is delivered to central Arizona via the Central Arizona Project. The Colorado River is the largest renewable supply

source available to Tucson Water. This section provides an update on the status of Tucson Water's allocation of Colorado River water, information related to future shortage issues associated with drought, and the potential implications of climate change.

Colorado River water is delivered to the greater Tucson area via the Central Arizona Project which conveys water from Lake Havasu to its terminus located southwest of Tucson. The City of Tucson has rights to the largest municipal allocation of Central Arizona Project water in the State—currently 135,966 acre-feet per year. For planning purposes, however, the City's allocation is expected to reach a total of 144,191 acre-feet per year in the near future. This anticipated increase in the City's allocation is due to the recently finalized Arizona Water Settlements Act (an addition of 8,206 acre-feet per year) and a pending allocation transfer from the Flowing Wells Irrigation District (19 acre-feet per year).

Clearwater Program and the Blend

Tucson Water's efforts to fully utilize its Central Arizona Project allocation are managed under its Clearwater Program. Through the process of recharge and subsequent pumping (recovery), Colorado River water mixes with native ground water to produce a blended water supply. The Central Avra Valley Storage and Recovery Project (CAVSARP), the Hayden-Udall Treatment Plant, and the 60-million gallon Clearwell Reservoir in the Tucson Mountains currently constitute the core infrastructure of the Clearwater Program. CAVSARP is permitted to annually recharge up to 80,000 acre-feet of Colorado River water. Recovery components are currently being upgraded to increase the facility's recovery capacity to about 70,000 acre-feet per year. The core facilities are currently sized to utilize about 50 percent of the City of Tucson's annual Central Arizona Project allocation and make it available for potable supply in Tucson Water's service area.

Figure 4-1: Aerial View of CAVSARP Taken January 2008.

Phase II of the Clearwater Program, the Southern Avra Valley Storage and Recovery Project (SAVSARP), is currently under construction. Deliveries of Colorado River water for recharge at SAVSARP will begin in spring 2008 to the first three recharge basins. When construction of the balance of the facility is completed by the end of 2008, SAVSARP is expected to have about 60,000 acre-feet of annual recharge capacity. Recovery will initially be conducted through an existing well field that will be expanded over time. Upon completion of additional wells, pipelines, a reservoir/booster station, and a large-diameter recovered water transmission main, the annual recovery capacity at SAVSARP will be approximately 60,000 acre-feet.

Since issuance of *Water Plan: 2000-2050*, Tucson Water has evaluated how the Pima Mine Road Recharge Project might be more fully utilized. The Utility owns a 50 percent share of the facility which is located near the Central Arizona Project terminus at I-19. Tucson Water's Santa Cruz Well Field is located adjacent to the Pima Mine Road Recharge Project, and water levels in the vicinity of the well field benefit from its recharge activities. Tucson Water plans to continue recharging a portion of its Central Arizona Project allocation at Pima Mine Road and to recover all or part through the Santa Cruz Well Field. This well field will be expanded with additional wells and pipelines in the future.

Between CAVSARP, SAVSARP, and the Pima Mine Road Recharge Project/Santa Cruz Well Field, Tucson Water will have sufficient capacity to recharge and recover its entire Central Arizona Project allocation. The Utility currently plans to begin purchasing its full allocation in July 2008. The collective recovery capacities of these facilities will expand over time as infrastructure projects are completed and as potable water demand increases. By 2012, the vast majority of Tucson Water's service area will be served a renewable water supply through Clearwater Program facilities.

Many additional potential Clearwater Program elements are described in *Water Plan: 2000-2050*. Newer initiatives under consideration include additional expansions of the recharge and recovery capabilities of CAVSARP. An application to expand its recharge capacity to 100,000 acre-feet per year was filed with the State in January 2008; the Utility may receive its permit before the end of the year. In the longer term, the CAVSARP and SAVSARP facilities could potentially be expanded beyond 100,000 and 60,000 acre-feet per year as additional renewable water supplies are brought into service.

Shortage on the Colorado River

The primary uncertainty related to Tucson's use of Colorado River water is the future impacts of potential shortage conditions. There are several factors that could individually or in combination result in a declaration of shortage on the Colorado River. In preparation, Tucson Water has developed supply-and-demand response contingencies to augment the institutional protections already in place to help offset the impacts of eventual shortages.

Factors Contributing to Shortage

Three critical factors that could drive a future declaration of shortage on the Colorado River are as follows:

- Annual allocations to Colorado River water exceed the actual long-term average yield of the Colorado River;
- Effects of extended drought conditions on water availability; and
- Potential ramifications of long-term climate change.

It is widely recognized that the annual average yield of the Colorado River was over-estimated in the 1920s. When compared to information collected and analyzed in subsequent years, it is clear that the annual average yield is significantly lower. As a result, the magnitude of flows in the Colorado River will not always be sufficient to fulfill all of the annual Central Arizona Project allocations.

Water users in the Colorado River basin have also experienced droughts which are intermittent periods of below normal water availability; these periods can sometimes last decades. Because of the current severity of drought conditions within the Colorado River Watershed, the first shortage declaration on the Colorado River may be just years away.

The probability of shortage in the longer term may increase based on current climate change projections for the Southwest. These projections, largely based on climate modeling simulations, generally agree that a gradual long-term warming trend is likely. These projections also suggest that there will be a decrease in annual precipitation in the Southwest (Christensen et al., 2007; Lenart et al., 2007; and Overpeck; 2007). The effects of climate change could be significant with regard to the long-term yield of the Colorado River.

Regardless of the factors that result in an eventual shortage declaration on the Colorado River, the potential effects on Tucson Water and the Utility's planned responses are similar. The Utility continues to prepare for periods of time when access to Colorado River water will be reduced. In order to prepare for eventual shortages, Tucson Water has taken several proactive steps with regards to both supply and demand.

Preparations for Shortage

The Utility has participated in state-wide planning efforts to protect Arizona's renewable water resources, cooperated with the Arizona Water Banking Authority (AWBA) to store excess Central Arizona Project water in the near-term for eventual recovery during times of shortage, and developed infrastructure that will remain viable when the supply of Colorado River water is reduced. In addition, the Utility will seek to acquire and develop additional, higher-priority sources of renewable water supply such as main-stem (non-Central Arizona Project) Colorado River water as well as locally-generated effluent; these potential supplies

are particularly attractive since they will not be curtailed except during the most extreme shortages and therefore offer greater resource and supply reliability.

An important institutional buffer is the high priority of the City's annual allotment within the Central Arizona Project's hierarchical allocation structure. The City of Tucson's allocation is for municipal and industrial (M&I) use which would only be impacted after shortages have become severe. To ensure full benefit its M&I allocation, Tucson Water must fully utilize its entire annual allotment no later than the year before a shortage is declared. According to the Central Arizona Project (2007b), the current worst-case estimate of when a shortage on the Colorado River might be declared is 2011. To prepare for this possibility, the City plans to fully utilize its entire allocation beginning in 2009.

When a shortage affects M&I usage of Central Arizona Project water, providers in the Central Arizona Project's three-county service area will have access to water that has been banked in long-term storage facilities through the AWBA. Plans to recover this banked water have not yet been finalized but the Central Arizona Project is in the process of developing conceptual plans to recover the stored water (Central Arizona Water Conservation District, 2007). Tucson Water has already provided the AWBA storage capacity at its recharge facilities. The water stored in these facilities can readily be recovered during times of shortage and brought into service; however, this represents only a small part of the AWBA water that would be required in a multi-year shortage.

Tucson Water's reliance on recharge and recovery as the means to bring its Colorado River water into use will also mitigate shortage impacts. A benefit of recharge over the use of a conventional water treatment plant is that recovery wells associated with a recharge facility can continue to operate for a period of time even when the availability of the source water is reduced. In contrast, a surface water treatment plant can only produce water as long as the source water is available.

An additional contingency is the Utility's diversified water-supply portfolio. As Tucson Water further expands and diversifies its portfolio, impacts to any particular water supply can be offset by relying on other available supply sources including the City's effluent resource. Access to locally-generated effluent is not subject to curtailment due to drought, Central Arizona Project infrastructure outages, or climate change. If this resource were used to augment the regional aquifers within the Utility's service area, it would provide the community with greater supply reliability during times of shortage.

The demand-management recommendations of Tucson Water's Community Conservation Task Force could generate long-term water savings. These savings could reduce the overall strain on the Utility's available water supplies and as such can become a significant part of Tucson Water's management strategy to prepare for shortages on the Colorado River. The Utility also developed a comprehensive Drought Preparedness and Response Plan to control demand in such times of need. These and other demand-management initiatives are more fully discussed in Section Three.

As the ultimate backstop, Tucson Water also possesses extensive ground-water production facilities which tap into the large regional aquifers in both the Tucson basin and Avra Valley. While the Utility is increasingly shifting its reliance to renewable water resources, the local regional aquifers have a very large volume of ground water in storage. Under the AWS rules, there is provision to allow ground-water pumping without debiting the Utility's credit accounts during shortages. This non-renewable supply source can be used for an extended period of time to satisfy customer demand.

Acquiring Additional Sources of Colorado River Water

The City of Tucson will continue efforts to increase its Central Arizona Project allocation and to access additional Colorado River water. This may be accomplished through reallocation, lease, and/or transfer and these options are discussed in detail in Chapter Four of *Water Plan: 2000-2050*.

Another potential mechanism to acquire additional Colorado River water is to participate in an "exchange" program by providing an alternate water supply. An option under state-wide consideration is to invest in a seawater desalination facility in partnership with a coastal community in the United States or Mexico that has higher-priority rights to Colorado River water. Under such a potential agreement, Tucson could, in partnership with others, provide funding to the coastal community to desalinate seawater for use in that location in exchange for more Colorado River water to import to the Tucson area via the Central Arizona Project. If this type of arrangement were to occur, it would likely be many decades out. Tucson Water plans to participate in these discussions in order to take advantage of this potential opportunity if and when it occurs.

ASSURED WATER SUPPLY PROGRAM

Under the current AWS Designation issued in 2007, the City of Tucson's 100-year supply of water that meets all of the AWS criteria is 185,688 acre-feet per year. However, Tucson's AWS designation is currently capped at 183,956 acre-feet which was the projected demand volume for 2015 at the time of the AWS application. The City's current water supply portfolio is based on its physically available ground water, Colorado River water and effluent supplies. The controlling factor in determining this total volume is the "Consistency with Management Goal" criteria (i.e. Safe Yield).

The current AWS designation contains a sufficient volume of approved water resources to meet projected growth through 2016. To maintain the designation without interruption, the Utility will need to re-apply to extend the designation order at least two years before this demand volume is reached. Based on current projections of the Utility's available water supplies, water credit balances, and future demands, Tucson Water expects to extend its AWS designation from 2016 to about 2025. There will be subsequent extensions to the AWS designation.

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. Since *Water Plan: 2000-2050* was issued in 2004, Tucson Water has continued to debit its allowable ground water credit account although the annual rate of ground-water use has steadily declined as use of renewable supplies has increased. Reliance on renewable supplies would allow for sustainable growth over the longer term.

SECTION FIVE

WATER DELIVERY SYSTEMS

Tucson Water operates two types of water systems: a potable system and a reclaimed (non-potable) system. These are physically separate and distinct systems which convey water from supply sources through a pressurized hydraulic system to customers situated at different elevations. Tucson Water's systems consist of a complex network of pipes, wells, pumps, reservoirs, valves, automated controls, and treatment facilities.

The existing water systems extend throughout a 330-mile area and served a population of about 720,000 people in 2006. The existing systems provide a baseline upon which future supply and demand needs are assessed.

EXISTING POTABLE SYSTEMS

Tucson Water's potable water distribution systems currently receive supply from more than 200 wells spread over five well fields with a collective pumping capacity of 196 MGD. Figure 5-1 shows the location of the five well fields within the Tucson basin and Avra Valley. The network of large diameter pipelines in Tucson Water's potable distribution system is shown on Figure 5-2. About 4,200 miles of pipelines (ranging from 2 to 96 inches in diameter) convey water from the various potable supply sources to more than 200,000 businesses and residences. The distribution system includes 50 fully enclosed reservoirs ranging in size from 15,000 gallons to 60 million gallons; the overall system has a total storage capacity of 273 million gallons. The system has 124 booster stations used to lift water to higher delivery elevations.

The ground water served by Tucson Water meets all applicable federal and state regulatory standards. Because the water delivered through the Tucson Water distribution system must be free of pathogens, Tucson Water introduces chlorine at various locations in the system to maintain a residual disinfectant in the water delivered to customers. Areas where ground-water contamination could pose a threat to potable supplies are being managed by controlling ground-water pumping or by pumping and treating to either augment the ground-water system or for direct potable use.

