



City/County Water and Wastewater Study



Date: March 6, 2009

To: City/County Water and Wastewater
Study Oversight Committee

From: C.H. Huckelberry
County Administrator

Mike Hein
City Manager

Handwritten signatures of C.H. Huckelberry and Mike Hein.

Re: **City/County Consolidated Drought Management Plan Technical Paper**

Background

One of the goals included in the scope for Phase II of the City/County Water and Wastewater Study was for the City and County to develop a consolidated drought management plan. A City and County interdisciplinary staff team was assembled to look at this issue and has been meeting since December to develop this report.

As you will find in the attached report, staff found that the actual consolidation of City and County drought management plans is not preferable because as a water provider the City has different drought planning requirements than the County. In addition, the City's drought management plan is unique because of the City's reliance on CAP water, which necessitates monitoring and establishing measures to respond to changing conditions that impact the Colorado River, not only local conditions. That said, a considerable amount of cooperation is already ongoing between the City, County, and local water providers regarding drought planning through the Local Drought Impact Group for this region and this effort can be enhanced. This group is coordinated by Pima County and was initiated by the Arizona Department of Water Resources to implement drought planning and management across Arizona.

The paper also serves as a good introduction and overview of drought planning requirements of the State, provides summaries of the City and County drought plans, explains the triggers and actions taken at each drought stage, and provides recommendations for increasing consistency among plans and improving drought preparedness.

The recommendations in the paper include:

- A. Working through the Local Drought Impact Group, continue to improve coordination of drought response across the region by taking specific steps as outlined below:
 - Develop a consistent local definition of "non-essential" uses;
 - Develop consistent drought awareness and response messages for the community;
 - Coordinate community education efforts including a youth education program emphasizing drought and the implications/impacts on the community; and
 - Identify inconsistencies in drought related ordinances and develop a strategy for conformance wherever possible or document the reason for the difference.

- B. In the face of uncertainty related to drought and climate change, the City and County should employ an adaptive planning approach that incorporates the following:
- Bringing experts together to brainstorm current and future vulnerabilities under a range of scenarios;
 - Scenario planning as a tool to assess the changing planning environment including the potential for extended drought or permanent climate change;
 - Periodic review and frequent updates to the Drought Response Plans to incorporate the latest information on drought and climate change;
 - Integrating climate change impacts over time to redefine “normal conditions” when assessing drought;
 - Evaluation and consideration of the social and financial impacts of drought on the utilities and their customers and ways to address them; and
 - Employing conservative approaches and a multi-pronged preparedness strategy that includes diversification of water supplies, demand management, and development and maintenance of necessary infrastructure to preserve options for the future.

The City has recently established a Climate Change Committee, which will be looking at issues associated with drought within the broader context of climate change mitigation and adaptation. Impacts on water use and availability will be part of this effort and could inform future updates to the City and County drought management plans. The County will participate in the process with the intent of adopting consistent policies and programs that result from the committee’s deliberations.

Recommendation

It is respectfully recommended that the Committee consider this report and provide input to the City and County on its recommendations.

- c: Mike Letcher, Deputy City Manager
John Bernal, Deputy County Administrator - Public Works
Dennis Douglas, Deputy County Administrator Medical and Health Services
Jeff Biggs, Director of Tucson Water
Mike Gritzuk, Director, Regional Wastewater Management
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City/County Water and Wastewater Study Phase II



City of Tucson and Pima County Consolidated Drought Management Plan Technical Paper

February 2009

This paper was prepared by a joint team of City of Tucson and Pima County staff from the following departments: City of Tucson - Tucson Water, Office of Conservation and Sustainable Development, and City Manager's Office; Pima County - Regional Wastewater Reclamation Department, Health Department, and County Administrator's Office. Lead authors on the paper were Karen LaMartina and Kathy Chavez.

City of Tucson and Pima County Consolidated Drought Management Plan Technical Paper

The Water and Wastewater Infrastructure, Supply and Planning Study, Phase II

March 2009

As part of the scope for the Joint City of Tucson/Pima County Water and Wastewater Infrastructure Supply and Planning Study, the City and County were asked to develop a consolidated drought management plan. This paper examines this request by providing:

1. A national and regional perspective;
2. An overview of State drought planning efforts and the relationship to City and County plans;
3. A summary of existing drought management plans of the City and County;
4. An analysis of the drought management plans of the City and County;
5. Opportunities for increased consistency and improved drought preparedness; and
6. Recommendations to improve City and County drought planning and preparedness.

