City/County
Water and Wastewater Study

Date: July 8, 2009

To: City/County Water and Wastewater Study Oversight Committee
From: C.H. Huckelberry
County Administrator

Re: Integrating Land Use Planning with Water Resources and Infrastructure Technical Paper

Background

The last technical paper, titled Location of Growth, Urban Form, and Cost of infrastructure, examined the impact of urban form on things like the cost of new roads, types of transportation modes and housing choices available, and water, energy, and land consumption. The recommendations called for the City and County to work jointly to identify growth areas in future land use plan updates, and to jointly develop public infrastructure and financing plans for these growth areas. The specific issue of integrating land use planning with water resources and infrastructure planning inside and outside of such growth areas was deferred to the attached Technical Paper since the topic deserves a significant amount of discussion in and of itself.

The Disconnect Between Land Use Planning and Water Resources and Infrastructure Planning

Historically water resources and infrastructure planning has not been considered with land use planning. While “water resources and infrastructure” can be defined as potable, reclaimed, wastewater, and stormwater, this Technical Paper focuses mostly on the potable water and potable water infrastructure disconnect with land use planning. Far fewer parties are involved in providing reclaimed, wastewater, and stormwater services and infrastructure, as opposed to potable water services, and the City and County already consider these types of water resources and infrastructure impacts when evaluating individual development requests. Therefore there should be no reason why the City and County can’t take simple steps to ensure that planning for these types of water resources and infrastructure is considered as part of long-range land use planning as well.

Potable water resources and potable infrastructure planning, however, has been much more difficult to integrate with both long-range land use planning and individual development decisions because we have numerous water providers, both public and private, with numerous service area boundaries, and more times than not the service area boundaries do not line up with the boundaries of those responsible for land use planning and decision making (cities, towns, and counties). The situation is further exacerbated by the Central
Arizona Groundwater Replenishing District (CAGRD), which was created by the State Legislature to allow development to occur in areas without access to renewable water resources, by requiring that replenishment of water occur but not that it occur in the same location as the pumping. This historic disconnect between land use planning and water resource and infrastructure planning has a number of negative impacts, including (1) continued groundwater level declines impacting both existing residents, customers, businesses, and the environment; and (2) the stimulation of growth in places that lack adequate water infrastructure, as well as other types of public infrastructure and services, causing costly impacts to local governments, other service providers, and existing tax payers.

While this is a regional problem, regional solutions have not been forthcoming, and therefore the City and County are taking a first step to do what we can within our own level of authorities.

What have the City and County been doing to address this disconnect?

Over the past couple of years the City and County have both taken steps to begin to better address the land use and potable water resources/infrastructure disconnect.

City Interim Water Service Policy: The City instituted an interim moratorium on extending water service beyond the existing Tucson Water obligated service area until the impacts of such actions to existing and future obligated customers, and to future land use planning decisions, could be fully analyzed. This provides the opportunity to develop criteria to inform the Mayor and Council if and when it is in the interest of the City, Tucson Water customers, and the broader community, to commit water resources and infrastructure outside of the service area.

The City realizes that this policy does not prevent addition development from occurring outside of the service area. Developers are often able to find alternative access to water. Since Tucson Water is the only water provider currently delivering Central Arizona Project (CAP) water via their recharge and recovery infrastructure, these new developments outside of the service area may be contributing to continued groundwater declines and the adverse impacts associated with continued groundwater declines.

Tucson Water Checkbook: The City has also instituted a method referred to as the “water checkbook” to track and communicate to Mayor and Council and the public how much renewable water Tucson Water has available to support proposed new developments or businesses. Renewable supplies are defined as wet-water supplies that are annually renewable and that can be used in Tucson Water’s potable and reclaimed water systems.

Amendment to the Water Element section of the Pima County Comprehensive Plan: The County adopted an amendment to the Water Element section of the Pima County Comprehensive Plan. This Amendment provides the Board of Supervisors, as the decision makers regarding land use changes in unincorporated Pima County, additional information regarding water resource impacts when considering individual development proposals. This includes whether the proposed development will have access to renewable water supplies, where pumping is proposed in relation to where recharge is proposed, and whether groundwater dependent ecosystems would be impacted. What this amendment does not include is policies requiring a similar water resource analysis in long-range land use planning efforts that should occur way ahead of growth and individual development requests.
What more can the City and County do regarding this disconnect?

The City and County already consider potable, reclaimed, wastewater and stormwater resources and infrastructure needs at the scale of individual development requests. However, it would be more effective if the City and County also considered water resource and infrastructure availability and impacts much earlier in long-range land use planning efforts. For example, the last Technical Paper called for the identification of agreed upon growth areas in the next City General Plan and County Comprehensive Plans (our long-range land use planning documents). These plans could also include the establishment of sustainability and smart growth goals for the growth areas, followed by land use planning and public infrastructure planning that includes assessments of water resources available to serve the area and the impacts of using these resources, and includes financial planning for public infrastructure.

The County, with one exception, is the regional wastewater manager for Pima County. The City and County are the largest entities in Pima County with responsibility for flood control and stormwater management. The City and County can better coordinate and integrate wastewater infrastructure planning and financing, as well as stormwater management, into long-range land use planning through updates to our respective long-range land use plans and capital improvement plans.

Tucson Water is the largest water and reclaimed water provider in Pima County, and similarly the City and County can better integrate potable and reclaimed infrastructure planning and financing into long-range land use planning for areas within the Tucson Water obligated service area.

The issue then becomes the areas outside of the Tucson Water obligated service area. Tucson Water has a significant share of CAP water, along with a significant share of reclaimed water, and has developed the infrastructure necessary to recharge, recover, treat and deliver such water throughout most of the Tucson Basin. Other water providers either lack renewable water supplies, or lack the infrastructure to deliver renewable supplies, and therefore development occurring within and outside of other water providers' service areas may be contributing to continued groundwater declines. Tucson Water may have the ability in some cases to provide solutions to this problem by extending services, wheeling and/or recharging other water providers' shares of CAP or reclaimed water. In Phase 1 of this Study, the Committee was presented with information on "when" Tucson Water would need the next bucket of water to sustain a growing population. While that date changes from one scenario to another, and in some growth scenarios (see previous growth technical paper), no new water is needed, there seemed to be agreement that the next bucket of water would cost significantly more than our existing water resources. So the question becomes how does Tucson Water helping to address regional water resource issues affect the need for, timing of and quantity of new water that may need to be acquired and could the be done in a way that would not adversely impact existing Tucson Water customers financially?