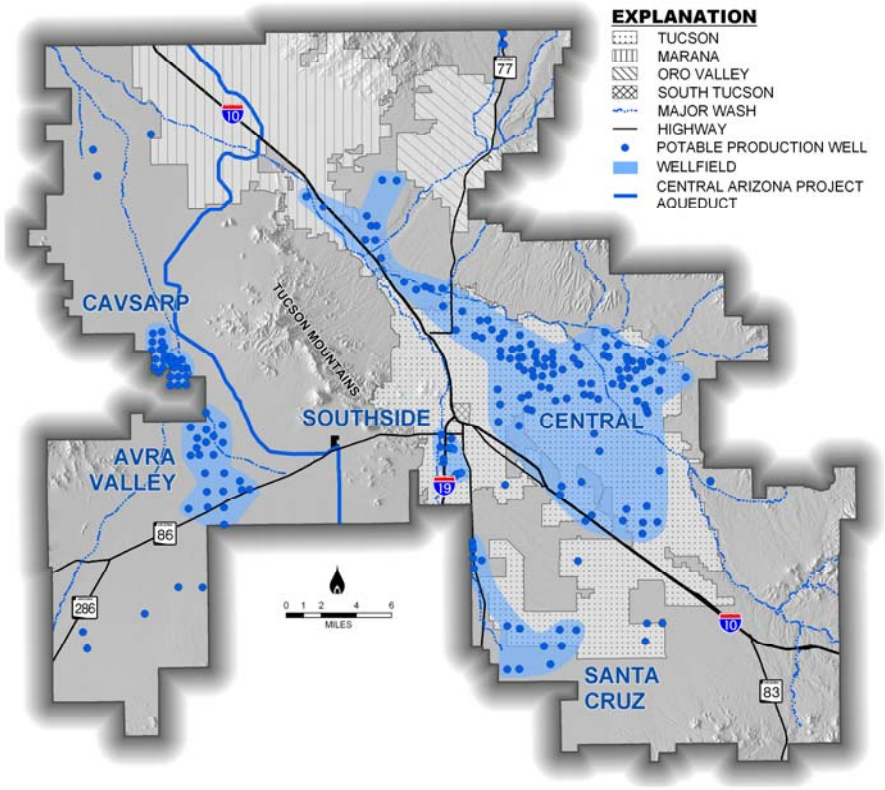


Figure 5-1: Tucson Water's Well Fields in 2006.

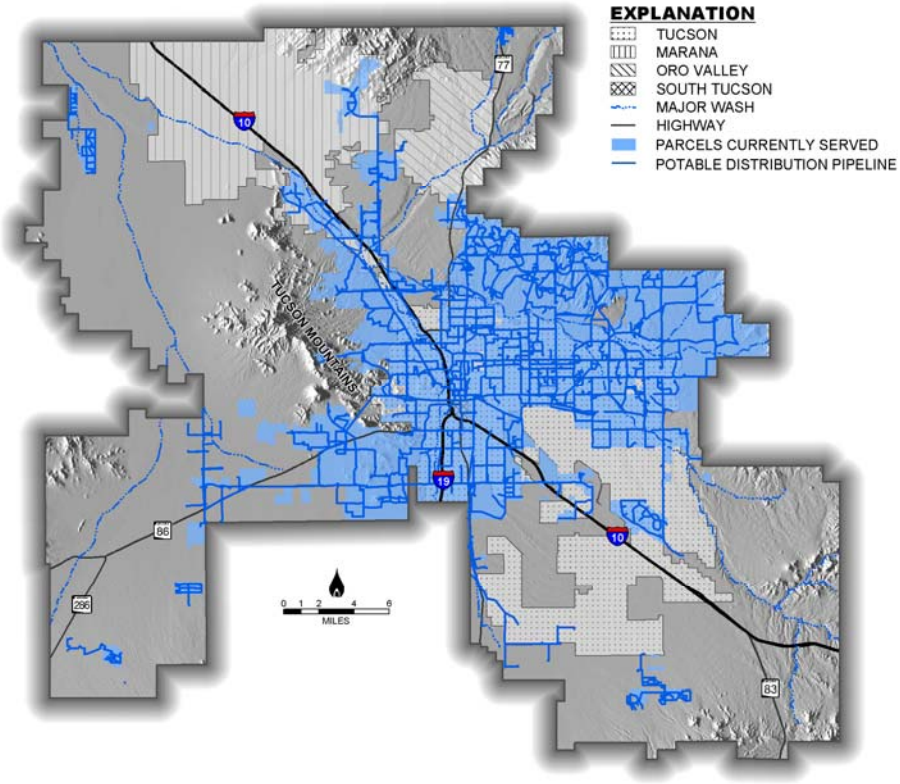


Figure 5-2: Tucson Water's Potable Distribution System in 2006.

EXISTING RECLAIMED WATER SYSTEM

Tucson Water has operated a reclaimed water system since 1984. The reclaimed system takes secondary effluent from Pima County's Roger Road Wastewater Treatment Plant, further treats it through filtration and chlorination, and delivers it for turf irrigation and other non-potable uses. The Utility delivered 14,168 acre-feet of reclaimed water through its reclaimed system in 2006. Of this total, 11,983 acre-feet of reclaimed water were utilized within the Tucson Water service area with the balance exported to Pima County and the Town of Oro Valley. Reclaimed usage in 2006 constituted about nine percent of total water demand for the Utility. The layout of the reclaimed water system is shown on Figure 5-3.

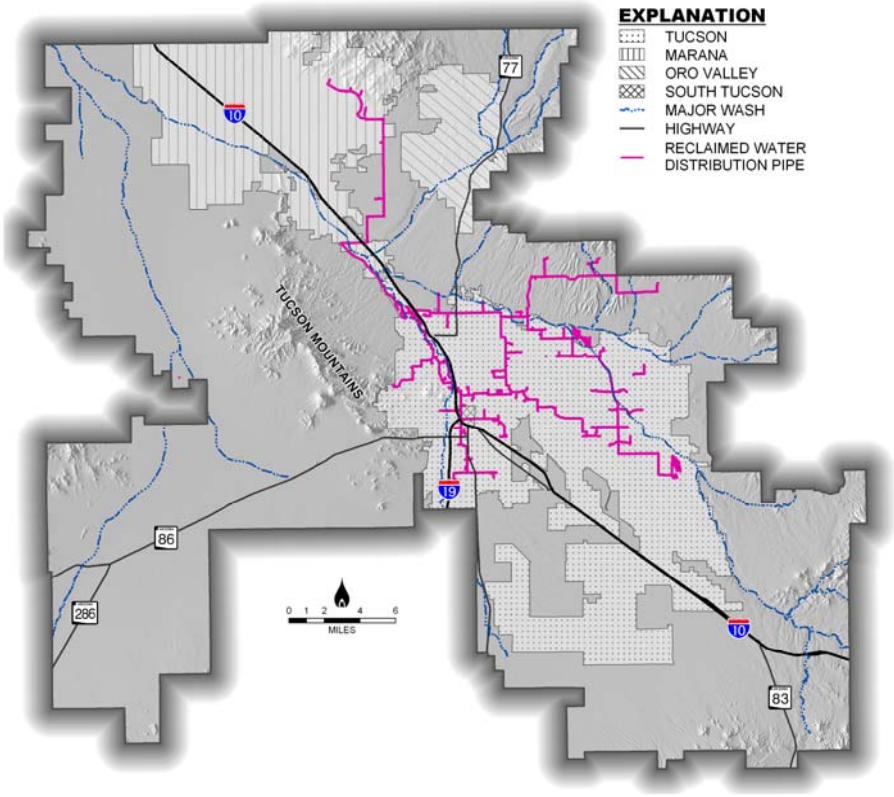


Figure 5-3: Tucson Water's Reclaimed Distribution Pipeline System in 2006.

The Utility's Reclaimed Water Treatment Plant is permitted to treat up to 10 MGD. The Sweetwater Recharge Facilities are permitted to annually recharge and recover up to 6,500 acre-feet of reclaimed water to meet seasonal peak demand requirements. The Utility plans to expand its annual recharge and recovery capacity at the Sweetwater Recharge Facilities up to 13,000 acre-feet by optimizing the operation of existing infrastructure and by constructing additional recharge and recovery facilities. The recovered effluent is blended with filtered water from the Reclaimed Water Treatment Plant, disinfected with chlorine, and boosted to customers through the reclaimed water distribution system. The total delivery capacity of blended water from the Reclaimed Water Treatment Plant and the Sweetwater Recharge Facilities is currently 27 MGD with plans to expand it to 33 MGD in 2009. In addition, the reclaimed water system receives about 2.5 MGD from the Randolph Park Water Reclamation Facility and up to 2.5 MGD from the Santa Cruz River Managed Underground Storage Facility.

IDENTIFYING POTABLE AND RECLAIMED SYSTEM NEEDS

Existing and future water system needs are identified and evaluated using computer models to simulate water flow velocities and pressures in the potable and reclaimed distribution systems. These computer representations of the two systems are called hydraulic models. The results of modeling assessments are portrayed schematically and are used to assess future potable and reclaimed system improvements.

Future Potable System Needs

Future potable water system needs are determined by applying a GPCD water use factor to population projections within Tucson Water's projected service area. As described in Sections Two and Three, population projections are distributed spatially to locate future delivery system needs. A hydraulic model is used to size the projected pipelines and to ensure there is adequate water supply, storage, and pressure to meet projected demands in future years. This necessitates adding infill capacity to the existing infrastructure.

In fiscal year 2006, Tucson Water spent approximately $14 million on electric power (over 100 Gigawatt-hours) and natural gas (nearly 6 million therms). Eighty-five percent of the electricity and 100 percent of the natural gas was used to power potable system facilities. Meeting the operational and regulatory requirements of the water distribution systems will increasingly require more energy in the future. As the demand for energy has increased over time, alternative energy sources have become increasingly viable because of technological advances, changes in regulations, voluntary programs, and incentives. At the same time, opportunities to develop geographically-distributed energy production facilities are being considered due to security and reliability concerns.

Tucson Water recognizes the need to utilize sustainable energy for its facilities. Opportunities are being explored to partner with the City of Tucson's Energy Manager and local electric providers to expand the use of solar power, evaluate the utility of low-head hydroelectric projects, and assess the potential of other sustainable energy technologies at potable facilities.

Future Reclaimed Water System Needs

In this Update, it is assumed that at least nine percent of the projected total water demand will be met with reclaimed water. At the present time, most reclaimed system customers are large turf facilities such as parks, golf courses, and schools. Capital improvement projects scheduled in the next decade will increase system capacity and water supplies; these projects will also improve operational efficiency to meet increasing future non-potable demand.

In fiscal year 2006, reclaimed water system facilities consumed approximately 15 Gigawatt-hours of power to meet operational and regulatory requirements. As with the potable water system, energy sustainability will also be pursued for reclaimed water facilities including installation of additional photovoltaic arrays on reclaimed reservoir roofs.

SECTION SIX

UTILIZING RESOURCES TO MEET DEMAND

This section updates Tucson Water's recommended resource-utilization plan presented in *Water Plan: 2000-2050*. This plan consists of a schedule for implementing essential programs and projects and specifies the scope and timing of critical decision points within the planning horizon.

COMMON ELEMENTS

The Common Elements are those programs and projects needed to ensure a resource-sustainable future for Tucson Water's existing customers and for future ones as well. These elements, previously identified in *Water Plan: 2000-2050*, have been actively pursued by the Utility to guarantee planning flexibility and system reliability. The following provides a status update for each project and program.

Common Elements: 2000 to 2008	Status
Acquire Additional Supplies	Local and state-wide policy discussions continue with CAWCD exploring opportunities to serve as the water broker for its three-county region. Additional allocations of Colorado River water have been acquired under the Arizona Water Settlements Act & from Flowing Wells Irrigation District.
Develop a Salinity Management Program	Initial local salinity evaluations are complete. Phase II of the regional Central Arizona Salinity Study (2006) was completed with off-shoot pilot studies continuing.
Encourage Sewer Connections	The Utility continues working with Pima County's Regional Wastewater Reclamation Department on long-range planning.
Additional Conservation Programming	Community Conservation Task Force was formed and a conservation consultant retained to assess potential options. The Task Force made 22 recommendations and these are discussed in Section Three and summarized in Appendix A. Some are being implemented while others are under review.
Evaluate Emerging Contaminants	Utility is involved with American Water Works Association Research Foundation and WateReuse Association which are conducting cutting-edge research and workshops.
Expand Public Outreach	The *Decision H2O* Program has fostered community dialogue on the first critical decision point of *Water Plan: 2000-2050.*
Provide Water-Resource Information	Tucson Water has met frequently with local water providers, state agencies, regulatory agencies, local business groups, professional organizations, and educators involved with water-resources planning efforts.

Common Elements: 2000 to 2008	Status
Pursue Regional Cooperation	Regional cooperation on long-range planning assumptions has been greatly improved. Several cooperative opportunities are currently under discussion in the local water community.
Reduce Lost and Unaccounted for Water	The Utility has established a capital program to replace aged meters in the distribution system to obtain more accurate water delivery information. A comprehensive system-wide "water audit" will be conducted in the near future.
Conduct SAVSARP Feasibility Assessment	Complete – the facility is under construction.
Construct Spencer Interconnect Pipeline	This project has been split into two separate pipelines – the Avra Valley Blending Main (to be constructed in the future) and the Viviana Transmission Main (not currently included in the Utility's capital budget).
Design SAVSARP Facilities	Complete – the facility is under construction.
Expand Recharge Capacity of CAVSARP	The recommended action to re-permit the CAVSARP recharge capacity to 80,000 acre-feet per year is complete. A subsequent decision has initiated efforts to further expand the facility's recharge capacity to 100,000 acre-feet per year.
Study Secondary Disinfectants	An initial assessment is complete. Additional studies will be conducted as the Utility expands its use of renewable water supplies.
Upgrade the Distribution system	Routine distribution system upgrades continue. The Utility is planning to expand the capital budget devoted to infrastructure replacement over time.

In addition to the projects and programs scheduled to be initiated by 2008, a second set of Common Elements was identified. These will allow the Utility to effectively address the priorities and challenges in the mid-term (through 2025) and long-term (2025-2050) planning periods.