It should be noted that there are distinct differences between Tucson Water and other water providers in the area because of Tucson Water's reliance on CAP water and therefore the need for Tucson Water's drought plan to take into account drought conditions that impact the Colorado River, as well as local conditions. There is also the distinct difference that Pima County is not a water provider. These differences impact the ability to easily accommodate consolidation of City and County drought management plans. That said, there are opportunities to improve local coordination and cooperative development of consistent programs and messages, as well as overall drought preparedness. Such recommendations are included in this paper.

1. National and Regional Perspective

Drought is a normal weather condition, which occurs in every climate zone. It starts with a shortage of precipitation over an extended period of time. The severity of the drought depends upon how dry it gets, how long there is no significant rain, and the size of the affected area. It can be described as dry weather that lasts long enough to cause serious problems such as crop damage or no crop yields, water supply shortages, loss of livestock and wildlife, or early onset of the wildfire season resulting in loss of income and increased costs.

National

Drought conditions in Georgia and California have recently received widespread national media attention. However, drought is not just limited to these two states. The U.S. Drought Monitor estimates 46 percent of the United States is experiencing some degree of drought conditions ranging from abnormally dry to exceptionally dry. Areas in Texas, Georgia and South Carolina are experiencing extreme drought conditions. The U.S. Geologic Survey (USGS) indicates

below normal stream flows in the Southeast and along the Eastern Seaboard when compared to the same time a year ago.

Southwest

The Colorado River provides water to seven Western states: Arizona, Nevada, California, Utah, Colorado, New Mexico and Wyoming and is an important water source for over 25 million people and 3.5 million acres of farmland. Major metropolitan cities that receive water from the Colorado River include Los Angeles, Las Vegas and Phoenix.

According to the Arizona Department of Water Resources, the Colorado River reservoir system is at 56 percent capacity. Lake Powell is 58 percent full, while Lake Mead, which supplies water to Arizona, California and Nevada, is at 47 percent full. The Upper Colorado River Basin has been experiencing a multi-year drought since 1999. Inflow to Lake Powell has been below average in every year for the last ten years, except 2005 and 2008.

Arizona

The short term drought status in the December 2008 Arizona Drought Monitor Report shows abnormally dry to moderate drought conditions in the entire northern half of the state, while abnormally dry conditions are prevalent in Eastern Pima County, Santa Cruz County and Western Cochise County. The State's long term drought status calls for sustained drought conditions for all of Arizona with moderate drought in most of Pima County, all of Santa Cruz County and portions of Pinal and Cochise County.

Regional Impacts

In the desert southwest, drought impacts may not be felt immediately. While a return of rain can quickly replenish the soil, if drought has been severe enough to impact groundwater levels, groundwater will typically be slower to return to usual levels, and therefore be the last to recover at the end of the drought. Under drought conditions, vegetation in grassland and rangeland areas will decrease while shrubs increase. These conditions can result in significant fuel sources for wildland fires. Drought impacts may affect the agricultural sector, wildlife and vegetation, outdoor recreation and water supply.

In California the Governor recently declared a state of emergency as a result of drought impacts. Three years of below average precipitation has caused lake reservoirs to be at their lowest recorded levels. The drought conditions are also resulting in thousands of unemployed agricultural workers. Mandatory water conservation measures including water rationing are either in place or being considered throughout the most impacted sections of the state.¹

Similarly, Las Vegas water officials have concerns that the ongoing drought, coupled with current economic issues may jeopardize the City's water supply within the next six years. The ten-year drought along the Colorado River has caused Lake Mead levels to drop and as a result, Las Vegas must lower an existing water supply intake pipe that provides over 40 percent of the City's water. The pipeline is estimated to cost \$1 billion. To augment water supplies, Las

¹ NY Times, February 27, 2009 "California Drought Emergency Declared; LA Times February 24, 2009 "California's Dry Future; LA Times February 28, 2009 "Schwarzenegger proclaims statewide drought emergency".

Vegas is also planning a \$3.5 billion 327-mile pipeline to deliver groundwater from rural areas northeast of the City.²

2. State Drought Planning Efforts and the Relationship to City and County Plans

Arizona Governor Janet Napolitano established the Governor's Drought Task Force in 2003 to develop a drought preparedness plan for the State of Arizona in response to on-going drought conditions across the state. In addition to developing the Arizona Drought Preparedness Plan, the Task Force also recommended drought-related legislation. The Arizona legislature passed House Bill 2277 during the 2005 legislative session requiring all water providers, except those with fewer than 15 services, to develop a Water Supply Plan, a Drought Preparedness Plan, and a Water Conservation Plan. In addition to developing these three plans, all water providers were required to provide annual water use reports to the Arizona Department of Water Resources.