Several criteria are discussed in this Technical Paper to assist the City in evaluating individual requests to Tucson Water to extend services outside of the existing obligated service area, as well as to assist the City in considering in long-range land use planning efforts whether to serve large areas not yet requesting service:
1. Is the proposed new development or new customer within a suitable growth area or infill into the existing built environment?
2. How will the addition of more customers impact the need to acquire additional water?
3. Will the proposed new development be fiscally sustainable from a public service and infrastructure standpoint?
4. Is the timing of development in this area logical considering City and County planned infrastructure, and land ownership patterns?
5. Will the proposed new development create new jobs and economic opportunities?
6. Will the development be designed to include smart growth and sustainable urban form concepts?
7. What are the implications of the water service options for this proposed new development if Tucson Water declines service?

Regarding criteria No. 2, how the addition of more customers may impact the need to acquire additional water, this Technical Paper does discuss a way to generate new water resources outside the Tucson Water obligated Service area in agreed upon growth areas to reduce the impacts of these new demands for water. In order to minimize the water demand impacts for new development, the City and County could explore opportunities to work cooperatively in agreed upon growth areas to develop and operate reclaimed water systems and recharge facilities at County sub-regional wastewater reclamation facilities. This would improve potable, reclaimed, and wastewater resource planning by taking a full-cycle water planning perspective, including making suitable use of locally generated effluent and reclaimed water resources.

What other solutions exist to this problem that would necessitate the cooperation of others in the region?

Expansion of CAP infrastructure: The hydrological disconnect between where water is being pumped and where it is being replenished is due largely to the fact there is a shortage of pipelines and recharge facilities in areas experiencing high growth pressures and subsequently high groundwater withdrawals. These areas are generally located in the Vail/Southeast area, Green Valley/Sahuarita area, and Oro Valley/northwest area. This Technical Paper discusses efforts by other water providers and users in the region to extend CAP pipelines and develop the infrastructure necessary to recharge, recover and deliver CAP water to alleviate groundwater pumping. These water providers and users include Metro Water, Oro Valley, Marana, Flowing Wells, Community Water Company of Green Valley, Farmers’ Investment Corporation (FICO), and Augusta Resources/Rosemont Mine. It does not appear that water providers and users in the Vail/Southeast area are considering similar investments. It is estimated in this Technical Paper that the costs to develop this infrastructure could amount to at least $380 million, and could be higher since not all of the planning efforts address comprehensively the need for replenishment facilities. Discussions of these planning efforts are occurring within the Southern Arizona Water Users Association and the Upper Santa Cruz Providers and Users Group, and should be incorporated into future land use planning efforts.

Legislative changes to CAGRD: The CAGRD was created by the State Legislature to allow development to occur in areas without access to renewable water resources. Legislative changes to the CAGRD, including efforts to mitigate the effects on groundwater supplies by
requiring the replenishment occur closer to the areas of withdrawal, are necessary in order to integrate land use planning and water resources planning.

**Summary and Recommendations**

The traditional model of not including water resources and water resource infrastructure (including potable, reclaimed, wastewater, and stormwater) when planning for or considering proposals for new development, has led to continued groundwater level declines and the stimulation of growth in places that lack adequate water infrastructure, as well as other types of public infrastructure and services, causing costly impacts to local governments, other service providers, and existing tax payers. Although the City and County have both recently taken steps to begin addressing this issue, and both include these considerations in evaluating individual development requests, more can be done to improve long-range land use planning well before individual development requests are made.

Recommendations to address the need for better integration of water resources and infrastructure planning and land use planning are as follows:

1. The City and County should identify agreed upon growth areas in upcoming City General Plan and County Comprehensive Plan updates, and include policies for these growth areas requiring the (1) establishment of fiscal, environmental and urban form sustainability goals, (2) coordinated, advanced land use planning, (3) water resources planning, including the availability and impacts of providing potable, reclaimed, wastewater and stormwater services within these areas (3) other public infrastructure and service planning, and (4) financial planning and phasing of infrastructure, ahead of development pressures. For infill areas, policies should focus on planning for and funding needed investments and improvements that must go along with higher densities and redevelopment. The City and County should also review the elements in the General Plan and Comprehensive Plan, and makes sure each are consistent with each other to the maximum extent possible.

2. The County should continue to implement the recent amendment to the Water Element of the Comprehensive Plan therefore providing the Board of Supervisors with the necessary water resources information concerning individual development requests.

3. The City should consider the following criteria (described further in the paper) in evaluating individual requests to Tucson Water to extend services outside of the existing obligated service area, as well as to assist the City in considering long-range land use planning efforts whether to serve large areas not yet requesting service.
   - Suitable growth area or infill into existing built environment
   - Affect on water resources
   - Fiscal sustainability of development
   - Appropriateness of timing/phasing of development
   - Economic impact/benefits
   - Urban form sustainability
   - Environmental implications of no service

The City should also continue to implement the “water checkbook” method of communicating to Mayor and Council how much renewable water Tucson Water has available to support proposed new developments or businesses.
4. Outside of the Tucson Water Obligated Service Area, the City and County should explore the following approaches:

- To help generate new water resources outside of the Tucson Water Obligated Service Area, the City and County should work cooperatively to explore, in agreed upon future growth areas, the development and operation of reclaimed water systems and recharge facilities at the County's sub-regional wastewater reclamation facilities.

- The City should continue to pursue discussions with other water providers regarding potential to wheeling and/or recharge agreements.