Common Elements: Beyond 2008	Status
Preserve Ground-Water Credits	Ongoing development of renewable supplies in order to preserve ground-water credits for the future.
Achieve Full Colorado River Water Use	Ongoing fiscal planning efforts are being conducted to achieve this goal as early as 2009.
Achieve Sustainable Ground-Water Pumping	This goal is on track to be achieved by 2012.
Evaluate Effluent Exchanges	Opportunities to exchange effluent and/or expand the use of this renewable supply continue to be explored.
Augment Avra Valley Main	This project is under conceptual design and is planned to be constructed in phases over the next five to ten years.
Develop Additional Reclaimed Water Supply	Sweetwater Recharge Facilities expansion is underway. A permit amendment to bring its recharge capacity to 13,000 acre-feet/year has been submitted to the State. This volume will be attained by making operational and maintenance changes, by constructing additional recharge and recovery facilities, and by expanding booster/conveyance capacities.
Operate SAVSARP Phase I	This project is under construction and recharge is scheduled to begin in early 2008. Expanded recovery will begin in 2012. The scope of the facility has been expanded to include 60,000 acre-feet per year of recharge and recovery.

The process of making the critical decisions is underway, but these Elements can only be initiated when issues are resolved and direction is provided.

DECISION POINTS

Water Plan: 2000-2050 outlined four critical decisions to be made at two key points in time: 2006 and 2014. Since the plan was released in 2004, the Utility has focused primarily on resolving the first decision and has conducted a reassessment of the need, timing, and format of the others. The basic rationale underlying the original choices remains valid, but the schedule of the latter decisions has been revised in order to account for changing circumstances, new population projections, and new planning assumptions. In this update, the first decision point is projected to occur in 2008, and the second may occur by 2014 or as late as 2027. Any significant change in population projections, water policy, and/or planning assumptions could also change the time in which decision points will occur and perhaps even the substantive issues associated with those decisions.

Decision Point 2008

In *Water Plan: 2000-2050*, the first two resource-management decisions pertained to the use of Colorado River water; these decisions were originally projected to be made in 2006. The first decision was concerned with the long-term mineral content of the Clearwater blend of ground water and recharged Colorado River water. The second decision focused on whether the Utility should consider bringing a surface (direct) water treatment plant into service for a portion of the City's current Central Arizona Project allocation.

To develop support information to address the decision on long-term mineral content, Tucson Water launched *Decision H2O* and it has since been the subject of wide-spread public discussion. The scope of *Decision H20* has included information review, extensive technological research, cost estimating, environmental impact projections, and public dialogue. Data collection and the accompanying assessment are in process with the expectation that a final decision will be made by the Mayor & Council in 2008. The current status of *Decision H2O* is discussed in Appendix E.

Since issuing *Water Plan: 2000-2050* in 2004, issues associated with the decision on the treatment plant have evolved in response to the changing planning environment. As originally conceived, this decision was centered on how best to bring the remaining balance of the City's unused Colorado River water allocation into service. The choice was either to rely on recharge and recovery or to incorporate an element of surface treatment by reconstituting the Hayden-Udall Treatment Plant. A study was conducted by Malcolm Pirnie (2007) which evaluated the two options. The study concluded that relying on recharge and recovery provided Tucson Water with greater operational performance and planning flexibility at less cost. In addition, drought-related discussions over the past few years as well as recent projections indicate that a worst-case shortage declaration on the Colorado River may occur sooner than previously predicted and before the Hayden-Udall Treatment Plant could be reconstituted. Due to the uncertainty and potential urgency regarding a possible

early declaration of shortage, Tucson Water moved forward with the following near-term initiatives in order to develop sufficient facility capacity to fully utilize the City's entire Central Arizona Project allocation as early as 2009:

- Expansion of the recharge and recovery components at the CAVSARP facility;
- Expansion of the recharge capacity of the first phase of SAVSARP; and
- Maximum utilization of the Pima Mine Road Recharge Project.

Building upon the proven success of the recharge and recovery approach, this decision has virtually eliminated the near-term uncertainty associated with having sufficient capacity in place to fully utilize the City's Central Arizona Project allocation prior to a shortage declaration. Nonetheless, the role of a surface (direct) treatment plant remains a potentially viable option as the range of possible futures evolve and new supply opportunities develop.

The Next Decision Point

In *Water Plan: 2000-2050,* the year 2014 was originally specified as the second critical decision point which focused on decisions associated with maximizing the paper-water and/or wet-water benefits of effluent reuse. With the updated assumptions of projected supply and demand, this Decision Point has been modified and may occur by 2014 or possibly as late as 2027. By the time this next decision point is reached, Tucson Water will need to have formulated its plans for bringing additional sustainable and/or non-renewable water supplies into use in order to update the City's Assured Water Supply (AWS) designation.

This next decision point will focus on how best to proceed with utilizing its available water resources. These include those that are already on hand as well as potentially new renewable supplies that would have to be imported into the area. In this process, Tucson Water will lay the groundwork for the next extension of the City's AWS designation. The options to be explored by the next decision point include the following both individually and in combination:

1. Acquire additional Central Arizona Project water;
2. Acquire higher priority rights to main-stem Colorado River water;
3. Import ground water from other basins in Arizona;
4. Initiate "full credit" effluent water banking in the Utility's service area; and/or
5. Exhaust the City's reserve of ground-water credits

In addition, other potential options to augment existing supplies such as seawater desalination and potential water exchanges may be possible in the future but such opportunities will most likely be the subject of decision points many decades further out in time.

Bullets #1, #2, and #3 all depend on the Central Arizona Project aqueduct to import new water supplies to Tucson Water's service area. As a result, the current role of CAWCD as operator of the 336-mile long Central Arizona Project system and its potential role as water broker for Maricopa, Pinal, and Pima Counties will likely prove critical in Tucson Water's efforts to augment its existing supplies with imported renewable resources. Intra-state discussions are on-going but it is unclear if and when such a new institutional arrangement will be in place to facilitate reallocations and water transfers. It is possible that imported resources may be available by 2014 but it could be later. Prudent planning dictates that all supply options be considered in the interim given the uncertainty.

The only local water resources currently available in the mid term are the City's effluent entitlement (Bullet #4) and the City's non-renewable reserve of ground-water credits (Bullet #5). The City's effluent entitlement is the only locally generated, renewable supply available to the Utility to support sustainable growth. Expanded use of effluent through marked increases in reclaimed water utilization and/or long-term full-credit banking would augment Tucson Water's renewable water supply portfolio and would further extend in time the availability of its reserve of ground-water credits. This option could ensure the City's ability to sustainably extend its wet-water supplies and its AWS designation for many years while preserving the City's non-renewable reserve of ground-water credits for their preferred purpose—as a transitional supply to be prudently debited while making preparations to acquire or develop the next renewable supply.

Without further developing the City's effluent resources and/or importing additional supplies in the mid term, the City's only option to extending its AWS designation would be to exhaust its reserve of ground-water credits. Although this action would allow the City to further extend its AWS designation for many years and in some scenarios for decades, it would be an unsustainable response to an immediate supply need which could reduce the Utility's planning flexibility in future years. If the ground-water credits were fully utilized to extend the City's AWS in the mid and longer terms, it would be in the City's interest to make arrangements with others (potentially with CAWCD) to import additional renewable supplies, develop its local effluent resources, and implement more aggressive demand-management measures to support sustainable growth in future years. As the Next Decision Point approaches, Tucson Water will provide status updates regarding the need to acquire and/or develop the next renewable supply to meet the projected water demand of anticipated growth.

PROJECTED DEMAND AND RESOURCES

The choices associated with the critical decisions to be made in 2008 and the Next Decision Point after that will help determine how the Utility's water resources will be utilized in future years. They will also affect how quickly Tucson Water will use its available water supplies, how demand may be managed in the future, and how additional wet-water supplies may be developed over time. The water-resource implications of the four demand scenarios discussed in Section Three illustrate how changes in the two critical planning variables could impact resource utilization and the City's AWS designation in future years.

Resource-Utilization Commonalities

Despite the key differences associated with *Demand Scenarios A* through *D*, the four share common resource-utilization assumptions and these are highlighted below:

- Reclaimed-water use will on average offset at least nine percent of the total projected annual water demand through 2050;

- Potable demand will be met in the near term through decreasing dependency on ground-water pumping and increasing reliance on renewable Colorado River water;

- Incidental Recharge refers to aquifer recharge which occurs after the Utility accesses its water sources for supply and constitutes four percent of Tucson Water's annual total demand;

- The City's entire Central Arizona Project allocation will be recovered before the Utility's contracted CAGRD ground-water replenishment volume of up to 12,500 acre-feet per year is utilized;

- The point in time at which renewable water resources associated with imported Colorado River water, Incidental Recharge, and the City's CAGRD contracted volume are fully utilized varies depending on the unique combination of assumptions represented by each of the four scenarios.

Additional background information and the rationales underlying each of the four water demand scenarios are provided in Sections Two and Three in this Update.

Scenario A – Increased Demand Management in the Obligated Area

In addition to decreasing future demand by limiting the Utility's service area expansion to the Obligated Area, this scenario is predicated on the assumption that the Utility's potable GPCD would gradually be reduced by ten percent by 2030. It is assumed that this reduction in per capita demand would be achieved by implementing more aggressive demand-management measures beyond those already in place.

Review of Figure 6-1 provides a view of how the Utility's resource utilization plan is projected to occur under *Scenario A*. The Utility's total water demand is projected to increase from 128,141 acre-feet in 2000 to approximately 180,000 acre-feet in 2030 and to about 215,000 acre-feet by 2050. This projected increase in water demand over time is the smallest of the four scenarios.

Under this scenario, projected potable demand would exceed the sum of the City's annual Central Arizona Project allocation, its Incidental Recharge increment, and its annual CAGRD contracted volume by about year 2032. However, Tucson Water would still have available

after 2032 the balance of its renewable effluent resources not committed to the Utility's reclaimed water system and much of its reserve of non-renewable ground-water credits.

The City could extend its AWS designation to about 2050 by depleting its reserve of ground-water credits; instead, Tucson Water recommends these credits be preserved as long as possible to provide planning flexibility for the future. It is more prudent to use these credits as short-term transitional supplies while additional renewable supplies are being acquired and/or developed.

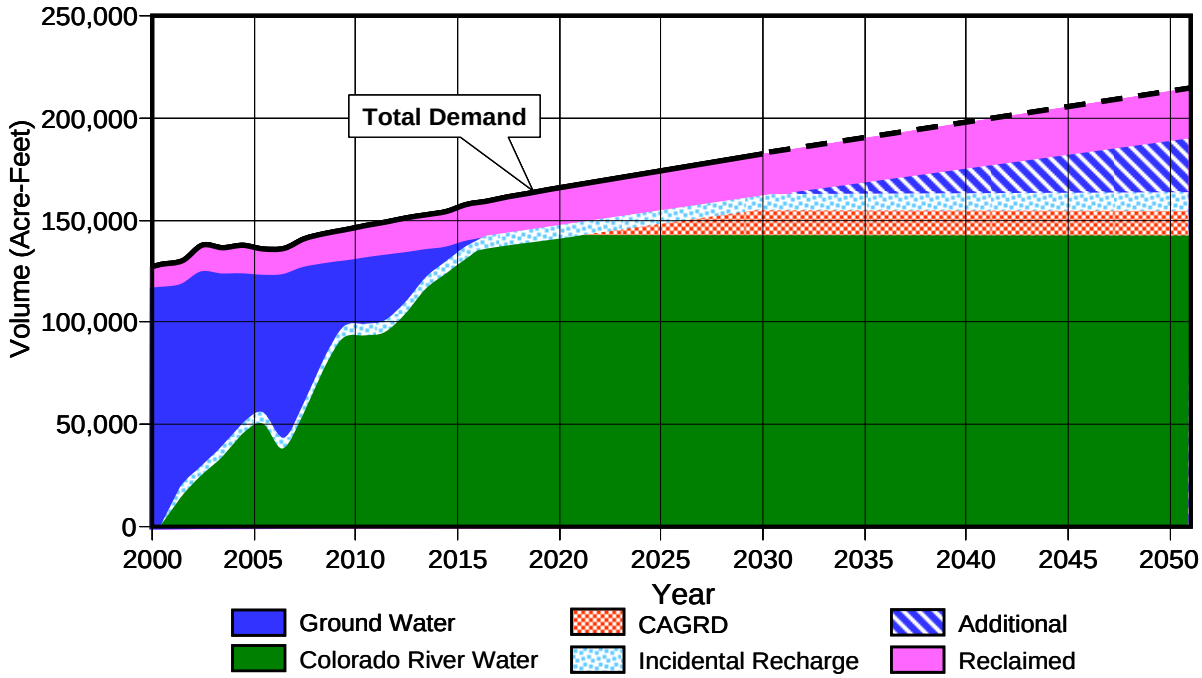


Figure 6-1: Scenario A, Projected Demand and Water Resource Utilization: 2000-2050.

Tucson Water recommends that the resource planning priority be placed on developing additional renewable resources such as the City's effluent supplies, additional imported supplies or a combination of both. In this manner, new growth after 2032 would become more hydrologically sustainable and the City's AWS designation could be extended well beyond the planning horizon of *Water Plan: 2000-2050*. Of the four future scenarios analyzed, *Scenario A* delays the need to develop or acquire additional renewable supplies furthest into the future and maximizes planning flexibility to deal with future uncertainties.

Scenario B – No Increased Demand Management in the Obligated Area

In addition to limiting future demand to within the Obligated Area, this scenario adopts the assumption that the Utility's potable GPCD would remain constant at 163 through 2050 thus assuming a lack of further investment and/or community support for further demand-management activities. Review of Figure 6-2 provides a snapshot of how the Utility's resource utilization is projected to occur under *Scenario B*. Tucson Water's total water

demand is projected to increase from 128,141 acre-feet in 2000 to approximately 200,000 acre-feet in 2030 and to about 235,000 acre-feet by 2050.