The Arizona Department of Water Resources' (ADWR) Statewide Drought Program coordinates three groups to implement drought planning and mitigation around the state: Local Drought Impact Groups (LDIGs), the Monitoring Technical Committee and the Interagency Coordinating Group. The Statewide Drought Program is also implementing a drought planning requirement for water providers, which include Tucson Water. Pima County staff coordinates the activities of the LDIG in Pima County.

The drought statute impacts water providers differentially, depending on their size and their Assured Water Supply status, but, mostly depending on if the provider is located within an Active Management Area (AMA) or not. For the City of Tucson and other large water providers in the Tucson AMA, an Assured Water Supply designation satisfies the Water Supply Plan requirements of the statute. Similarly, all large providers in the AMA are also subject to the conservation requirements of the Groundwater Management Act's "Management Plans" which satisfies the Water Conservation Plan requirements. Annual reports the City and other large providers have submitted to ADWR since the 1980s were deemed to satisfy the annual water use reporting requirement. The Drought Preparedness Plan, therefore, represents the only new requirement affecting the City of Tucson and many of the large water providers in the Tucson AMA.

While Pima County was not required to develop a Drought Preparedness Plan under the statute because it does not operate a water system, in order to address various health risks associated with drought, the Board of Supervisors adopted a drought preparedness plan in 2006 including a water waste ordinance.

The Governor's Drought Task Force and the ensuing legislation recognized that the water resources portfolio and infrastructure characteristics of water providers are not homogenous. Specifically, the Drought Preparedness Plan as laid out in A.R.S. § 45-432.J is required to be "designed for the specific needs of the water systems" and should include:

- Drought or emergency response stages providing for the implementation of measures in response to reduction in available water supply due to drought or infrastructure failure.

² Las Vegas TV, February 11, 2009 "I-Team: Dire Predictions Made of Las Vegas Water Supplies"

- A plan of action that the community water system will take to respond to drought or water shortage conditions, including:
 - Provisions to actively inform the public of the water supply shortage and a program for continued education and information regarding implementation of the drought preparedness plan.
 - Development of emergency supplies, which may include identification of emergency or redundant facilities to withdraw, divert, or transport substitute supplies of the same or other types of water.
 - Specific water supply or water demand management measures for each stage of drought or water shortage conditions, subject to approval by the Arizona Corporation Commission if the community water system is a public service corporation. This requirement may be met by providing a curtailment tariff on file with the Corporation Commission.

Most providers, including Tucson Water, were required to file their drought response plans with the Arizona Department of Water Resources (ADWR) by January 1, 2007. Mayor and Council adopted Tucson's plan in December 2006 with an implementing ordinance following in March 2007. The City's Drought Preparedness and Response Plan and additional information can be found at <http://www.tucsonaz.gov/water/drought-intro.htm>

To assist water providers in developing their drought plans, ADWR developed the "*System Water Plan Guidance Document*" (Guidance Document) included as Attachment A to this paper. While the Guidance Document allows for flexibility in plan development, it also includes both a table of "drought plan requirements" and various recommendations related to development of a meaningful plan for the communities served by each water provider. For example, all drought plans required under this legislation must include drought or emergency response stages and measures to respond to a reduction in available water supplies resulting from drought or infrastructure failure. Although the Guidance Document encourages adjacent water systems to share ideas, it stresses that each Plan should be *specific to the water supplies, water demand and infrastructure of each individual system.* (*System Water Plan Guidance Document*, p. 11.)

Tucson Water's Drought Preparedness and Response Plan development process closely followed all of the elements of ADWR's *System Water Plan Guidance Document*, tailoring and fitting the plan to Tucson Water's specific water supplies, system characteristics, and customer use patterns. For example, the State's Guidance Document says, "*the drought stages that each water system develops should be specific to the system and based on water supply availability.*" Tucson Water has a large enough allocation of Central Arizona Project (CAP) water to supply most, or all, of its potable demand currently and for some time in the future. In addition, Tucson Water is the only water provider in Southern Arizona directly utilizing CAP water to meet demand.

Figure 1 below shows Tucson Water's relationship to the Colorado River System. The river begins in the Rocky Mountains where its levels are greatly dependent on snowmelt and runs through the Colorado River basin collecting additional runoff. This large CAP allocation means that drought conditions in the Rocky Mountains and within the Colorado River basin play a major part in Tucson Water's drought indicator and response planning. In essence, the City's CAP allocation has transformed the focus of the Utility from a local one to that of the regional Colorado River basin.