- The City and County should work with other jurisdictions and together support regional solutions, such as the expansion of CAP infrastructure and legislative changes to the CAGRD, if such efforts are comprehensive and would result in addressing the hydrological disconnect between where water is being pumped and where it is being replenished.

Richard Miranda, Deputy City Manager
Nicole Ewing Gavin, Assistant to the City Manager
Jeff Biggs, Director of Tucson Water
Chris Avery, Acting Deputy Director, Tucson Water
Sandy Elder, Acting Deputy Director, Tucson Water
Albert Elias, Director, City of Tucson Housing and Community Development Department
Leslie Liberti, Director, City of Tucson Office of Conservation and Sustainable Development
John Bernal, Deputy County Administrator - Public Works
Mike Gritzuk, Director, Regional Wastewater Reclamation Department
Suzanne Shields, Director, Regional Flood Control District
Carla Blackwell, Deputy Director, Pima County Development Services
Arlan Colton, Pima County Planning Director
Melaney Seacat, Project Coordinator, City/County Water and Wastewater Study
Nicole Fyffe, Executive Assistant to the County Administrator
City of Tucson and Pima County
Integrating Land Use Planning with Water Resources and Infrastructure
Technical Paper

July 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, Planning, and City Manager’s Office; Pima County – Regional Wastewater Reclamation Department, Regional Flood Control District, Planning and Development Services, and County Administrator’s Office.
The scope of work for the Joint City of Tucson/Pima County Water and Wastewater Infrastructure Supply and Planning Study states that land use planning must be integrated with water resources and infrastructure planning for each jurisdiction. A lack of integration in the past has contributed to the lack of infrastructure and other water problems we see today.

The following excerpts from the Committee Themes section of the Phase 1 Report provides further guidance for this technical paper:

In the past, our land use planning efforts have been incremental and site specific, rather than comprehensive and regional. We have not directed growth, but have responded to demand for it. Water and wastewater infrastructure have followed suit, extending service based on demand. It is difficult to develop answers about how and where growth should occur based simply on water supply because, while we do have limited water supplies, more water can be acquired at a cost if growth is desired. Water is part of the equation, but not the only driver or limiting factor determining growth. We must plan for and direct growth considering a wide array of factors (environment, transportation, public services, infrastructure, etc.), of which water is one, albeit critical, factor. Such planning could then guide our water and wastewater service extension decisions.

The definition of the Tucson Water service area has implications for many things. The Committee recognizes there are both positive and negative impacts of limiting service. Examples of specific questions that need to be addressed include how areas outside the obligated area will get water if not from Tucson Water, and what financial implications there are for Tucson Water's current ratepayers if service is extended, and as a result, new water resources need to be acquired.

A pumping/re-charge disconnect is created by the State’s Assured Water Supply (AWS) rules and the CAGRD (Central Arizona Groundwater Replenishment District) under which water can be pumped in one location while it is recharged in another location – negatively impacting environmentally-sensitive locations where the water is pumped. While this regulatory structure is the purview of the State, there are steps we can take locally to address the problems. This is an issue for the Tucson AMA, not the Tucson Water Service area per se and must be addressed regionally.

This paper addresses these issues by examining:

1. The land use and water resources planning disconnect
2. Land use planning and water resources within the Tucson Water obligated service area
3. Land use planning and water resources outside the Tucson Water obligated service area
4. Development/water service case studies
5. Opportunities and challenges to addressing the land use planning/water disconnect
6. Recommendations for better connecting land use planning with water resources and infrastructure
1. The Land Use and Water Resources Planning Disconnect

Water and growth are linked in a “chicken or egg” relationship. Does the availability of water drive growth or does growth drive the need for water? Clearly, the availability of water is a basic necessity for new development to occur, but there are often many options for new development to obtain water. Water service may be available from a municipal or private water provider, by drilling a well and pumping groundwater, or for small-scale developments, trucking in water or relying on rainwater harvesting. On the flip side, making water service available by extending water infrastructure can help encourage growth in a particular direction (“build it and they will come”). It is also important to note that a lack of groundwater or surface water resources have not necessarily prevented many urban areas from expanding (e.g. Las Vegas) as communities have found ways to overcome the financial and physical obstacles to securing additional water supplies.

The Study scope of work refers to a 2007 report by the University of Montana called Bridging the Governance Gap: Strategies to Integrate Water and Land Use Planning. The report, which is posted to the Study website, describes the fact that land use planning and water planning have typically occurred separately from one another. In many cases, water rights and allocations are made by state agencies and land use planning authority resides locally. In Arizona, both the State and local governments play a role in water and land use planning. At the local level, there are multiple land use authorities and water providers.

As the City of Tucson and Pima County develop, it is becoming increasingly important to consider the localized effects of land development on water resources. The adverse effects of urbanization on water resources is well known and can include subsidence, habitat loss or degradation, incised channels, groundwater contamination, and higher incidence of flooding, among other things. Developing and applying principles for integrated water resources and land use planning can reduce the adverse impacts of development.

The framework for examining the topic of integrated land use and water resources planning encompasses a comprehensive set of best practices within the land use planning and water resource planning arenas. Land use planning based on smart growth practices can be applied at various scales of development and include such practices as compact, mixed-use, transit oriented, pedestrian friendly development resulting in fewer car trips and vehicle emissions, more efficient water use, and minimization of urban sprawl. A best practice within the water resource planning field is to evaluate the entire life cycle of development and its use of water resources, considering the potable, wastewater, and stormwater as an integrated set of systems.

In this region, most of the constraints to integrated water resources and land use planning stem from the disconnect with potable water, and in particular, the availability and access to renewable water resources to serve new growth. As such, this paper recognizes the comprehensive nature of the topic but it focuses primarily on the relationship of potable water resources and long range land use planning.