Review of Figure 6-2 indicates that projected potable demand would exceed the sum of the City's annual Central Arizona Project allocation, its annual Incidental Recharge increment, and its annual CAGRD contracted volume by about year 2022—ten years earlier than in *Scenario A.* As noted previously, Tucson Water would still have available after 2022 the balance of its renewable effluent resources not already utilized in the Utility's reclaimed water system and most of its reserve of non-renewable ground-water credits.

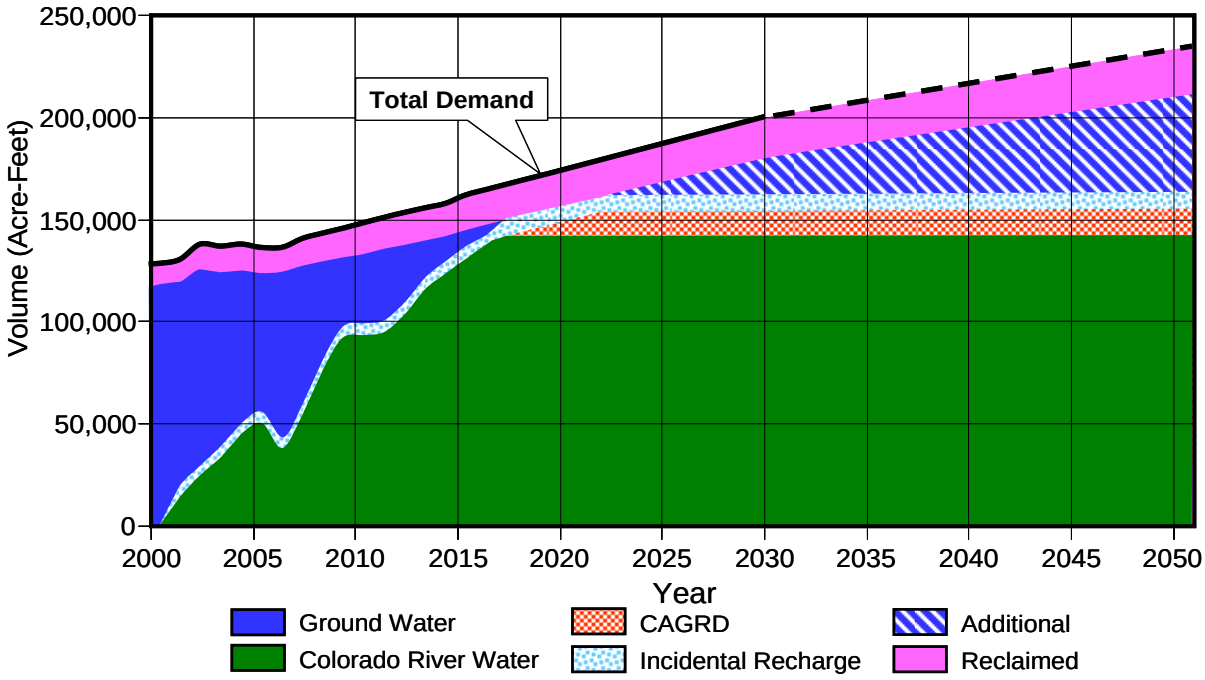


Figure 6-2: Scenarios B & C, Projected Demand and Water Resource Utilization: 2000-2050.

The City could extend its AWS designation to about 2035 by depleting its reserve of ground-water credits. Consistent with *Scenario A*, Tucson Water recommends these credits be preserved as long as possible to provide planning flexibility for the future. It is more prudent to use these credits as short-term transitional supplies while additional renewable supplies are being acquired and/or developed.

Tucson Water recommends that the resource-utilization priority be placed on developing additional renewable resources such as the City's effluent supplies, additional imported supplies or a combination of both. In this manner, new growth after 2022 would become more hydrologically sustainable and the City's AWS designation could be extended even further. Of the four future scenarios analyzed, *Scenario B* only moderately delays the need to develop or acquire additional renewable supplies and provides limited planning flexibility.

Scenario C – Increased Demand Management in the Potential Service Area

Scenario C assumes that Tucson Water's ultimate service area would coincide with the larger Potential Service Area. This scenario also assumes that the Utility's potable GPCD would gradually be reduced by ten percent by 2030. The Utility's total water demand is essentially the same as shown for *Scenario B* in Figure 6-2. This means that *Scenario C* would also exceed the sum of the City's entire annual Central Arizona Project allocation, its Incidental Recharge increment, and its annual CAGRD contracted volume by about year 2022. Similarly, the City could extend its AWS designation to about 2035 by depleting its reserve of ground-water credits. The same water-resource utilization strategy previously discussed for *Scenario B* would apply to *Scenario C*. Again, this scenario would only moderately delay the need to develop or acquire additional renewable supplies and provides limited planning flexibility.

Scenario D – No Increased Demand Management in Potential Service Area

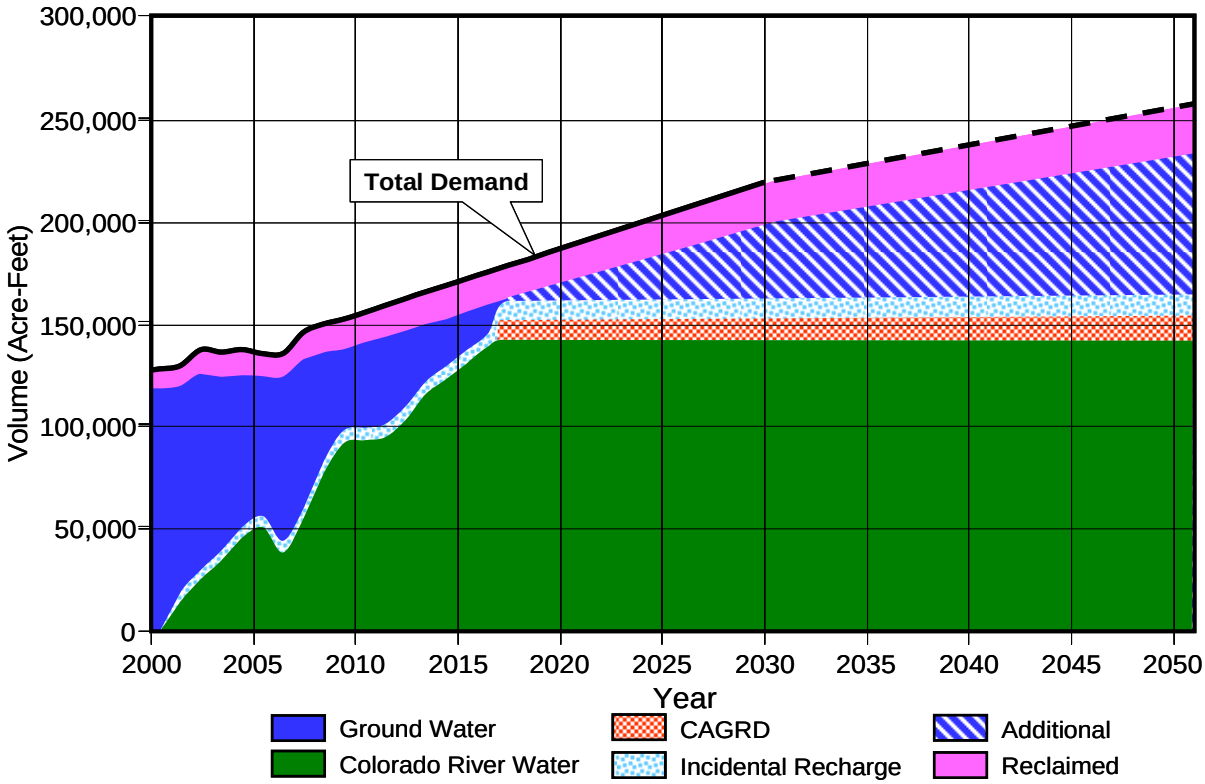


Figure 6-3: Scenario D, Projected Demand and Water Resource Utilization: 2000-2050.

Scenario D is based on the conservative demand assumptions used in *Water Plan: 2000-2050*. *Scenario D* assumes that Tucson Water's future area of service is the larger Potential Service Area and that the Utility's potable GPCD remains constant at 163 through 2050. The Utility's total water demand is projected to increase to approximately 220,000 acre-feet per year by 2030 and about 255,000 acre-feet by 2050.

Review of Figure 6-3 indicates that projected potable demand would exceed the sum of the City's annual Central Arizona Project allocation, its Incidental Recharge increment, and its annual CAGRD contracted volume by about 2017. Tucson Water would still have available beyond 2017 the balance of its renewable effluent resources and most of its reserve of non-renewable ground-water credits.

The City could extend its AWS designation to about 2025 by depleting its reserve of ground-water credits; instead, Tucson Water recommends these credits be preserved as long as possible to provide planning flexibility for the future. It is more prudent to use these credits as short-term transitional supplies while additional renewable supplies are being acquired and/or developed.

Tucson Water recommends that the resource planning priority be placed on developing additional renewable resources such as the City's effluent supplies, additional imported supplies or a combination of both. In this manner, new growth after 2017 would become more hydrologically sustainable and the City's AWS designation could be extended further out in time. Of the four future scenarios analyzed, *Scenario D* is the least able to delay the need to develop or acquire additional renewable supplies and provides the least planning flexibility with which to deal with future uncertainties.

WHAT LIES AHEAD

The water-resource opportunities, critical decision points, and conservation impacts described in this section are graphically summarized on Figure 6-4, a conceptual planning timeline which extends from 2000 to 2050. From 2000 to 2010, Tucson Water's primary focus is to fully utilize its annual CAP allotment before a shortage on the Colorado River is declared. To provide a solid foundation for a sustainable water future, Tucson Water must bring its full allocation of Colorado River water into use as early as 2009. The outcome of *Decision H2O* will determine if the Utility must bring an enhanced treatment plant into operation.

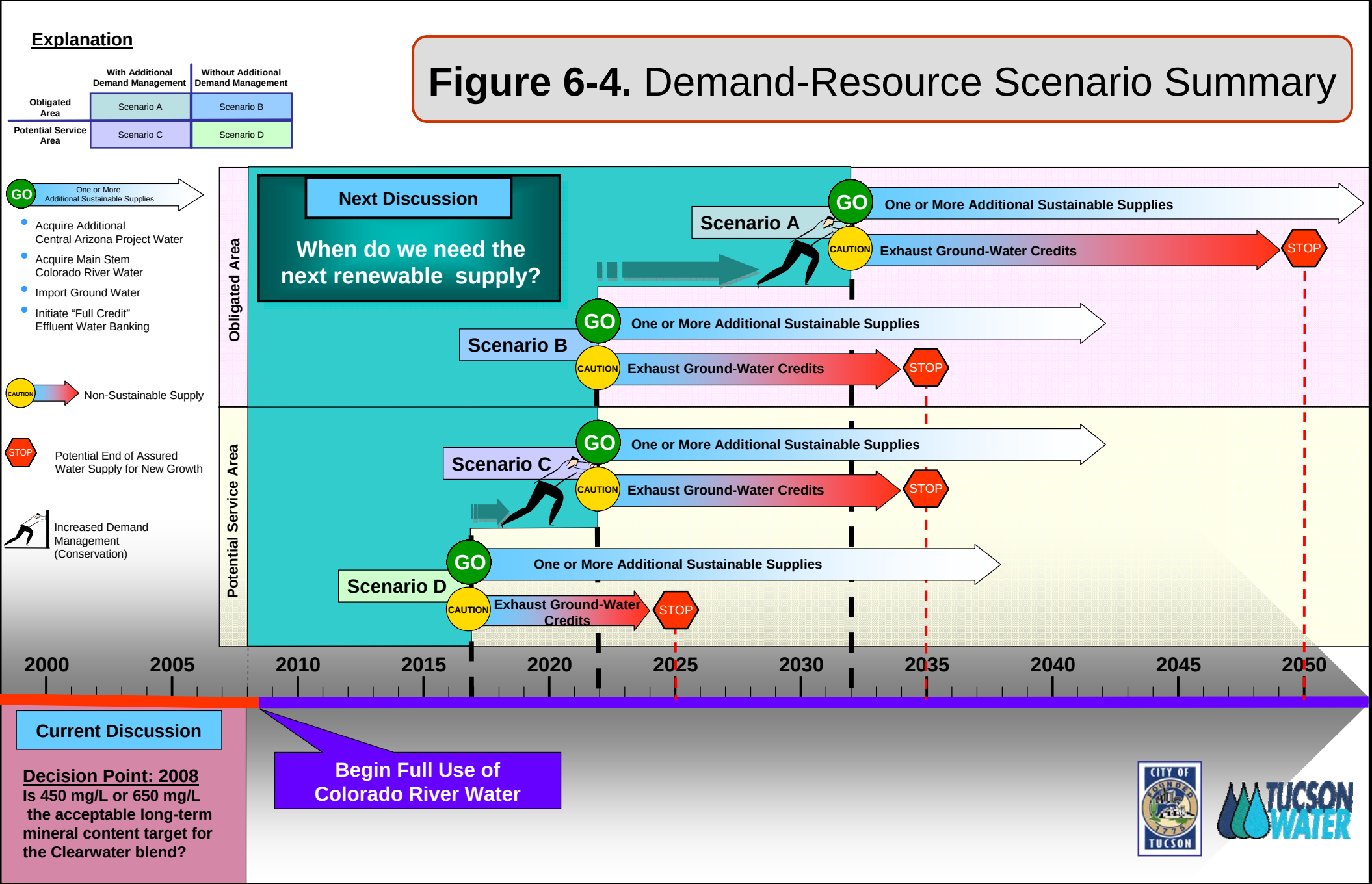
Beyond 2010, the community faces the challenge of determining its long-term water future. The Utility fortunately is not limited to exhausting its reserve of ground-water credits to extend its AWS designation to meet the needs of anticipated growth. Tucson Water has a number of potential opportunities to acquire or develop additional water supplies. These potential opportunities have been discussed in detail in this section and summarized on Figure 6-4.