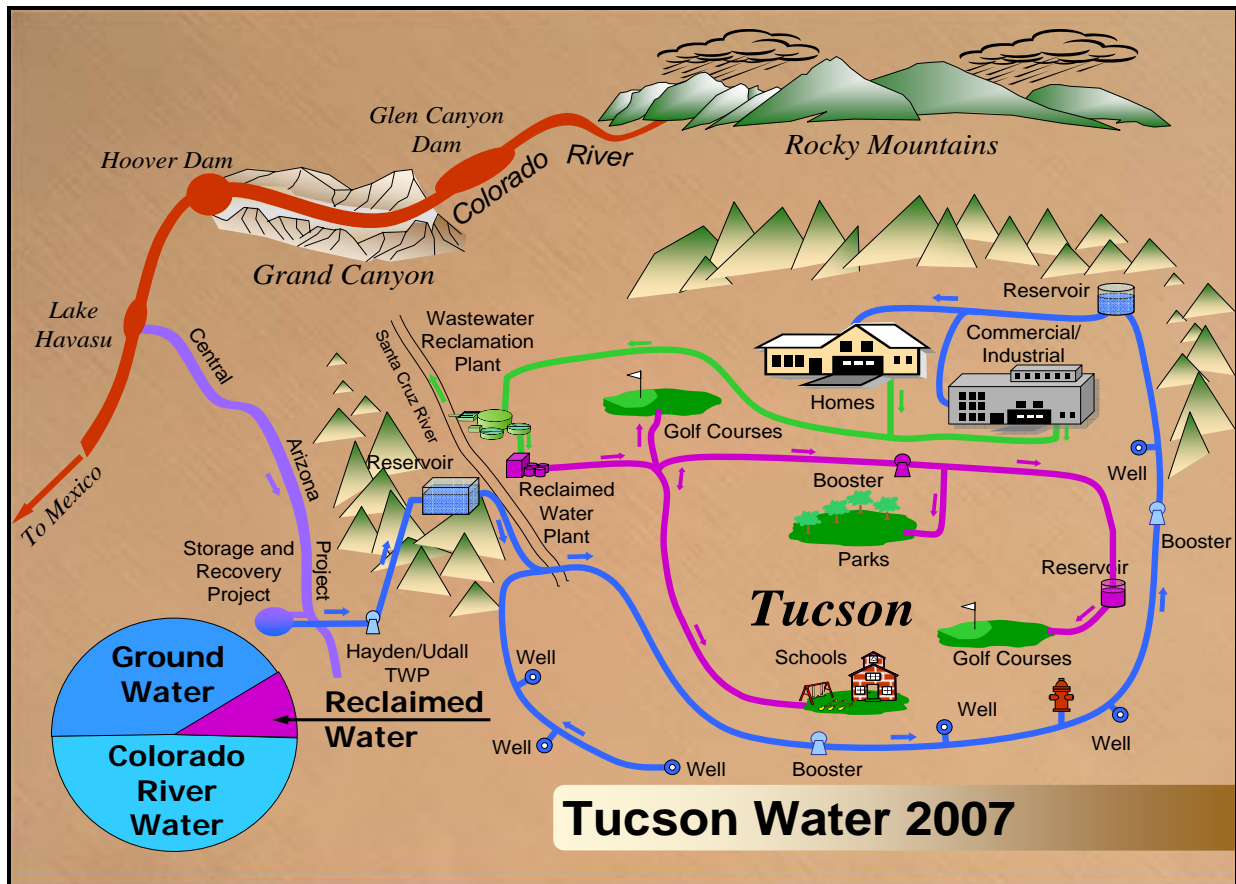


Figure 1. Tucson Water's relationship to the Colorado River Basin

The City has authority to enforce City ordinances, such as ordinance #8461 (City of Tucson Emergency Conservation Response, 1995) as a condition of water service. Therefore, an ordinance to declare and enforce drought response actions was developed in conjunction with the Plan (#10380, Drought Preparedness and Response Plan, 2007) and applies to all Tucson Water customers - including those in unincorporated Pima County - as a condition of water service like Ordinance #8461.