In this region, the availability wastewater infrastructure is a stronger determinant than water service of where growth is likely to occur due to the fact that, with minor exception, there is basically one wastewater manager in the area – Pima County, and new development at densities greater than 1 house per acre are required to connect to this public wastewater system. In addition, the County is able to deny wastewater service, and this can be a strong deterrent to development occurring. Wildcat development and subdivisions occurring at densities at 1 house per acre or lower do occur, and are permitted to rely on septic systems as opposed to the public wastewater system. However, these occur less frequently than higher density developments.
In an ideal world, growth would take place in areas that have been determined to be most suitable for development, with minimal impact to the environment, making use of renewable water resources, near existing infrastructure, with adequate services and facilities, and being as self-sustaining as possible from a fiscal and resource perspective. In some cases, development does occur in locations determined best for growth. However, other factors influence the location for development. These factors include the cost of the raw land, the availability of large parcels of vacant land, land ownership patterns, the anticipated cost to properly entitle the land for development (e.g., proper zoning, the anticipated degree of support from neighboring parcels), the degree of government regulation tied to the land (e.g. development standards), the environmental issues associated with the site/location, and the cost to bring the necessary infrastructure to the development site. All of these factors are analyzed to compare the expected profitability of developing in various locations. Growth will seek the path of least resistance – vacant land with minimal cost and the fewest obstacles.

The previous technical paper, *Location of Growth, Urban Form, and Cost of Infrastructure*, identified areas within or adjacent to the City of Tucson that are most suitable for new development and discussed what form this growth might take from a sustainability perspective. Our water resources and infrastructure should help shape and be shaped by the community’s vision in these areas.

Market forces and state and local government regulations affect where and how growth occurs. Arizona, like many western states, was founded on the rights of individuals and their ability to control their land. This history has resulted in a land use regulatory environment that is not as strong as other states that have been more successful in directing growth. Arizona state law limits local governments’ ability to regulate land use and direct growth. Arizona law tends to favor private property rights, and regulations such as Proposition 207 may limit the ability of local governments to regulate growth. Arizona water law also plays a large part in where and how we grow. Under the State’s Assured Water Supply (AWS) rules, the Central Arizona Groundwater Replenishment District (CAGRD) allows new development to pump groundwater virtually anywhere in the Tucson Active Management Area that it is physically available. This “easy” access to water hurts the local government’s ability to direct growth to the more preferred locations. These factors (strong property rights atmosphere, strong property rights laws, and easy access to water) result in more of a “free market” environment that makes tying land use and water resource planning together difficult.

It is also important to recognize that in this region development occurs at varying levels of regulation, from unregulated wildcat development to development at existing zoning, to development subject to rezoning. The opportunity to regulate and plan for land use and water resource issues differs dramatically across this scale, as do the impacts. Unregulated wildcat development, for example, provides the least opportunity, is often disconnected to potable water infrastructure and on septic systems, and can have the greatest adverse impact from an environmental and cost of public infrastructure and services perspective. Development subject to rezoning provides the greatest opportunity to regulate and plan jointly for land use and water resource issues, and the greatest opportunity to avoid adverse environmental and cost of public infrastructure and services impacts.

So what are these adverse environmental and cost of public infrastructure and services impacts associated with the disconnect land use planning and water resources planning? From an environmental perspective, growth has taken place in areas where loss of surface water flow due to groundwater depletion and continued overdraft has negatively impacted riparian systems. With the proliferation and deepening of wells, groundwater levels have continued to decline in certain areas of the community because of (1) a lack of access to renewable water resources; (2) an imbalance between where pumping occurs and where recharge occurs, and (3) a lack of infrastructure that could address these problems. Property owners, developers and/or water companies often sink wells to
serve new development without connecting to existing water infrastructure and without considering the potential impacts to water quality and water supply.

For example, the ability to continue wildcat development and development at densities low enough to rely on septic far from existing water and wastewater distribution systems can depending on its location negatively impact water quality, water supply options, groundwater levels and access to renewable water resources. Additionally, the lack of wastewater infrastructure in these areas limits the region’s ability to reclaim water for future beneficial uses such as to replenish depleted aquifers, support environmental restoration, replace groundwater for turf irrigation, or provide a supplemental source for landscape irrigation.

From a fiscal perspective, the disconnect between potable and wastewater service decisions from long-range land use planning in particular, has led to growth in areas that are not necessarily desirable in terms of infrastructure and public services. Growth has occurred in areas without adequate roads, parks, stormwater and flood control facilities, libraries, and public safety facilities and without the tax base and revenue sources to pay for this infrastructure nor the ongoing public services needed to serve these areas. This has resulted in a situation where local governments are continually playing a game of catch up to supply adequate infrastructure and provide the necessary public services. Public dollars must be re-directed from existing built areas to these newer areas, depleting the existing areas of funds for infrastructure improvement and services. This scenario is often referred to as “existing residents subsidizing growth.” It is important again to recognize though, that the ability to recover costs for infrastructure and public services varies considerably based on the type of development and the extent to which it is subject to local regulations. Wildcat development provides the least opportunity to recover costs, therefore requiring considerable service cost subsidies, while development subject to rezoning is often subject to road impact fees, park fees, wastewater and potable water connection fees, etc.

Within the study area, the issues related to land use planning and water resources vary depending on location. The next two sections describe the land use planning/water resource perspective within the Tucson Water service area and outside of this area in unincorporated Eastern Pima County.

2. Land Use Planning and Water Resources Within the Tucson Water Obligated Service Area

This section focuses on the Tucson Water service area depicted in Figure 1 which shows the areas currently served by

![Figure 1](image)
Tucson Water (dark blue) and those undeveloped areas the utility is required by contract or law to serve (light blue). The dark and light blue areas on the map are collectively referred to as the Obligated Service Area, which covers a total area of about 410 square miles. Tucson Water provides service to almost all of the areas within the Tucson City limits plus areas within the towns of Marana, Oro Valley, and South Tucson and in unincorporated Pima County.

From an environmental perspective, there are generally few impacts from the water services provided within the Tucson Water service area, because Tucson Water has decreased its reliance on groundwater with approximately two-thirds of its current supply now coming from recharged Colorado River water. Because of Tucson Water’s increasing reliance on Colorado River water and Tucson Water’s recharge and recovery efforts, it is likely the proposed developments within the Tucson Water service area will not contribute to groundwater level declines.