Assuming either *Scenario B, C, or D* is the most representative portrayal of future demand, it is currently projected that the Utility would need to have a plan in place to acquire/develop additional supplies by about 2014 or 2017 in order to preserve its ground-water credits for the longer term. This would coincide with the time by which the Next Decision Point would occur.

In contrast, if *Scenario A* more closely approximates future water demand, Tucson Water would need to have a plan to acquire/develop additional supplies in place by about 2027. Under *Scenario A*, this would be the approximate time of the Next Decision Point by which direction would be required. If additional renewable supplies are made available for use, the limit of the Utility's hydrologically sustainable water supply for new growth can be ensured and even extended beyond 2050.

How far this threshold can be extended into the future will depend on the areal extent of Tucson Water's future service area, whether there is a commitment to invest in additional, more aggressive demand-management measures, and the volume of additional renewable resources that the Utility is able to develop locally and/or import into the Utility's service area.

Figure 6-4. Demand-Resource Scenario Summary



SECTION SEVEN

CONCLUSIONS

The water-resource planning environment is in constant flux. In *Water Plan: 2000-2050*, Tucson Water provided recommendations that would allow the Utility to achieve the specified planning goals while retaining maximum flexibility. These are updated below in order to reflect the actions and changes which have occurred since the plan was issued in 2004.

UPDATED RECOMMENDATIONS

Many of the recommendations and conclusions noted in *Water Plan: 2000-2050* have already been implemented while others are currently in process or have been revised to reflect the changing planning environment. The updated recommendations are summarized below.

1. **Emphasize "Wet" Water Management Strategies**: The community's sustainable future ultimately depends on maintaining a physical hydrologic link between renewable water sources and the infrastructure needed to convey those waters to customers within the projected service area.

2. **Utilize Renewable Ground Water**: Tucson Water plans to limit its ground water withdrawals at or below this hydrologically sustainable level in order to ensure the long-term viability of the aquifer within the Utility's service area.

3. **Preserve City's Ground-Water Credits for Longer Term:** The City could extend its AWS designation under any future scenario by depleting its reserve of non-renewable ground-water credits in the near or mid terms. Instead, Tucson Water recommends that these credits be preserved as long as possible to provide planning flexibility for the future. It is more prudent to use these credits as short-term transitional supplies while additional renewable supplies are being acquired and/or developed. This would ensure that the water resources needed to support new growth will be hydrologically sustainable.

4. **Reassess the Water-Quality Target for Colorado River Water**: Customer preferences are being reassessed through the on-going *Decision H20* program by linking costs and environmental sustainability issues with potential mineral level targets. The goal is to finalize this aesthetic water-quality management decision in 2008.

5. **Fully Utilize Colorado River Water**: Between CAVSARP, SAVSARP, and the Pima Mine Road Recharge Project, the Utility will have sufficient recharge capacity in place to fully use its Central Arizona Project allocation as early as 2009.

6. **Fully Utilize Effluent for Future Supply**: Tucson Water recommends that the resource-management goal should be to maximize the future use of the City's effluent through additional treatment and recharge in order to augment the aquifer within Tucson Water's service area.

7. **Acquire Additional Water Supplies**: The City of Tucson is already exploring opportunities to acquire potentially available supplies to augment its water-resource portfolio. The availability of additional water resources will become increasingly competitive and costly both locally and statewide. The Utility is encouraged that the Central Arizona Water Conservation District is actively exploring ways to play the leading role in acquiring additional supplies for water interests in its three-county service area.

8. **Manage Water Demand**: Tucson Water is taking a number of actions to further manage demand including expanded conservation programming, reducing lost and unaccounted for water, encouraging the practice of water harvesting, and providing public information programs. Additional demand management efforts have been evaluated and recommended by the Community Conservation Task Force to further reduce per capita potable water use.

9. **Adjust Development Fees to Shift the Cost of Growth to New Customers**: Tucson Water has developed a financial plan that continues to shift the cost burden of growth to new customers as they are added to the system. The Utility recommends that in the future, development fees be adjusted to ensure that existing customers do not inordinately bear the cost of growth.

10. **Continue to Expand Regional Cooperation**: Tucson Water has taken steps to initiate new cooperative efforts and expand existing ones with local providers. These cooperative actions focus on acquiring additional sources of water supply, developing resource credit banking agreements, and exploring potential win-win arrangements to wheel renewable resources within the region.

MORE ON REGIONAL COOPERATION

Over the years, Tucson Water has been an active participant in many formal and informal local groups such as the Southern Arizona Water Users Association (SAWUA) where local water-management issues are discussed. In 2004, Tucson Water began discussions about regional cooperation on water-resource issues with the largest water providers in the area. These discussions resulted in a 2006 proposal from SAWUA for a cooperative water-supply organization.

At approximately the same time, the Central Arizona Water Conservation District (CAWCD) Board developed a strategic plan that included the goal of acquiring additional water resources on the behalf of all water providers within its three-county service area. In effect, CAWCD proposed performing the same functions as envisioned under the SAWUA proposal but on a much larger and far-reaching scale. In addition, Pima County has proposed the establishment of a countywide water-and-wastewater authority which would include all public and private water and wastewater providers located within the county.

As these alternative proposals have been discussed, local water providers have continued to discuss potential cooperative projects related to water supply and management. The discussions have included concepts such as joint projects for delivering renewable water supplies to areas of need, common issues and concerns for coordinated lobbying at the State level, and consideration of water credit transfers to reduce costs to ratepayers and meet water-management goals.

Tucson Water has extensive credit account balances from recharged Colorado River water, recharged effluent, and groundwater credits. Making these "paper water" credits available to other water providers can benefit water ratepayers in the region and Tucson Water can leverage these resources in ways that provide benefits to its own ratepayers. In early 2007, Tucson Water took the discussions a step further and proposed principles and limitations for future credit transfers. The other local water providers agreed that the principles would include the transfer must benefit regional water management goals, must benefit water ratepayers, and must be a win-win for both parties. Tucson Water notified local water providers of the principles and limitations and the available credits for transfer. Two local water providers expressed potential interest and discussions are ongoing.

REASSESSING THE FUTURE

The recommended plan will periodically be reassessed and revised as planning assumptions and circumstances change over time. Within the 50-year planning horizon, new water planning futures will undoubtedly materialize while those currently envisioned may evolve or fade away. Tucson Water will continue to update and improve the planning tools developed to support this planning process. These tools will allow the Utility to update planning projections and to complete comprehensive revisions in an expeditious manner. Future updates and/or comprehensive revisions to this plan may be initiated by the following:

- Specific direction provided by the City of Tucson's Mayor & Council.
- Significant change in PAG's updated population projections.
- Marked change in the anticipated size of Tucson Water's future service area.

- Significant changes in the current or projected availability of water resources.

- Advent of new technologies that could alter costs and/or the technical effectiveness of planning elements.

- Marked changes in the regulatory environment in terms of water-quality and/or water-use requirements.

- Major shifts in the preferences of Tucson Water customers.

Through prudent resource planning, Tucson Water has diversified its portfolio of water resources to include not only ground water but also Colorado River water and reclaimed water. Tucson Water will ensure a sustainable water future within its service area by continuing to reduce the community's reliance on ground water while working toward maximizing the use of its renewable supplies. The Utility is also committed to continue upgrading its water storage and conveyance facilities ensuring a highly reliable and efficient link between its water supply sources and the community's many points of use.

Tucson Water currently has access to sufficient supplies of ground water, Colorado River water, and reclaimed water to extend its AWS designation for decades. Current water demand projections indicate that failure to acquire additional renewable water resources and/or not fully utilizing the balance of the City's effluent entitlement in a timely manner means that Tucson Water would have to deplete its finite paper-water reserve of ground-water credits to satisfy near- and mid-term demands. Conversely, fully utilizing the balance of the City's entitlement of effluent through long-term banking and/or acquiring additional renewable supplies that would be imported into the area would extend the City's AWS designation for many decades. And as shown in the scenario analysis, more effective conservation measures could markedly reduce projected water demand which in turn would extend the City's AWS designation even further.

This is the first update to *Water Plan: 2000-2050*, and there will be others in the years to come. As critical planning assumptions change and as new uncertainties arise, a new comprehensive revision to Tucson Water's long-range plan will be needed to reset the compass. As the present unfolds into the future, the primary necessity is to prepare for change since it is the only certainty. This recognition reinforces the need for continuous resource planning and wise water management.

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APPENDIX A

CONSERVATION MEASURES RECOMMENDED BY THE COMMUNITY CONSERVATION TASK FORCE

I	**Rebates & Incentives (8)**	Single-Family Residential	• Ultra-Low-Flow Toilet Rebate • Gray Water Incentive
		Multi-Family Residential	• Irrigation System Upgrade Rebate • High Efficiency Toilet Rebate
		Commercial/ Industrial	• In-door/Out-door Sub-metering Incentive • Ultra-Low-Flow Toilet Rebate • Pre-rinse Spray Valve Rebate • Waterless Urinal Rebate
II	**Retrofit on Resale Ordinances (5)**	Multi-Family Residential	• Irrigation System Retrofit on Resale Ordinance • Ultra-Low-Flow Toilet Retrofit on Resale Ordinance • Condominium Conversion: In-door/Out-door Sub-metering Incentive
		Commercial/ Industrial	• Irrigation System Retrofit on Resale Ordinance • Passive Water Harvesting Retrofit on Resale Ordinance
III	**New Construction Ordinances (4)**	Multi-Family Residential	• Revised Landscape Design Standards • In-door/Out-door Sub-metering Ordinance • Irrigation System Design Ordinance
		Commercial/ Industrial	• Water Harvesting and Gray Water Ordinance
IV	**Demonstration Programs (3)**	All Sectors	• Hot Water Re-circulation Program • Smart Irrigation Controller Program • Water Harvesting Program
V	**Other (2)**	Multi-Family Residential	• Ultra-Low-Flow Toilet Community-Based Distribution
		Other	• Ultra-Low-Flow Toilet Vendor-Driven Delivery

APPENDIX B

CITY OF TUCSON WATER DEPARTMENT DROUGHT PREPAREDNESS AND RESPONSE PLAN

Answers to Commonly Asked Questions

1. What is a "Drought Preparedness and Response Plan"?

A new law passed in 2005 required all Arizona water systems to develop a drought preparedness and response plan and file it with the Arizona Department of Water Resources ("ADWR") by January 1, 2007. **TUCSON WATER** developed a plan that addresses the potential impacts of drought on the water resources our community depends upon, and outlines the actions we would take in response to increasing impacts associated with sustained drought. Mayor & Council approved the Plan on November 28, 2006 and an implementation ordinance (No. 10380) was approved on March 20, 2007.

2. What does "drought" mean?

To ensure that our Drought Preparedness and Response Plan meets the requirements of the State of Arizona, **TUCSON WATER** uses the same definition of drought that is used in the State's own Plan: *"a sustained, natural reduction in precipitation that results in negative impacts to the environment and human activities."*

3. The City already has an "Emergency Water Conservation Ordinance" - Doesn't it already address drought?

The 1995 Emergency Water Conservation Ordinance (No. 8461) broadly outlines a response plan for an unforeseen event. Unlike an emergency situation, it is important to recognize that drought impacts to water supplies typically do not occur without warning, particularly for a large, multi-source water system such as Tucson's. With proper planning and investment, **TUCSON WATER** may avoid ever experiencing a water crisis as a result of drought.

TUCSON WATER's Drought Preparedness and Response Plan refines and expands upon the 1995 ordinance. Drought indicators and response measures were developed to fit the unique characteristics of the Utility's water resources, water system attributes, and customer-use patterns so that the Utility can appropriately respond to potential drought impacts on its water supplies. For example, our use of Colorado River water ("CAP" water) as part of our drinking water supply is unique in the Tucson region. The use of both groundwater and CAP water supplies, particularly the operation of the Clearwater recharge and recovery system, provides a high degree of water supply reliability to **TUCSON WATER** customers during times of local drought.

4. What does Tucson Water's Drought Preparedness and Response Plan include?

Tucson Water's Plan includes four drought response stages:

Stage 1 — *Will be declared based on regional indicators such as a severe and sustained drought on the Colorado River and/or a State declaration of drought in the Tucson region.*

Stage 2 — *Will be declared if an initial shortage (i.e., a shortage that does not affect municipal uses) is declared on the Colorado River, or if local system factors require additional response actions.*

Stage 3 — *Will be declared based on limited reductions in CAP deliveries to the City or if local system factors require additional response actions.*

Stage 4 — *Will be declared based on additional reductions in CAP deliveries to the City or if local system factors require additional response actions.*

5. How will each stage affect me?

As you might expect, the more a drought affects our ability to deliver water, the more stringent the responses must become. All response measures implemented during a lower response stage will remain in effect in later stages, along with additional measures. **TUCSON WATER**'s Drought Plan includes some of the following recommended actions.

Stage 1

Public education on drought issues;
Modify water system operations;
City departments identify water-saving and water efficiency measures for all City facilities;
Possible additional measures may include voluntary self-audit programs for commercial, multi-family and industrial users.