The State's Drought Plan included development and coordination with localized county-based groups that would be better positioned to determine drought impacts in their areas. Local Drought Impact Groups, or LDIGs, are county-level groups created voluntarily to coordinate drought public awareness, provide impact information to local and state leaders, and develop, coordinate, and implement local mitigation and response options. Pima County staff coordinates the Pima County LDIG which includes participation from many local water providers including the City of Tucson as well as State and Federal agencies, and other interested parties. LDIG objectives include:

- Identifying local drought-related impacts;
- Defining and assessing societal impacts, severity, loss and costs associated with those impacts;
- Identifying response options;

- Identifying unmet needs or needs for response; and
- Identifying and facilitating efforts to mitigate impacts focusing on preparedness and reducing drought vulnerabilities.

Under the State's Plan, LDIGs provide “ground-truth” information to the Monitoring Technical Committee. The Monitoring Technical Committee uses local drought impact information, along with scientific data, to determine drought conditions in each watershed in the state. Pima County coordinates the local drought impact information being forwarded to the State’s Monitoring Technical Committee. See Appendix B for the 2008 annual LDIG Drought Report for the entire State. Included in it is a section on Pima County.

3. Drought Management Plans of the City and County

City of Tucson Plan

Planning for drought preparedness for the Tucson Water service area is a complex exercise because of the inherent uncertainties associated with drought events (such as duration, severity, and level of public response) and the unique attributes of the Tucson Water system. Tucson Water is the largest water provider in Southern Arizona, serving approximately 730,000 customers or about 80 percent of the population of Pima County and with a service area located both inside the City limits and in areas of unincorporated Pima County. Tucson Water's system also differs significantly from other water systems in Arizona because: it is not fully reliant on either surface water or groundwater; the service area includes several isolated systems that function as small groundwater systems; and the Utility operates a large reclaimed water system that meets a significant portion of total system demand, particularly during peak demand periods.

In addition, Tucson Water is the only water provider in Southern Arizona currently delivering any Colorado River (or CAP) water to its customers. To set this in context, Arizona’s Colorado River allocation is 2.8 million acre feet (maf) per year. Approximately 1.3 maf is diverted and delivered along the river either to agriculture or river communities and the remaining 1.5 maf is available for delivery through the Central Arizona Project canal either as subcontract water or excess CAP water. Arizona’s CAP allocation supports about 5 million people or about 80 percent of the State’s population and is delivered to cities, businesses, agriculture and Indian communities in Pima, Maricopa and Pinal counties. CAP water is being increasingly used to replace groundwater for municipal, industrial and agricultural purposes.

A water management strategy to increase the reliability of CAP deliveries during potential CAP shortages or canal outages is the Arizona Water Bank Authority (AWBA), created by the Arizona Legislature in 1986. Under the AWBA, up to 400,000 acre-feet of Arizona’s unused CAP allocation can be diverted and stored underground for recovery during times of shortage. The AWBA has stored this “firming” water at recharge facilities in the TAMA on behalf of Tucson Water and other CAP subcontractors in the region. This water can then be recovered (pumped) during shortage periods. However, AWBA is dependent on the availability of excess supplies, availability of funds, and continuing legislation to permit storage beyond 2016.

Almost half of Tucson Water's annual customer demand at present is met through use of CAP water, and this percentage is projected to increase over the next several years. The conjunctive use of groundwater and CAP water supplies, particularly the operation of the Clearwater recharge and recovery system, provides a great deal of resiliency for the Tucson Water supply system during times of local drought. However, of the 7.5 million acre-feet of Colorado River water available to the lower basin states of California, Arizona and Nevada, Arizona's 1.5 million acre-foot CAP water supply has the most junior priority (Colorado River Basin Project Act – 1968). Section 301(b) of the Act provides for Arizona to curtail use of its CAP entitlement to assure water availability to satisfy uses in California and water rights in Arizona and Nevada which have higher priority under the Act than the Central Arizona Project if Colorado River water supplies are below normal. When the Colorado River Compact was negotiated, average annual flows were estimated to be about 18 million acre-feet. Today a more accurate flow estimate is 14 million acre-feet annually. Because of this, the City's Drought Preparedness and Response Plan specifically monitors annual Colorado River conditions for potential impacts on Tucson Water's water supply availability.

It is, however, important to recognize that drought impacts to water supplies typically do not occur without warning, particularly for a water system such as Tucson's. Therefore, attention to and analysis of key drought indicators (such as projections of annual Colorado River flows) allow the Utility to implement staged response actions to avoid reaching emergency conditions. These response actions can vary from mandating reductions in water use to developing alternative water supplies.