However, water planning and land use planning are not necessarily well-coordinated in this area. Water service decisions are made by Tucson Water while land use planning decisions and development review authority within this area reside with five different jurisdictions (Marana, Oro Valley, South Tucson, Pima County, and the City of Tucson).

**Water Resources Within the Tucson Water Obligated Service Area**

Tucson Water operates under the Assured Water Supply (AWS) rules which regulate municipal water-resource management in Arizona’s Active Management Areas to ensure that the water supplies supporting developing communities are based on renewable water supplies and not mined groundwater. The City of Tucson first applied for and received a Designation of Assured Water Supply from the Arizona Department of Water Resources in 1998. The City’s AWS portfolio (Figure 2) is based on its physically and legally available groundwater, Colorado River water and effluent supplies.

**Central Arizona Project Water** - The Central Arizona Project (CAP) is the largest source of renewable supply available to Tucson Water. Tucson Water intends to purchase its entire annual allocation of 144,191 acre-feet of water by 2012. The City of Tucson utilizes its CAP allocation through the Clearwater Program of recharge, blending, and recovery.

The Clearwater Program is comprised of three separate recharge facilities and their associated recovery wellfields. CAVSARP (Central Avra Valley Storage and Recovery Project) is permitted to annually recharge up to 100,000 acre-feet of Colorado River water. The CAVSARP boosters are currently being upgraded to increase the facility’s recovery capacity to about 70,000 acre-feet per year. Any water not recovered, up to 30,000 acre-feet, will be held as “banked” water for future needs, e.g. drought, canal outages, or other unforeseen needs. SAVSARP (Southern Avra...
Valley Storage and Recovery Project) currently has 60,000 acre-feet of permitted annual recharge capacity. The completion of additional wells, pipelines, a reservoir/booster station, and large-diameter recovery water transmission mains by 2016, will bring the annual recovery capacity at SAVSARP to well over 60,000 acre-feet per year. Finally, Tucson Water and the Central Arizona Water Conservation District (CAWCD) co-own the Pima Mine Road Recharge Project, near the Central Arizona Project terminus at I-19 and Pima Mine Road. Tucson Water’s Santa Cruz Well Field is located down-gradient of the Pima Mine Road Recharge Project, so that water levels in the vicinity of the well field benefit from recharge at the facility. 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 its Santa Cruz Well Field. This well field may be expanded with additional wells and pipelines. The Pima Mine Road facility offers the Utility important flexibility and storage capacity for managing its water supplies.

With 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, plus additional water supplies that may become available to the utility and the region from time to time, or through additional allocation process, such as the Acquisition, Development and Delivery (ADD) water process. The collective recovery capacities of these facilities will expand as infrastructure projects are completed and potable water demand increases. By 2012, the vast majority of Tucson Water’s demand will be met through delivery of a renewable water supply through Clearwater Program facilities, and by 2016, Tucson Water expects to have excess capability to deliver recovered water to its service area.

**Groundwater** - The Assured Water Supply (AWS) program places a finite cap on the amount of groundwater that can be pumped by Tucson Water without incurring a replenishment obligation. This is referred to as allowable groundwater. Decades of over-pumping the Tucson-area aquifers have resulted in significant water-level declines and loss of riparian habitat. During the transition from a groundwater-based supply to Colorado River water-based supply, Tucson Water has continued to debit its allowable groundwater credit account. But the annual rate of groundwater use has steadily declined as the use of renewable supplies has increased. Tucson Water’s objective is to reduce groundwater pumping to a more hydrologically sustainable level. For the Utility’s efforts to have the most impact, other local groundwater users will also need to work to ensure the regional aquifers will provide a sustainable supply. A best practice of water management is using surface and groundwater supplies in hydrologically sustainable ways over the long-term.

In 2005 the Arizona Legislature passed a bill that places constraints on the ability to drill “exempt” wells within the service area of a water provider, like Tucson Water that holds an Assured Water Supply designation. This was an important step toward managing the proliferation of new, unregulated demands on the local aquifers.

Tucson Water will continue to rely on local groundwater resources and its five well fields as an important supply source because it will provide supplemental water to meet peak demand during the hottest months. It will also provide a source of supply when demand exceeds currently available renewable water resources or as a backup supply when there is a sufficiently large Colorado River water shortage which would reduce the City of Tucson’s access to its annual CAP allocation.

**Wastewater, Reclaimed Water, and Stormwater**

Within the Tucson Water Obligated Service Area, Pima County is the regional wastewater manager, Tucson Water is the sole reclaimed water provider, and both Pima County and the City of Tucson manage stormwater within their respective jurisdictions.
Land Use Planning within the Tucson Water Obligated Service Area

Within the Tucson Water service area, land use planning and development review authority reside with five different jurisdictions: the City of Tucson, the City of South Tucson, the Town of Marana, the Town of Oro Valley and unincorporated Pima County. While the majority of the Tucson Water service area lies within the City of Tucson, this jurisdictional split makes it challenging to link land use planning and water resource planning.

Within the City of Tucson’s land use authority, there are currently three primary ways that water service and land use planning are linked: the City’s General Plan, the interim water service policy, and the Tucson Water “checkbook”. Each is described below.

City General Plan - The City’s General Plan includes a Water Resource element, a Growth Area element, and a Land Use element that relate to the land use planning/water resource issue. The upcoming update to the Plan provides an opportunity to further strengthen these elements, and in particular to strengthen the link between long-range land use planning and water resources.

The Water Resource element includes:
- Implement conservation programs that meet state regulatory requirements, minimize the need for new water sources and reduce water waste;
- Include conservation of water resources in plans and policies to guide land use decisions and protect natural ecological systems;
- Implement Floodplain and Erosion Hazard Area Regulations to maintain drainage patterns and hydrologic and hydraulic processes and conserving groundwater recharge; and
- Implement the provisions of the Watercourse Amenities, Safety, and Habitat (WASH) regulations to promote opportunities for groundwater recharge along certain washes within the urbanized area and protecting vegetation that supports wildlife;
- Policies to coordinate regional water related communications and cooperation;

The Growth Area element includes:
- Promote strategically located mixed-use activity centers and activity nodes in order to increase transit use; reduce air pollution; improve delivery of public and private services, and create inviting places to live, work, and play.
- Support development which utilizes existing facilities and which minimizes the need for additional public facilities.
- Support compact development patterns which minimize the need for additional public facilities.
- Investigate the establishment of a "Concurrency" ordinance, an "Adequate Public Facilities" ordinance, or a "Service Area Boundaries" ordinance to require public facilities to be in place or to be properly phased to meet the demand of new development.