Stage 2

Additional public education and additional system or operational actions;
Prohibit public fountains and other non-essential uses within City operations;
Implement water savings/efficiencies identified in Stage 1 for all City uses of potable water;
All potable water users requested to make additional voluntary reductions;
Mandatory self-audits required for commercial, multi-family, and industrial users;
Irrigation restrictions required for commercial, multi-family, and industrial customers.

Stage 3

Mandatory water reductions by all potable water users; and
Plumbing retrofit on resale for residential, commercial, multi-family, and industrial users.

Stage 4

Implement the City's Emergency Water Conservation Ordinance;
Non-essential outdoor water use restricted or prohibited;
Restaurants provide water only upon request;
Outdoor misting systems in public areas prohibited;
No filling of swimming pools, fountains, spas or other exterior water features;
Car Washes only at facilities which recycle water, except for emergency vehicles; and
Additional response actions may be developed if warranted.

6. What are Tucson's back-up or emergencies water supplies?

Groundwater can serve as a short-term backup supply, but the Plan acknowledges that long-term reliance on groundwater is not sustainable. To minimize groundwater overuse, **TUCSON WATER** may require additional mandatory demand reductions and/or develop alternative renewable water supplies.

7. Will the Plan ever be changed?

The Plan will be updated regularly to reflect changing conditions and as new information is developed.

8. Who can I contact for more information?

Contact the Tucson Water Conservation Office at 791-4331 for additional information.

APPENDIX C

EFFLUENT GENERATION PROJECTION MEMORANDUM

Water Department

MEMORANDUM

Pima County Wastewater Management Department

Date: November 29, 2005

To: David V. Modeer
Director
Tucson Water

Michael Gritzuk
Director
Pima County Wastewater Management Department

From: Joint Planning Group – Population and Effluent Projections

Pima County Bill Richardson
Steve Munsell
John Regan

Tucson Water Tim Thomure
Dean Trammel
Sandy Elder
Peter Chipello

Subject: Resolution of Population and Effluent Variances between the Tucson Water and Pima County Wastewater Management Long-Range Plans

Within the last year, the Pima County Wastewater Management Department (PCWMD) and Tucson Water have each released draft long-range plans for community comment. Staff members of PCWMD and Tucson Water have met frequently over the last several months to resolve the methods used by each entity to project future population and effluent availability in the greater Tucson area. The details of this process are provided in the attached "Joint Planning Summary".

The initial drafts of Tucson Water's *Water Plan: 2000-2050* (November 2004) and Pima County Wastewater Management Department's *Facility Plan* (May 2005) presented markedly different projections of future population and effluent availability even though both plans utilized data from the Pima Association of Governments (PAG) in their analyses. These differences are attributable to the following factors:

- The data sets used by each entity were different (although both were obtained from PAG),
- The two plans covered slightly different time horizons,
  The two plans covered significantly different areas, and
- Each entity applied its own set of assumptions to project effluent volumes.

The methods used in each draft plan are defensible in their own right; however, the desire to achieve consistent results led to the formation of the Joint Planning Group.

This process has resulted in concurrence amongst the members of the Joint Planning Group on recommended projections of population and effluent availability to be used in the final versions of each plan. Both plans will project population and effluent availability within the five major sewer tributary areas (Roger Road including the Randolph Plant, Ina Road, Marana, Avra Valley, and the Southlands

including Corona de Tucson) for every five years through 2030 based on PAG's Traffic Analysis Zone (TAZ) data. Both entities will assume the same factors for the percentage of population on septic systems and the daily per capita rate of sewer return flow. For the year 2030, the Joint Planning Group projects a total of 1,247,963 customers on sewer that will generate 106.14 MGD (118,900 AF/YR) of effluent in the five sewer tributary areas.

In addition to resolving the current projections of population and effluent availability, the Joint Planning Group developed recommendations for further work. These recommendations include:

- Provide the results of this process to PAG for use in their current "208 Plan" update,
- Closely monitor water deliveries and sewer return flows in two neighborhoods (one established and one newly constructed) to collect additional information on effluent generation over time, and
- Continue an ongoing dialogue between PCWMD, Tucson Water, and PAG staff to obtain improved future projections of population and apply consistent assumptions for forecasting effluent availability in the community.

If you should have any questions regarding this transmittal memorandum or the attached Joint Planning Summary, please contact Bill Richardson (PCWMD) at 740-6567 or Tim Thomure (Tucson Water) at 791-5080 x1404.

CC:

City of Tucson – Marie Pearthree, Bruce Johnson, Dennis Rule, Ralph Marra, Jeff Biggs, Mark Seamans, Karen Dotson, Chris Avery, Joint Planning Group Members

Pima County – Paul Bennett, Ed Curley, Harlan Agnew, Paul Loucks, Jackson Jenkins, Joint Planning Group Members

Joint Planning Summary

Background

Within the last year, the Pima County Wastewater Management Department (PCWMD) and Tucson Water have each released draft long-range plans for community comment. Projections of population and effluent production are critical factors that affect both plans. In order to bring a common basis to influent/effluent forecasting, PCWMD and Tucson Water staff have met periodically to discuss and resolve the variances between their respective population and effluent projections. For purposes of this discussion, Treatment Plant influent and effluent flows are used interchangeably.

Population

Tucson Water's draft Water Plan ("Water Plan: 2000-2050" – November 2004) used the Pima Association of Governments (PAG) Transportation Analysis Zone (TAZ) population forecast to estimate the effluent flow in the Tucson Water Long Range Planning Area for the years through 2030.

Pima County Wastewater Management Department's Facility Plan first draft (May 2005) used PAG's Census Tract data in the Facility Plan Model to forecast influent flow to the five major plants (Roger Road including the Randolph Plant, Ina Road, Marana, Avra Valley, and the Southlands including Corona de Tucson) in the Eastern Pima County Area for the years through 2025. The Census Tract and TAZ population forecasts vary significantly in magnitude and location of growth.

Based on the recommendations of PAG and discussions with Tucson Water, PCWMD will use the PAG TAZ population forecasts through 2030 in its final version of the Facility Plan. PAG supplied PCWMD with its TAZ population forecasts in June 2005. PCWMD has incorporated these forecasts in its Facility Plan Model to develop the Treatment Plant influent projections that will be compared to the Tucson Water effluent projections based on TAZ data.

Tucson Water compared the PCWMD June 2005 TAZ projections with the TAZ data issued in 2003 that was originally used in the Water Plan. These two data sets are slightly different; therefore, Tucson Water will utilize the more recent PAG TAZ data to update the Water Plan projections. The 2005 PAG TAZ's will be used to generate the joint TW/PCWMD projections.

Also of note, PAG is in the process of upgrading its method of projecting population to the process currently used by the Maricopa Association of Governments (MAG). The MAG model is based on a 1-acre grid which is much more refined than the TAZ data. PCWMD and Tucson Water anticipate using the 2005 PAG TAZ data until such time as PAG develops the new system. However, if the new system is not on-line within two to three years, both entities will request updated TAZ projections from PAG for updating their respective plans.

Tucson Water Long Range Planning Area vs PCWMD Five Treatment Plant tributary areas

Tucson Water's Long Range Planning Area encompasses eastern Pima County from Robles Junction in the west to the Pima/Cochise county boundary in the east and from the Pinal County line in the north to Pima Mine Road in the south. The area defined by PCWMD's five treatment plant tributary boundaries is significantly smaller. The areas included in the Water Plan but not in PCWWM's Facility Plan are generally on the outskirts of the Metropolitan area in regions of low population density. The population in the non-overlapping areas is about 3% of the 2030 projected population (45,187 out of a total of 1,382,587 people). The use of different planning areas for each entity is appropriate due to the different purposes of each plan. However, in order for both entities to utilize the same projections of future effluent generation, these areas must be reconciled as discussed below.

Effluent/Influent Quantity Generation Methodology

Tucson Water's Previous Methodology
In the draft Water Plan, Tucson Water forecasted effluent quantities based upon a population of 1,405,799 people living within the Long Range Planning Area in 2030. Tucson Water records support potable water deliveries of 162.84 gallons/person/day (GPCD) over the past several years. This per capita water usage was assumed to remain unchanged through 2030. To project future effluent quantities, Tucson Water applied a sewer return flow factor of 60% of potable supply or 162.84 x 60% = 97.7 GPCD. Tucson Water further estimated that 90% of the population in the Long Range Planning Area will be connected to a wastewater treatment plant in 2030 (1,405,799 x 90% = 1,265,219 people). Based on these assumptions, that population would generate 123.62 MGD (138,469 AF/YR).

Pima County Wastewater Management Department's Previous Methodology
PCWMD forecasted influent flow by arranging the individual sewer basins in the five treatment plant tributary areas in a hierarchal manner from the basins on the outskirts of the metropolitan area to the basins closest to the treatment plant. The basins in each tributary area flow to the next basin through the major interceptors in the conveyance system. The population within each basin was assigned a return flow in GPCD and the calculated flow was compared to flow meters located within the collection system in 2005. A system-wide average figure of about 85 GPCD was found to most closely match the metered flow in 2005 and was thus used in the Facility Plan projections through 2025. Further, the number of people on septic within each basin as of 2005 was estimated from the Pima County Map Guide by observing the location of sewer lines in relation to housing. Housing without adjacent sewers was considered on septic. For future projections, all new development within the five treatment plant tributary areas was assumed to be connected to sewer. (Therefore, the population on septic systems is projected to remain unchanged through 2025 within the five treatment plant tributary areas.) The overall percentage of septic tank usage projected for the year 2025 within the five tributary areas was about 6.7%. The draft Facility Plan applied the calculated GPCD factors and septic percentages to the PAG Census Tract data for future years to project effluent production. The draft Facility Plan projected an effluent volume for the five treatment plant tributary areas (Roger Road including the Randolph Plant, Ina Road, Marana, Avra Valley, and the Southlands including Corona de Tucson) for 2025 of 87.27 MGD (97,750 AF/YR).

Joint Planning Future Methodology
In order to achieve consistent projections of effluent, PCWMD and Tucson Water staff discussed the most appropriate data sets and assumptions to apply. The entities agreed to the following:

PCWMD will shift toward using the PAG TAZ data and will extend their plan to 2030;
Tucson Water will continue use of the PAG TAZ's, but will update to the 2005 data set;
PCWMD will summarize the development of the GPCD sewer return flow rates (Table 1) in the final Facility Plan and Tucson Water will reference this source in the final Water Plan;
PCWMD will summarize the development of the septic usage values (Table 1) in the final Facility Plan and Tucson Water will reference this source in the final Water Plan;
Tucson Water will adopt the GPCD sewer return flow rates developed by PCWMD (instead of using 60% of potable GPCD);
Tucson Water will adjust its method of estimating the use of septic tanks as follows:

1) The population located within the Long Range Planning Area, but outside of the five sewer tributary areas, will be assumed to be on septic.
2) The population located within the five sewer tributary areas will assume to have the septic usage values presented in Table 1.

The net result of these agreements is that, for purposes of projecting effluent availability:

- Both entities will be working from the same basic data set (PAG TAZ 2005),
- Both entities will assume the same number of customers connected to septic in five-year increments (see Table 1), and
- Both entities will apply the estimated GPCD factors (Table 1) to calculate sewer return flows in five-year increments.

Utilizing this methodology, PCWMD's and Tucson Water's current estimate of the total population within the five treatment plant tributary areas in the year 2030 is 1,337,400 people. (The total population located within Tucson Water's Long Range Planning Area is 1,382,587, with the assumption that the 45,187 people living outside the five tributary areas will be served by septic systems.) Applying the septic and GPCD factors shown in Table 1 results in a projection of 1,247,963 persons on sewer in the five plant tributary areas in 2030, generating 106.14 MGD (118,900 AF/YR) of influent/effluent. This volume is then analyzed based on the various intergovernmental agreements relating to effluent to determine the projected distribution of effluent entitlements in 2030 for resource planning purposes. Table 1 presents the projected population, effluent volume, GPCD factor, and septic tank factor for every five years from 2005 through 2030.

Roger Road, Ina Road, Avra Valley, Marana and Southlands Treatment Plants

	2005	2010	2015	2020	2025	2030
Total Projected Population in Sewer Basins	837,571	928,849	1,031,142	1,133,129	1,235,513	1,337,400
Projected Population on Septic Systems	89,437	89,437	89,437	89,437	89,437	89,437
Percentage of Projected Population on Septic Systems	10.68%	9.63%	8.67%	7.89%	7.24%	6.69%
Projected Population Connected to Sewer	748,134	839,412	941,705	1,043,692	1,146,076	1,247,963
Sewer Flow GPCD Factor	85.53	85.39	85.28	85.18	85.12	85.05
Total Influent/Effluent Plant Flows (MGD)	63.99	71.68	80.31	88.90	97.55	106.14
Total Influent/Effluent Plant Flows (AF/YR) - *Rounded*	71700	80300	90000	99600	109300	118900

Table 1 – Projections of Population and Effluent, 2005-2030

Also of note, the Pima Association of Governments (PAG) is in the process of updating the regional "208 Plan" relating to wastewater planning. TW and PCWMD staff have met with PAG staff and have determined that the 208 Plan will use these same projections of population and effluent generation. PCWMD and Tucson Water have also agreed to study two test areas within the sewer collection systems to collect additional information on the GPCD factor and determine if/how this factor may change in the future as new development occurs. The two areas include an older neighborhood located in central Tucson and a newly constructed neighborhood in the Continental Ranch area. Finally, PCWMD and Tucson Water staff agree to work cooperatively in the future when forecasting effluent availability so that subsequent planning efforts are closely aligned for the community.