Tucson Water's drought indicators are specific to its service area and consist of indices that either describe local or regional drought conditions or reflect potential drought impacts on the Utility's water supplies.

The Utility's regional indicators are:

- Shortages on the Colorado River; and
- The State's drought status for the Santa Cruz Watershed.

Local indicators include:

- Measures of aquifer storage;
- Potable and reclaimed water production capacity; and
- Water use as measured by gallons per capita per day (GPCD).

The upward or downward trends of these indicators act as triggers to initiate the declaration or termination of different stages of drought response within the Tucson Water service area. In keeping with the State's Guidance Document, Tucson Water's drought indicators and response triggers were developed to fit the unique characteristics of the Utility's water resources, water system attributes, and customer-use patterns so the Utility can appropriately respond to potential drought impacts on its water supplies.

Tucson Water's Plan includes four drought response stages ranging from Stage 1 to Stage 4. A Stage 1 drought response is declared based on either one or both of the regional drought indicators. The regional drought indicators include monitoring of local drought conditions and an

associated declaration of drought posted on the ADWR website, or a severe and sustained drought on the Colorado River Watershed as monitored by the U.S. Drought Monitor. These Stage 1 triggers are among the primary “hard line” triggers in Tucson Water’s Plan. Once a Stage 1 drought response has been declared for Tucson Water’s service area, progression through Stages 2, 3 and 4 will be declared based on either threats to Tucson Water’s Colorado River supplies or on local system indicators that signal negative impacts to the Utility’s groundwater supplies. A summary of the drought indicators and response measures for Stages 1 through 4 of the City’s Plan is included in Appendix C.

In addition to the current drought planning efforts, the City of Tucson is beginning to undertake efforts to address the anticipated impacts of climate change on the regional environment and social and economic systems. This area has always experienced periodic drought cycles; however, climate trends toward a warmer environment with less precipitation will amplify the effect of drought events. These future planning efforts will take this combined effect into account.

With drought, we are concerned with water shortages in the whole of the Colorado River basin, as well as with reduced rainfall locally. Climate change will complicate this effect by potentially increasing water use to maintain an adequate quality of life within the community. As temperatures rise, there will be an increase in water use for things such as evaporative cooling, misters, and landscape irrigation. Higher evaporation rates stress plants and result in greater water loss from water features such as pools and fountains. Plants will not only need more irrigation water to survive, but the community may require a significant increase in landscaping to mitigate rising temperatures associated with urban heat island effect. The increase in water use to cool buildings and to make outdoor areas more comfortable through shading and mister use, will not simply be a behavioral choice but may be necessary to address heat stress on residents, particularly the young, old, and other vulnerable populations. Fuel prices will eventually return to, and exceed, their historic highs. The link between fuel costs and food prices means that water use for local, small-scale food production will be an important topic of discussion. At the broader scale of reducing our community’s contributions to greenhouse gas emissions, this region will see a shift towards greater use of renewable energy. At this point in time, the most efficient means of producing renewable energy is through industrial-scale solar thermal facilities, which utilize some amount of water.

Starting in 2009, the City will be working with a 26-member climate change committee to develop a set of recommendations for both reducing local greenhouse gas emissions and for adapting to the climatic and other resource changes that will occur as a result of past world-wide greenhouse gas emissions. Appendix D includes a list of the 26 members and their area of representation. As part of this planning effort, the City will consider how climate change may increase the per capita use of water, how this increased use will be linked to preserving human health and welfare, the need to shift water for purposes of meeting local food and energy needs, and how potential future shortages in water availability can be handled to reduce social, economic, and environmental consequences for our community. Pima County is not a member of this committee, but will be represented at each meeting, will provide technical expertise as needed, will provide input to the committee and the City, and pending a successful process, will consider adopting outcomes of this effort.

In addition to the City’s climate change committee, there is also a study currently ongoing titled "Assessment of Climate Impacts on the Surface Water Resources for Central Arizona". The

main participants are the City of Phoenix Water Department, Salt River Project, Central Arizona Project, the Bureau of Reclamation, City of Scottsdale, Arizona State University, and University of Arizona. Tucson Water technical staff are participating at the invitation of the City of Phoenix Water Department. Phoenix's concerns relate to both the Colorado River Watershed (Central Arizona Project) and the Salt River Watershed (Salt River Project). Tucson is primarily interested in the former.