The Land Use element includes:
- Promote regional land use planning and coordination within metropolitan Tucson to provide more livable communities and more compact and integrated land use patterns.
- Promote the development and adoption of a regional land use plan that defines priority development areas to balance economic and environmental values.
- Develop coordinated growth management plans to guide future development to areas that are served by existing infrastructure to foster contiguous development and infilling and to protect environmentally sensitive areas.

Urban Landscape Framework:
- Recognizing the landscape connections to the quality of life within the City, the greater Tucson region, and need to interface with Pima County’s Sonoran Desert Conservation objectives, Mayor
and Council endorsed the Urban Landscape Framework in March of 2008. The goals of the Urban Framework are to (1) advance the City’s General Plan, (2) increase understanding of urban ecology, (3) examine and make choices about Tucson’s natural and cultural landscape and (4) chart a course of action fostering civic health and environmental, social, and economic sustainability. The actions in the Framework begin to address the benefits of increased water conservation through reduced water demand, storm water management and rainwater harvesting by:
- Strengthening interdepartmental communication and cooperation;
- Improving departmental standards and practices, and;
- Promoting inter-jurisdictional and regional coordination.

Interim Water Service Policy - Tucson Water’s interim water service policy brings land use considerations into water service decisions recognizing that the past demand-based service expansion has not been sustainable from a land use planning perspective. The interim policy states that Tucson Water will not provide service outside of its obligated area until further guidance is provided by this Study. When extending water service outside city limits the City needs to make sure it is not inadvertently perpetuating an unsustainable fiscal and public service situation for City residents as well as the implications for future water supplies.

Tucson Water’s Current New Area Development Process

Proposed new development within Tucson Water’s Obligated Service Area must receive a Water Assurance Letter from Tucson Water in order to proceed through the development review process. Within the obligated area, Tucson Water must provide service on an equal basis to all; this obligation may be predicated on availability of supply and upon compliance with the City’s General Plan.

As shown in the Figure 3, once a parcel receives a Water Assurance Letter, the developer can proceed with submitting plans for review by Tucson Water staff. The first plan is a master plan, which hydraulically models the existing and proposed water infrastructure to ensure adequate water pressures and fire flows will be obtained. Following the master plan approval, a design plan, also known as construction drawings, are submitted and reviewed for code and specification compliance.
**Tucson Water “Checkbook”** – In 2008, the City of Tucson’s Mayor and Council adopted a method to track how much water was available to support new development within the Tucson Water Obligated Service Area. The so-called “water checkbook” shows the volume of total renewable supplies owned or controlled by the City (“checkbook deposits”), the volume of water that is currently delivered to customers or held in reserve for approved developments (“checkbook debits”), and the volume remaining that is available to new customers (the “checkbook balance”).

Renewable water resources (the “deposits” in the water checkbook) were defined as those wet-water supplies that are annually renewable and that can be utilized in Tucson Water’s potable or reclaimed water systems.

The “debits” in the water checkbook consist of the amount of water that is actually delivered to Tucson Water customers, plus the amount held in reserve for approved future developments. This held-in-reserve amount reflects the aggregate demand of all proposed developments that had a current water assurance letter, master plan, or development design in process. The total checkbook debit amount (reflecting actual deliveries plus the held-in-reserve amount) was 129,000 AF in 2007 and 127,000 AF in 2008.

The resulting “water checkbook balance” reflects the total renewable water resources (the deposits) minus the amount delivered to Tucson Water customers and the amount held in reserve for approved future developments (the debits). As shown in Figure 4, the potable checkbook balance increased about 2,000 AF from 2007 to 2008 (from 33,157 AF to 35,153 AF) due primarily to a reduction in demand. To put this available amount into context, in the 10 years between 1998 and 2007, Tucson Water’s potable deliveries increased approximately 1,200 AF each year (beginning in 1998 when 111,000 AF was delivered).
The water checkbook provides a simple annual snapshot for water planners, the Mayor and Council, and the public, of available renewable supplies vs. recent demand and active development requests. The checkbook “balance” will change over time to reflect the results of whatever policy the City of Tucson has adopted with respect to growth, expansion of the Tucson Water system, and acquisition of new water resources. The checkbook does not drive growth policies, but will help inform it, in the same way that a gas gauge in a car helps the driver to plan accordingly.

Outside of the City of Tucson – For areas inside the Tucson Water Obligated Service Area, but outside of the City of Tucson, there are four other governing bodies have authority over land use decisions (Oro Valley, Marana, South Tucson, and Pima County). But due to the City of Tucson’s current Interim Water Service Policy, the relationship between land use decisions made by these three other governments within the Tucson Water Obligated Service Area is simple in that Tucson Water is the committed water provider. If the City of Tucson changes this policy, it will be important to coordinate water service planning and decisions with these other governments.

3. Land Use Planning and Water Resources in Unincorporated Pima County Outside the Tucson Water Obligated Service Area

This section focuses on water service and land use planning for unincorporated areas that are outside of the Tucson Water Obligated Service Area and within Eastern Pima County. It is development that occurs in this area that is most likely to contribute to ground water declines due to a lack of access to renewable water resources and an imbalance between where pumping occurs and were recharge occurs. Large areas of Pima County are not within a service area of a water provider as depicted in the map to the left. Furthermore, for those areas that are within a service area of a water provider, not all water providers are designated to have an assured 100-year water supply and of those water providers that have assured water supply, only Tucson Water directly utilizes renewable water resources. Consideration of water availability and demand are a crucial element for evaluating...
land development impacts. In considering water resources for development, critical review of both legal and physical access to renewable water are necessary, as well as the impacts from accessing non-renewable water.