APPENDIX D

A PRIMER ON THE COLORADO RIVER AND THE POTENTIAL FOR SHORTAGE

The Colorado River is one of the primary sources of water supply, power generation, recreation, and environmental habitat in the western United States. The river channels runoff from a drainage area of about 246,000 square miles within seven states to meet the water supply needs of over 25 million Americans. It provides a large part of the State's water-supply portfolio and by virtue of the Central Arizona Project, it is the largest renewable water source available to Tucson Water.

A shortage has yet to be declared on the Colorado River, but one will likely occur in the coming years. Depending on its magnitude, a shortage could have negligible to very significant impact on water providers who rely on this water source to meet water demand within their service areas. This appendix summarizes what a declaration of shortage means and how prepared Tucson Water is to meet such a challenge.

BACKGROUND

The Utility's access to the Colorado River relies on the State of Arizona's annual apportionment of Colorado River water, a physical delivery mechanism called the Central Arizona Project, and the City of Tucson's Municipal and Industrial (M&I) subcontract. These elements determine the means through which Tucson Water has rights to using Colorado River water and the relative priority of the City of Tucson's Central Arizona Project allocation in times of shortage.

Colorado River Water Apportionment

The waters of the Colorado River were first apportioned between the states of the upper basin division (Colorado, New Mexico, Utah, and Wyoming) and the lower basin division (Arizona, California, and Nevada) under the Colorado River Compact of 1922. Each of the basins were allocated 7.5 million acre-feet per year. The division point between the two basins was identified as Lee's Ferry which is located where Arizona State Highway 89 crosses over to the north side of the Colorado River. However, the Compact did not apportion annual rights to Colorado River water to individual states within the upper or lower basin divisions.

The specific allocation of water between the three lower basin states was set forth a number of years later in the Boulder Canyon Project Act of 1928. Under this Act, and as shown on Figure D-1, the State of Arizona obtained rights to 2.8 million acre-feet per year of Colorado River water. In 1944, a Treaty for the Utilization of Waters of the Colorado and Tijuana Rivers and the Rio Grande was established between the United States and Mexico. Under this Treaty, the Republic of Mexico was annually allotted 1.5 million acre-feet of Colorado

River water. Allocation of Colorado River water amongst the upper basin states occurred in 1948 under the Upper Colorado River Basin Compact. Review of Figure D-1 indicates that the annual apportionment among the upper basin states were specified in terms of percentages while those among the lower basin states and Mexico were specified as quantified annual volumes.

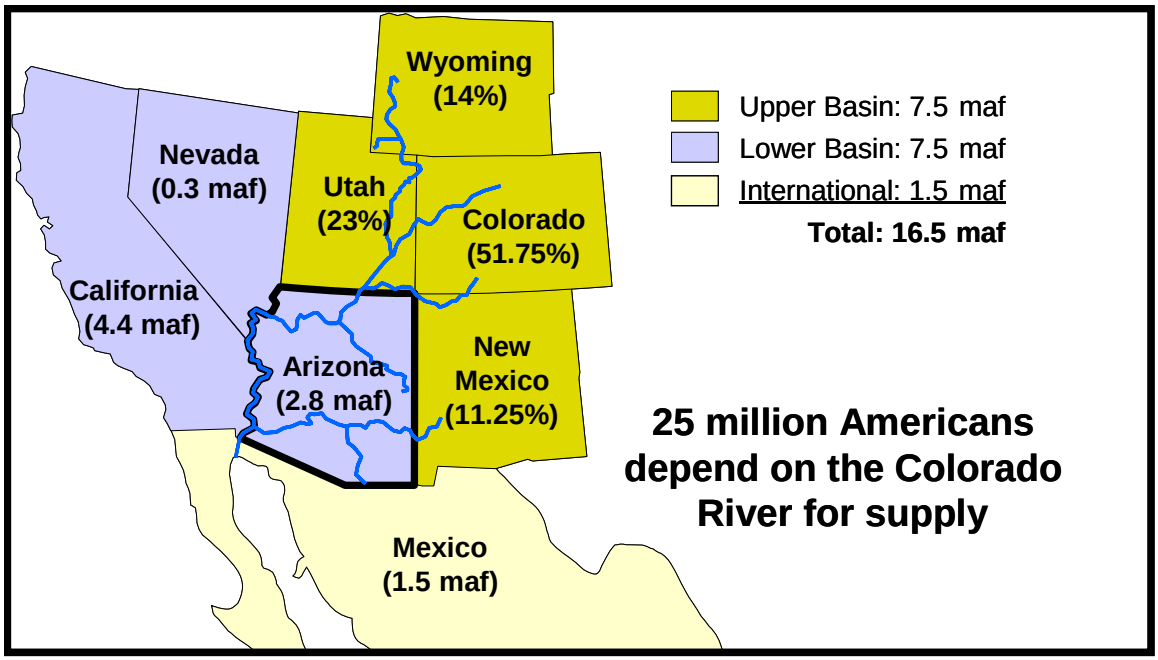

Figure D-1: Annual Allocations of Colorado River Water by State and Mexico

It took many decades before Arizona was able to fully utilize its allocation, and the State had to withstand a series of attempts to take its unused portion away. Over time, these inter-state issues were resolved, and many Arizona communities, Native American tribes, and agricultural interests have obtained their own rights to a portion of Arizona's annual allocation. These allocations were obtained pursuant to the master repayment contract between the U.S. Bureau of Reclamation and the Central Arizona Water Conservation District (CAWCD) related to the Central Arizona Project (Contract No. 14-06-W-245). In the case of the City of Tucson, an allocation of Colorado River water was acquired through its subcontract with the CAWCD and the U.S. Bureau of Reclamation (Contract No. 9-07-30-W0199). Tucson's allocation has changed over time due to various re-allocations, water system acquisitions, and legal settlements. As discussed in Section Four, the City's current allocation is 135,966 acre-feet per year with two pending reallocations that will bring the total to 144,191 acre-feet per year in the near future.

Central Arizona Project

The Central Arizona Project is a 336-mile long system of aqueducts, pipelines, and pumping plants that extends from Lake Havasu to the southwestern edge of Tucson. The project is designed to deliver about 1.5 million acre-feet of Colorado River water per year to Pima,

Pinal, and Maricopa counties, and it is the largest single source of renewable water supplies in Arizona.

Efforts to develop the Central Arizona Project began in earnest in 1946 when the Central Arizona Project Association was formed to educate Arizonans and lobby the United States Congress to authorize its construction. Construction was finally authorized in 1968 under the Colorado River Basin Project Act which enabled the U.S. Department of the Interior (and the Bureau of Reclamation) to fund and construct the Central Arizona Project and established a repayment mechanism to recover costs. In 1971, the Central Arizona Water Conservation District (CAWCD) was created to provide a means for Arizona to repay the federal government for project construction and to manage and operate the Central Arizona Project. Construction took twenty years and the entire project cost over $4 billion (Central Arizona Project, 2007a).

Pursuant to the City of Tucson's subcontract with CAWCD, the City's allocation of Central Arizona Project water is designated for Municipal and Industrial (M&I) use. An M&I allocation has the highest priority within the Central Arizona Project allocation hierarchy along with Native American allocations.

Colorado River Water Availability

In-stream flows at Lee's Ferry can vary widely from year-to-year. Review of Figure D-2 indicates that the magnitude of the annual flows at Lee's Ferry have on average been trending downward. In recent years, the annual flows have continued to decline overall due to the ongoing multi-year drought in the Colorado River basin (United States Geological Survey, 2004).

The time period used to estimate water flows for apportionment under the Colorado River Compact in 1922 was from 1905 to 1922. Unknown at the time, this time period had the highest long-term annual flow volume of the past century averaging 16.1 million acre-feet per year at Lee's Ferry (USGS, 2004). Further review of Figure D-2 indicates that annual flows of the Colorado River have generally been below 16.1 million acre-feet since 1920. This in turn means that the time will come when some Colorado River water users will experience periods of shortage despite the presence of significant storage reservoirs on the system. Projections based on current on-river conditions strongly suggest that the first shortage may be close at hand.

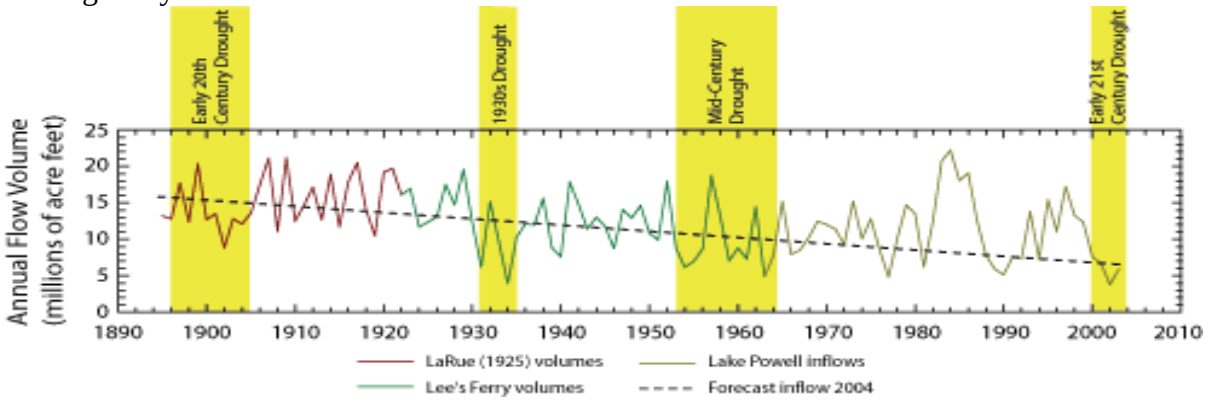

Figure D-2: Annual Colorado River Flow at Lee's Ferry (modified from USGS, 2004)

LAW OF THE RIVER AND THE CENTRAL ARIZONA PROJECT

The Colorado River is managed and operated subject to a long litany of laws, treaties, and court decisions dating back to the Colorado River Compact of 1922. Collectively referred to as the "Law of the River," a broad legal framework has evolved which addresses most issues. However, the Law of the River only provides limited guidance to the Secretary of Interior for times of shortage. Selected elements of the Law of the River that relate to a potential Central Arizona Project shortage are summarized in the following sections.

Mexican Water Treaty of 1944 (Treaty Series 994)

In 1944, a Treaty for the Utilization of Waters of the Colorado and Tijuana Rivers and the Rio Grande was established between the United States and Mexico. Amongst other things, this treaty allocated waters between the United States and Mexico for each of the three rivers included in the agreement and authorized the construction of dams, the study of flood control works, and the evaluation of the potential to produce hydro-electric power.

Colorado River shortage issues are indirectly addressed in this treaty. Article 10 indicates that in the event of extraordinary drought or serious accident which would make it difficult for the United States to make required deliveries to Mexico, the water allotted to Mexico would be reduced in the same proportion as consumptive uses in the United States. Beyond this statement in the 1944 Treaty, however, no agreement is in place which specifies how Colorado River shortages would be shared between the United States and Mexico. This apparent legal ambiguity may have significant effect on water users on both sides of the border when the Secretary of Interior eventually declares a shortage.

Arizona v. California IV (376 U.S. 340)

The 1964 U.S. Supreme Court decision in *Arizona v. California IV* resolved a long-standing dispute between the two states. Among various other issues, the Supreme Court decided the case in favor of Arizona by confirming that Arizona will have access to its full allocation of Colorado River water (2.8 million acre-feet per year) at such time as it is needed (United States Supreme Court, 1964).

In Section II(B)(3) of the 1964 decision, it was confirmed that in times of shortage, California could not use more than its allotted 4.4 million acre-feet per year just by putting a greater volume to consumptive use before Arizona could fully utilize its annual allocation. In effect, the Supreme Court upheld that agreements associated with the Law of the River had precedence over the doctrine of prior appropriation. This decree essentially laid the groundwork for the construction of the Central Arizona Project. However, the political fallout from this decision led California to apply significant pressure in Congress to work language into the Colorado River Basin Project Act of 1968 which specified a lower priority for Central Arizona Project water in times of shortage.

Colorado River Basin Project Act (U.S. Public Law 90-537)

The Colorado River Basin Project Act was signed into law in 1968 to authorize the construction, operation, and maintenance of the Colorado River Basin Project and for other purposes. Under this Act, the Secretary of Interior was directed to conduct a "full and complete" investigation in support of developing a general plan to meet the future water needs of the Western United States. The Act also included guidance on the potential to augment flows in the Colorado River in order to offset delivery obligations to Mexico under the Mexican Water Treaty of 1944. Finally, the construction, operation, and maintenance of the Central Arizona Project were authorized.

The Act contains two sections pertinent to shortage issues. Section 201(b) discusses the administration of the Supreme Court decree in *Arizona v. California IV* (376 U.S. 340) noting that during times of shortage, deliveries to the Central Arizona Project will be curtailed. Such a reduction would ensure that sufficient water is available to first satisfy the demands of other Lower Basin rights including the full 4.4 million acre-feet per year to California and right holders of similar standing in Arizona and Nevada. Section 304(e) establishes a protection for any Central Arizona Project user who legally relinquished water from other sources in exchange for Colorado River water deliveries via the project. Such users will have the first priority to receive Central Arizona Project deliveries.

Standing of the Central Arizona Project during Shortage

Based on the guidance provided to date by the Law of the River, the 1.5 MAF associated with the Central Arizona Project has the lowest priority during times of shortage. It is probable that Mexico would be co-equal with the Central Arizona Project pursuant to language in the Mexican Water Treaty of 1944; however, the specifics of this relationship have yet to be formalized. Rights to Colorado River water along the main stem in Arizona and Nevada that post-date 1968 would also be co-equal with the Central Arizona Project; however, this does not represent a large volume when compared to the 1.5 million acre-feet per year conveyed via the project. At the present time, California's entire Colorado River allocation of 4.4 million acre-feet per year would be protected during times of shortage until such time as the entire Central Arizona Project allocation and other post-1968 rights are curtailed.