Another important resource that can be tapped for information on drought and climate change are experts at ASU and UA who are looking to "downscale" selected global climate/circulation models to get a better understanding of what might occur in the Southwest and Arizona and to assess the range of uncertainty in such modeling forecasts. Results from this effort and efforts such as the City's climate change committee, will be available for use by water providers, university researchers, and others to improve drought planning and preparedness. Coordination among the various efforts will be important.

Pima County Plan

Sustained drought conditions affect the ecosystem, agriculture, ranching and urban water supplies. In 2006 the Pima County Board of Supervisors adopted a Drought Response Plan and Water Wasting Ordinance. The drought plan consists of four drought stages that have progressively more restrictive water use measures that apply to unincorporated areas of Pima County. A drought stage may be declared by the Board of Supervisors upon a recommendation from the County Administrator and information developed by the Drought Monitoring Committee. The Drought Monitoring Committee considers the Arizona Drought Monitor Report in recommending drought stages. A declaration by the U.S. Secretary of the Interior of either a shortage on the Colorado River or a curtailment of water delivered through the Central Arizona Project canal to any local water provider may increase the drought level by one stage. If the severity of the drought lessens, the Board of Supervisors may downgrade the drought stage to a lower stage. The Water Wasting provisions of the ordinance prohibit wasteful use of water and include civil penalties for violations.

As discussed previously, Pima County also leads the Local Drought Impact Group (LDIG) for Pima County. To consolidate activities and increase efficiency, the Drought Monitoring Committee functions as the LDIG. Information can be found at <http://www.pima.gov/drought/>. A summary of the drought response measures for Stages 1 through 4 of the County's Plan is included in Appendix E.

In 2007 Pima County, in collaboration with the City of Tucson and other local water providers including Oro Valley, Marana and Community Water Company of Green Valley, declared a Drought Stage 1. For 2008, these entities also continued the declaration of a Drought Stage 1. For Pima County this means the public is asked to reduce their water consumption, restaurants are asked to provide water only on request and hotels are urged to conserve water.

4. Analysis of Plans

The City and County Plans include a number of similarities including:

- Four progressively severe drought response stages with increasingly stringent response measures. The drought triggers in the City and County Plans include both similarities

such as drawing data from the State's Drought Monitoring Technical Team as well as differences related to specific water resource and system characteristics, primarily reflective of the City being a water provider and the County not being a water provider; and

- Drought response measures that focus on public education and awareness campaigns, visible leadership and reducing non-essential uses in the early drought response stages with progressive restrictions, fines and curtailment in the more severe drought response stages. Appendix F provides a comparison of local drought response plans compiled in 2007 just prior to formation of the Pima County LDIG.

The similarities found within the Plans are not merely coincidental. Staff from Tucson Water, Pima County, Water CASA, (whose membership includes smaller water providers in the area-- Oro Valley, Metropolitan Domestic Water Improvement District, Marana, Flowing Wells Irrigation District and Community Water of Green Valley – as well as Pima County) began meeting in April 2006 in an effort to coordinate local drought response plans to the extent possible given the Guidance Document and statutory requirements. Through multiple meetings, it became clear that while efforts to coordinate local drought response were important to the region, the distinct differences in Tucson Water's water supplies and system characteristics must be reflected in the City's drought indicators and triggers incorporated into its Plan in order to meet the State's guidelines. Consequently, although each of the local water providers developed a drought response plan tailored to their system characteristics there has continued to be coordination and cooperation in communicating with the local community. For example, a joint press release was issued in 2007 to explain the drought response plan process and the response stages by entity. Coordination between the City and County continued with the 2008 annual drought monitor report and continuation of Stage 1 response. The 2009 annual drought monitor reports are currently under development with an expectation of no significant changes.

The Pima County Local Drought Impact Group (LDIG) also continues to provide a forum for local water providers and interested parties to discuss coordination efforts for implementation of local drought planning. Pima County staffs this group, coordinating not only with local participants but also with ADWR, and Tucson Water staff is a member.

5. Opportunities for Increased Consistency and Improved Drought Preparedness

The statutory requirements imposed on water providers by the State and the distinct differences in system resources among the local water providers throughout Pima County do not easily accommodate consolidation of City and County drought plans. However, there currently exists considerable coordination and cooperation with respect to drought planning and response through the use of the LDIG, which should continue. In addition to the LDIG, there are several other groups of stakeholders, experts on climate change, and on-going study efforts that can better inform local water providers and public management agencies regarding future uncertainties that could impact water supply and demand and how to prepare for and manage such uncertainties. An adaptive planning approach for improved drought preparedness is necessary, and should include scenario planning.