In this area, land use planning and regulatory authority resides with one entity, Pima County, however there are multiple water providers in this area and Pima County does not have regulatory authority over water.

**Water Resources**

**CAGRD** - Outside of the Tucson Water obligated service area, new development typically relies on mined groundwater for their water service through enrollment in the Central Arizona Groundwater Replenishment District (CAGRD). The problem is that the CAGRD was created by the Arizona legislature to allow subdivisions with no access to renewable water like CAP water or effluent to continue to grow, while meeting the assured water supply rules. By doing so, CAGRD takes on the obligation to replenish groundwater pumped to serve these areas.

The City and County share three major concerns regarding the CAGRD:
1. While replenishment is supposed to occur close to the area of groundwater pumping, more than often it does not because of lack of recharge facilities in region (see appendix for location of recharge facilities). This hydrological disconnect has led to significant groundwater declines in some areas of region, such as the Green Valley/Sahuarita area.
2. While the CAGRD is obligated to acquire sufficient water resources to meet replenishment obligations, it is unknown how the CAGRD will meet this obligation in the future.
3. It is unknown what the financial implications will be to members from the costs to continue acquiring new water resources for replenishment obligations. There are two membership types – member lands and member service areas. Member lands are typically subdivisions, and the costs to member lands are assessed as a property tax to property owners within these subdivisions. Member service areas are typically municipal water providers or water providers to multiple subdivisions, and the costs to member service areas are assessed to the water providers, who in turn assess the cost to customers through water bills. As costs burdens grow on water customers to pay for the CAGRD, it reduces residents’ ability to pay for other services (public and private), and in the extreme could lead to de-valuing of properties and home foreclosures.

Additional information regarding the differences between member types, current and future costs, replenishment facilities, and strategies by CAGRD to acquire more water, can be found in the Appendix.

**Wastewater, Reclaimed Water, and Stormwater**

Outside the Tucson Water Obligated Service Area, but within Unincorporated Pima County, Pima County managers wastewater and stormwater, and Tucson Water managers reclaimed water.

**Land Use Planning**

Land use planning and development review authority in the unincorporated area outside of the Tucson Water obligated service area rests solely with Pima County which is helpful in terms of developing consistent land use plans and regulations for this area.

The County’s Comprehensive Plan includes four elements (described below) that relate to water resource availability and impacts from accessing those water resources..
The County’s Comprehensive Plan and Water Resources Element - In 2008 the County adopted an amendment to the Water Element section of the Pima County Comprehensive Plan, for the purpose of integrating water conservation into new developments, increasing the use of renewable water resources, reducing the current imbalance that occurs in this community with regard to the location of water pumping and the location of water recharge, and protecting key shallow groundwater dependent ecosystems. Essentially, the Pima County Board of Supervisors will now have additional information regarding water resource impacts of proposed developments, and can use this information to better evaluate requests to increase development intensity especially when such requests are in areas without access to renewable water resources, where water pumping is out of balance with recharge, and where groundwater dependent ecosystems would be negatively impacted. This policy can establish a better link between land use planning and water resource as long as hydrologic assessments and water infrastructure reviews prepared to support this process accurately portray current and anticipated future hydrologic conditions and opportunities for sustainable water service.

For comprehensive plan amendments, staff conducts a water supply impact review to identify pertinent policies that could apply at later stages of land development. These may include policies that promote the efficient use of existing infrastructure and the prudent construction of additional infrastructure needed for a safe, reliable, and renewable water supply, and actions to minimize the adverse impacts of water supply development upon groundwater-dependent ecosystems of Pima County, including springs, perennial and intermittent streams, and shallow groundwater areas.

Applications for significant rezonings are required to include a preliminary integrated water management plan that provides information on the proposed development’s water supply, its potential to impact groundwater dependent ecosystems, its relationship to existing infrastructure and recharge areas, a projected water demand, and water conservation measures.
Section 4 of this Technical Paper describes real life case studies of developments that have been subject to this new Water Resources Element, the policy implications of the water resources proposed to serve each new development, and potential solutions.

Pima County’s Conservation Lands System Environmental Guidelines - The Comprehensive Plan adopted by the Pima County Board of Supervisors in 2001 incorporated the Conservation Lands System (CLS) and the associated environmental guidelines into the land use planning process. The CLS and guidelines were developed to protect the most biologically important areas of Pima County. They are intended to be used to guide private development and public investments in infrastructure to the least biologically sensitive area of the County, and to establish conservation measures to compensate for impacts that do occur within the CLS. Biologically sensitive areas include important riparian areas and areas of shallow groundwater dependent ecosystems.

Public Services and Facilities - The Comprehensive Plan also includes policies specific to wastewater services and stormwater within the Land Use Element. Wastewater policies address requirements to connect to the public sewage treatment and conveyance system, requirements for conveyance system infrastructure to be paid for by private development, capacity requirements, and planning and sizing for future needs. Stormwater policies address protection of natural floodplains and riparian areas, planning and design on a regional master plan basis considering the entire watershed impacts.

Reviews of individual development requests by the County include availability and impacts to water, and wastewater, and stormwater.

Cost of Development Element – The Comprehensive Plan also includes policies within the Cost of Development Element that call for the establishment of Urban Service Areas and Urban Expansion Areas, and that these areas should be established using the existing wastewater infrastructure as a starting point. In addition, the policies go on to state that once build-out projections for these areas have been calculated, level of service standards for public infrastructure should be determined, infrastructure and service delivery capacity should be reviewed, public infrastructure costs should be completed, and this can then be used to establish equitable developer-assessment fees for each area. The County’s planning of the Southwest Infrastructure Planning area (SWIP) followed these policies.

4. Development/Water Service Case Studies in Unincorporated Pima County

The development case studies below are provided to illustrate the review process under the new County Comprehensive Plan Water Resources Element and how the Element was applied to provide the Board of Supervisors information on water resources. Each of these case studies demonstrate the policy implication (ie. how the availability (or lack) access to renewable water resources and water infrastructure impact water resource development) along with potential solutions if necessary. Review comments are provided in the Appendix.