SHORTAGE PROPOSAL UNDER CONSIDERATION

In order to establish guidelines for river operations during shortage conditions, the Secretary of Interior initiated a process to establish operating criteria. In 2005, the Secretary solicited recommendations for shortage guidelines and two main proposals were submitted – one crafted by the seven basin states and a second developed by a group of non-governmental environmental organizations. The Secretary also brought forward two additional potential options (a "Water Supply" alternative and a "Reservoir Storage" alternative) as well as a "No Action" alternative. The Secretary of Interior issued a draft Environmental Impact Statement (EIS) in February 2007 and a final EIS in November 2007. Detailed information on the EIS, each of the five initial alternatives, and the eventual Preferred Alternative is available

through the U.S. Bureau of Reclamation's website for the Lower Colorado River Region at *www.usbr.gov/lc/region/programs/strategies/documents.html*.

The "Preferred Alternative" was developed by the U.S. Bureau of Reclamation based on the concepts and criteria presented in the five original options. The Preferred Alternative is closely aligned with the alternative proposed by the seven basin states.

The primary goals of the Preferred Alternative are to minimize the extent and duration of shortages in the Lower Basin and to reduce the risk of a "Call on the River" where Upper Basin water usage could be curtailed to satisfy deliveries to the Lower Basin. This alternative includes the use of small-scale, proactive (stepped) shortages of 400,000 acre-feet, 500,000 acre-feet, and 600,000 acre-feet to maintain reservoir storage as long as possible; coordinated operation of Lakes Powell and Mead; and creating a mechanism to store and deliver conserved system water (through infrastructure improvements that reduce system losses) and non-system water (generally land fallowing in tributary watersheds that results in increased flows in the Colorado River). The primary purpose of the stepped shortages is to accept small-scale shortages sooner in time to forestall a major shortage later in time.

An important innovation that was proposed is the potential to accrue a new class of water credits in the Colorado River system referred to as Intentionally Created Surplus (ICS). Under this proposal, users of Colorado River water would obtain ICS credits through "extraordinary conservation" projects, tributary conservation projects, introduction and/or exchange of non-Colorado River system water, and system efficiency improvements (Basin States, 2006).

It is assumed in the Preferred Alternative that Mexico shares the reduced delivery volumes on a pro-rata basis. It is proposed that Mexico's shortage share be set at 17 percent which represents Mexico's percentage share of the total volume of Colorado River water entitled to Mexico and the Lower Basin states. Negotiations to finalize Mexico's proposed sharing level are ongoing. The proposed Lake Mead elevation triggers and stepped shortage volumes under the Preferred Alternative are summarized on Table D-1.

Lake Mead Level (Feet amsl[1])	Shortage Volume (Acre-Feet)	United States Share (Acre-Feet)	Mexico Share (Acre-Feet)
1075	400,000	333,000	67,000
1050	500,000	417,000	83,000
1025	600,000	500,000	100,000
<1025	Re-consultation	Re-consultation	Re-consultation

Table D-1- Elevation Triggers at Lake Mead and Shortage Volumes.

The Secretary of Interior issued a draft set of Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lakes Powell and Mead on December 10, 2007. The current planning assumption is that the Secretary of Interior's final Record of Decision will reflect most, if not all, of the concepts of the Preferred Alternative. The concepts included in this Alternative have already been endorsed by the contract users of Colorado River water. It is also assumed that Mexico will share in Colorado River water shortages at the 17% level although this is not yet certain.

SHORTAGE IMPACTS AND TUCSON WATER'S PREPAREDNESS

The Colorado River is the largest renewable water resource available to Tucson Water. The Utility is currently in the process of bringing its full allocation into use to help offset groundwater mining and to comply with the State of Arizona's Assured Water Supply regulations. The City's current allocation is 135,966 acre-feet per year; two pending reallocations will bring the total to 144,191 acre-feet per year in the near future. While use of Colorado River water is a key step toward maintaining a more sustainable water supply, the Utility will also be prepared to deal with the uncertainties and impacts related to shortages of its Colorado River water supply.

Probable Shortage Impacts

To assess Tucson Water's preparedness for eventual Colorado River water shortages be they caused by extended drought and/or climate change, it is important to first evaluate what shortage conditions will mean for the Utility. Once a shortage is declared, the Central Arizona Project will be curtailed to a significant degree – presumably in accordance with the Preferred Alternative. Discounting the minor shortage contributions of other late-priority water, it is assumed that the Central Arizona Project will be curtailed at 83% of the appropriate volume for each shortage tier which assumes 17% of the shortage will be borne by Mexico.

Once shortages occur, the relative priority of different water uses will determine which Central Arizona Project water users will be impacted. Not all water uses are of equal priority. In the Record of Decision for the allocation of waters and contracting under the CAP, major categories of water allocation included Native American use (309,828 acre-feet per year), M&I (640,000 acre-feet per year), and the remaining supply for "non-Indian" agriculture (Secretary of Interior, 1983). The Record of Decision also set shortage criteria including a condition that 25 percent of the 173,100 acre-feet annually allocated to the Gila River Indian Community would be curtailed while the remaining allocation would share the same priority as 510,000 acre-feet per year of the M&I allocation. The Record of Decision goes on to state the following:

> "…During years of water supply shortages, Indian users and non-Indian M&I users would share a first priority on project water supplies…water delivery for miscellaneous uses would be reduced pro-rata until exhausted; next, non-Indian agricultural uses would be reduced the same way until exhausted; next, the Gila Tribe allocation would be reduced by 25 percent and other Indian agricultural uses would be reduced by 10 percent on a pro rata basis until exhausted.

> Thereafter, the remaining water contracted for by 11 Indian entities under existing contracts and 75 percent of the Gila River Tribe allocation would share a priority with 510,000 acre-feet of non-Indian M&I uses…and would be reduced on a proportional basis, and within each class on a pro-rata basis, ***based on the amount of water actually delivered to each entity in the latest non-shortage year***."
>
> (Emphasis added; from Secretary of Interior, 1983).

Based on the above language, Tucson Water does benefit from the relative priority of M&I uses within the Central Arizona Project's hierarchical scheme. The Central Arizona Project allocation totals 1.5 million acre-feet per year. Of the total, M&I subcontracts currently account for 555,031 acre-feet per year, Native American contracts total 555,086 acre-feet per year, and the remainder is allocated to "non-Indian" agriculture and miscellaneous uses (Central Arizona Project, 2007a). Therefore, it is highly likely that M&I allocations would not be curtailed until a shortage of 600,000 acre-feet per year or more is declared.

M&I allocations will only retain this relative priority based on the amount that was used in the most recent non-shortage year (i.e. last normal year). An M&I allocation is only as valuable as the demonstrated use of it prior to entering a shortage. The actual subcontracts held by individual entities may also have additional language that can affect the distribution of water between M&I users.

SUMMARY

Eventual shortages on the Colorado River will have a significant impact on the water providers such as Tucson Water which have come to rely on this renewable water supply. The Law of the River has evolved over time and provides limited guidance for shortage impacts. Under this framework, the Central Arizona Project has the lowest priority for water deliveries. With an ongoing drought and the increasing possibility of a shortage occurring in the near term, the Secretary of Interior is in the process of evaluating operational shortage guidelines proposed in the Preferred Alternative. Tucson Water will remain active in ongoing planning activities to ensure the Utility is adequately prepared to deal with supply impacts caused by shortage.

Tucson Water is well positioned for eventual shortages on the Colorado River. Nonetheless, there are additional steps that will be taken to further augment the Utility's protections. Of primary importance, Tucson Water plans to bring its full allocation of Central Arizona Project water into use as soon as practicable to ensure that it has access to the greatest potential volume of water during the first and second tiers (steps) of Central Arizona Project shortages. The Utility will also continue working with the AWBA to maximize the amount of firmed water that is in storage at its own facilities while working toward finalizing recovery plans for the majority of the water that currently lacks a clear recovery mechanism. Finally, Tucson Water will continue to engage in state-wide and basin-wide planning efforts related to the Colorado River.

APPENDIX E

ENGAGING THE COMMUNITY

The first sentence of *Water Plan: 2000-2050* expressed Tucson Water's commitment to public outreach and customer service:

> Water Plan: 2000-2050 was developed to initiate a dialogue between Tucson Water and the community about the water-resource challenges which must be addressed in the coming years.

This engagement with both customers and stakeholders continues to be a primary driver for the Utility.

Presentations, Discussions, and Public Outreach

Tucson Water had taken elements of *Water Plan: 2000-2050* "on the road" even before it was issued in November 2004. Utility staff and management have provided well over a hundred presentations on all aspects of water-resource planning including the analytical tools that have been developed, the overall Scenario Planning process, the various Common Elements and plan recommendations, financial impacts, and the critical decisions with the primary focus being on *Decision H20*. Audiences have ranged from local community groups and town halls to national conferences and seminars.

Public discussion of water resource availability in the Tucson area has been almost continuous since *Water Plan: 2000-2050* was issued. A subsequent report issued by the University of Arizona's Water Resources Research Center (2006) considered water resource availability throughout the greater metropolitan Tucson region. That report drew conclusions consistent with *Water Plan: 2000-2050* regarding the need to shift to renewable water resources and the growing importance of effluent utilization in the future.

To provide information more directly to its customers, Tucson Water relies on several methods of communication. In addition to the presentations referenced above, the Utility has released a number of Public Service Announcements and bill inserts to explain aspects of the water planning process. Additional printed materials have been distributed throughout the community at various forums. Staff has responded to hundreds of phone calls and e-mails on Plan related topics. Local news media, both print and electronic, were actively engaged as part of the Utility's outreach efforts, resulting in numerous articles and television and radio stories highlighting aspects of the Water Plan. Finally, all aspects of the plan have been posted on Tucson Water's website for ease of information sharing and to elicit comments from the community.

Key decisions and on-going policy direction regarding the Water Plan are provided to the Utility by Tucson's Mayor & Council. To ensure that the governing body has sufficient information to provide this direction, Tucson Water has provided periodic updates to the Mayor and Council, both in session and through individual meetings with the elected representatives. As part of this on-going process, the Utility works closely with the City Manager's Office, the Citizens' Water Advisory Committee (CWAC) and the Mayor & Council's Environment, Planning, and Resource Management (EPRM) subcommittee.

Decision H2O

One of the largest outreach campaigns ever conducted by Tucson Water has centered on issues associated with Decision #1 of *Water Plan: 2000-2050*. This campaign has been titled *Decision H2O* and is focused on determining the long-term mineral content of the Utility's Colorado River water supply delivered through the Clearwater Program. As additional Colorado River water is added to the Clearwater project, the mineral content of the blended supply will increase over time eventually reaching approximately 650 parts per million (ppm), the average mineral content of the Colorado River water. During the Utility's initial public involvement campaign which was conducted to determine acceptable mineral content of the Clearwater blend, Tucson Water customers selected 450 ppm as the preferred blend. The data collection process being conducted to support Decision #1 is intended to determine whether customers will accept the slow rise in mineral content, or would prefer to pay for a new treatment facility to maintain the minerals at 450 ppm. To support the mineral content decision, comprehensive technical and cost information was developed and shared with Tucson Water's customers through the Decision H2O outreach program.

The outreach effort is centered on determining consumer preferences between two potential future mineral levels of the Clearwater blend and customer's willingness to pay in order to meet discretionary water quality targets. Three investigations were undertaken including a Flavor Profile Analysis (taste tests conducted by a trained panel), structured consumer panels, and an extensive kiosk outreach program.

The most visible part of the outreach program involved direct interaction with Tucson Water customers at information kiosks from October 2006 through January 2007. Tucson Water operated demonstration kiosks at two retail malls and two traveling kiosks that visited locations and events throughout the community. Participants had the opportunity to taste each mineral blend (blind test) and express their taste preference. The participants were then provided additional information about water resources, environmental impacts, health considerations, treatment costs, and potential household impacts of changing mineral levels. After the customers received the additional information and staff responded to their questions, they were asked to provide their overall preference. Over a period of four months, more than 13,000 Tucson Water customers participated in kiosk activities. Throughout the course of the program, weekly results were posted on a *Decision H2O* a website established specifically for the program: *www.decisionh2o.com*.

Throughout 2007 and into early 2008, the Utility continued to conduct a number of studies to develop a final recommendation to bring forward to Tucson's Mayor & Council. These

efforts include decision-matrix analyses on the customer surveys and further investigations of the potential treatment technologies and costs to ensure that the information provided to Mayor and Council is as current and accurate as possible. Tucson Water is also in the process of conducting a comprehensive sustainability analysis to determine the environmental, financial and social impacts of the two alternative water qualities and provide a broader context within which to make the mineral decision. Factors such as carbon generation, salt loading, land usage, water efficiency, affordability and social equity are being assessed to compare the various options. It is expected that these remaining steps will be completed in 2008 and a recommendation will be forwarded to Mayor & Council.

Continuing the Engagement

Water Plan 2000-2050 is an evolving document which will change over time as new circumstances, opportunities and challenges are identified. Tucson Water is committed to continued engagement with customers and other stakeholders to ensure that the community is aware of these changes and is offered multiple opportunities to participate in the decision making process. Through community-wide education, interaction and collaborative planning, the Mayor and Council, the Utility and the community we serve will be better able to identify and meet the water management challenges that lie ahead.