Local Drought Impact Group (LDIG)

Use of the Pima County LDIG to develop consistent messages regarding regional and local impacts and explaining any "necessary" differences is an important role for this group. The

development of consistent messages will help to avoid confusion among the community. In addition, consistent messages will reduce unnecessary overreaction when unwarranted, and will prevent the community from becoming complacent when additional drought mitigation measures are needed.

Education is also key to preparing a community for the implications of drought. The LDIG should be used to coordinate community education efforts, including a youth education program emphasizing drought and the on the community.

Furthermore, the LDIG should continue to coordinate drought planning and response related ordinances. Just as consistency in messages is important, consistency among ordinances, to the extent possible, is important for community understanding, support, and implementation.

Adaptive Planning and Multi-Pronged Preparedness Strategy

We are in a time of uncertainty with global warming, climate change, and drought potentially affecting local water demand, local rainfall, and future flows of the Colorado River. Recent drought events regionally, nationally and even internationally demonstrate the need for our community to be strategically prepared for sustained drought conditions. Sustained drought coupled with climate change could affect the community's ability to address drought impacts on a social, economic and quality of life basis.

Because of the level of uncertainty we face, an adaptive, flexible, and regularly updated scenario planning approach is needed to ensure we are as prepared as a community for drought in the variety of ways it may get triggered and manifest itself. There is less need for certainty in forecasts than there is for a regularly monitored credible range of possibilities that the utilities and the community can prepare for.

Some examples of various scenarios that could be looked at under this type of planning approach include:

- A decadal or multi-decadal drought like those that have occurred in the past and a combination of climate change events could be evaluated to determine whether the amount of water stored by the AWBA is sufficient to offset large-scale future shortage;
- The capacity of regional infrastructure and locally banked water to respond to sustained drought conditions lasting at least ten years or more;
- California, Nevada and Mexico all experiencing a long term shortage (ten years or more) with curtailments in municipal water deliveries in which the ramifications to our community are examined; and
- More water is needed and local GPCD rates need to increase in the future to mitigate effects of permanent increases in temperature due to global warming and heat island effects.

A multi-pronged preparedness strategy can make the community more resilient to a variety of possible future scenarios and may include such approaches as diversification of water supplies, water demand management (including increasing reliance on locally generated non-municipal delivery options such as water harvesting), and development and maintenance of necessary infrastructure. Elements of this planning approach are already underway. For example, the Central Arizona Project's "ADD Water" process explained in more detail in the Phase I report of

the City/County Water and Wastewater Study is currently considering the feasibility of acquiring, developing and distributing water to enhance the reliability and diversify currently available water sources and to meet future demands. Tucson Water has been an active participant in this process since its inception. The Utility's *Water Plan 2000-2050* also incorporates management of water demand through various tools including water conservation programs and City ordinances to help delay implementation of costly infrastructure improvements and "stretch" the water supplies currently available. Preserving readiness in the groundwater system by regular maintenance on wells, pumps, and reservoirs allows the Utility to bring these facilities into service if needed due to a shortage related to drought. In addition, maintaining adequate and well-functioning recharge facilities such as CAVSARP and SAVSARP, as well as effluent recharge facilities, adds reliability to water supplies in times of drought. Use of scenario planning methods within this multi-pronged approach will further enhance the flexibility of water utilities to respond to drought impacts within the region.

6. Recommendations

- A. Working through the Local Drought Impact Group, continue to improve coordination of drought response across the region by taking specific steps as outlined below:
 - Develop a consistent local definition of "non-essential" uses;
 - Develop consistent drought awareness and response messages for the community;
 - Coordinate community education efforts including a youth education program emphasizing drought and the implications/impacts on the community; and
 - Identify inconsistencies in drought related ordinances and develop a strategy for conformance wherever possible or document the reason for the difference.

- B. In the face of uncertainty related to drought and climate change, the City and County should employ an adaptive planning approach that incorporates the following:
 - Bringing experts together to brainstorm current and future vulnerabilities under a range of scenarios;
 - Scenario planning as a tool to assess the changing planning environment including the potential for extended drought or permanent climate change;
 - Periodic review and frequent updates to the Drought Response Plans to incorporate the latest information on drought and climate change;
 - Integrating climate change impacts over time to redefine "normal conditions" when assessing drought;
 - Evaluation and consideration of the social and financial impacts of drought on the utilities and their customers and ways to address them; and
 - Employing conservative approaches and a multi-pronged preparedness strategy that includes diversification of water supplies, demand management, and development and maintenance of necessary infrastructure to preserve options for the future.