- **Monument West Estates, LLC.** (Comprehensive Plan Amendment) Located along Sandario Road in Avra Valley, the development is within the Avra Water Co-Op service area. The water company lacks an assured water supply, therefore, the developer will need to enroll in CAGRD to obtain a certificate of assured water supply. The proposed development is within one mile of Tucson Water’s Central Avra Valley Storage and Recovery Project and five miles of the CAP Lower Santa Cruz Replenishment Project. Due to the proximity of the recharge facilities, groundwater levels...
have recovered by as much as 75 feet. Avra Water Co-Op has a CAP water subcontract, but does not take direct delivery of CAP water. Therefore the development will enroll in CAGRD as a member land and groundwater will be pumped to serve the development. Policy Implication: The pumped groundwater will be replenished elsewhere in the Tucson basin in spite of the fact the development is physically located in proximity to renewable and potable water supplies. However, this hydrologic imbalance between pumping and replenishment is less of a problem in this location because groundwater levels in the area are recovering due to Tucson Water’s storage and recovery efforts, and the CAP Lower Santa Cruz Replenishment nearby.

- **Pomegranate Farms.** (Rezoning) Located along Valencia Road and south of Ryan Field, the site is not currently within a water provider service area. The development is within 2 miles of major Tucson Water facilities including its Avra Valley Well Field and its Southern Avra Valley Storage and Recovery Project. When presented as a Comprehensive Plan amendment in 2007, the assumption was that Tucson Water would be the water service provider even though Tucson Water officially denied service in October of 2007. With the change in Tucson’s policy for servicing areas outside of their obligated service area, Diablo Village Water Company will now serve the development even though physically available groundwater in the area may be limited. The developer will also need to enroll in CAGRD facilities to obtain a certificate of assured water supply. Policy Implication: without access to renewable resources, the development will contribute to continuing groundwater declines. Potential Solution: One option is for the CARGD to recharge their replenishment water in Tucson Water’s existing storage facilities. However, this could potentially mean less storage capacity would be available at CAVSARP, SAVSARP, and/or the Pima Mine Road Recharge Project to serve the needs of Tucson Water’s existing and future customers. In addition, such an option could limit the ability of the Arizona Water Banking Authority, who is charged with firming the City of Tucson’s CAP allocation, to bank surplus CAP water that would be needed in times of future shortage. This may be particularly important given the longer term water resource uncertainties caused by extended drought, climate variability, and climate change in the Colorado River watershed.

- **Sisters of the Immaculate Heart.** (Comprehensive Plan Amendment) This planned assist living facility is located in the northeast area along Sabino Canyon Road. The development is located within the Metropolitan Domestic Water Improvement District (Metro Water) service area; however, in this area, Metro Water does not currently have access to renewable and potable water supply. Metro Water is actively working with other northwest water providers to have the infrastructure in place to deliver CAP water directly to its customers by 2014 but this development is located in an isolated water service area that will not be directly connected to Metro’s main water service area and will therefore not receive CAP water. Tucson Water’s major service lines cross the property and north of the property, Tucson Water has a storage facility. The depth to groundwater is approximately 50 feet and is likely to support groundwater dependent ecosystems. In addition, there is evidence that this is a shallow perched aquifer. Metro Water’s supply wells are designed to pump from the deeper aquifer to avoid impacts to the shallow perched aquifer. Policy Implication: Without water infrastructure that provides renewable and potable water, the development is likely to pump groundwater without replenishing the groundwater in the same location. While the County would prefer to have water service provided by the utility providing access to renewable water, Metro Water has the service right for this property. Potential Solution: One option is for a wheeling agreement between Metro Water and Tucson Water to allow Metro’s CAP water to be delivered in Tucson Water’s infrastructure.

- **Mission Peaks.** (Comprehensive Plan Amendment) A large (4,217 acres) proposed development located west of Sahuarita on the foothills of the Sierrita Mountains. The proposed development is not currently within a water provider service area but intends to connect to the Rancho Sahuarita...
Water Company. Policy Implication: The water company does not presently have access to a renewable potable water supply. Much of the proposed development would occur on bedrock, and lacks groundwater resources. Potential Solution: The developer intends to work other regional partners to extend CAP pipeline to the Upper Santa Cruz Valley. This is an example where the developer is willing to extend the renewable and potable water infrastructure. The Comprehensive Plan amendment was withdrawn from Pima County and subsequently approved as an amendment to the Town of Sahuarita’s General Plan. The developer is seeking annexation into the Town.

5. Opportunities and Challenges to Further Addressing the Land Use Planning/Water Disconnect

Sections 2, 3, and 4, of this Technical Paper discussed ways in which the City and County have tried to incorporate the availability and impacts of water resources into land use decisions, and some of the obstacles to this. This section describes what more the City and County can to address this issue, and where regional partnerships are needed.

City of Tucson Water Service Policy

In the past, Tucson Water has operated in the context of a large planning area extending service throughout the region based on demand. This approach has led to the ongoing expansion of the service base and has increased the need to focus on the acquisition of new water resources. In an effort to move away from this demand-driven approach, the City of Tucson has implemented an interim policy to provide water service only to its obligated service area, which includes city limits plus the built-out areas of the water system. Before decisions to extend service beyond the obligated area are made, the City needs to understand the economic, social, and environmental implications of extending service. The City understands that not providing service does not necessarily stop growth since developers are typically able to find other access to water. The City also understands that from a regional perspective, there may be negative implications to not extending service since other water companies do not have access to renewable resources and therefore the development will likely contribute to groundwater declines without localized replenishment.

The following factors could be considered in making decisions to extend water service outside of the obligated area, either in response to requests from individual developments or during long-range land use planning efforts. The decision grid shows in which cases the City would definitely provide service,
would not provide service and when these criteria could be applied to determine if water service should be provided. Within the obligated area, Tucson Water must provide service on an equal basis to all, however this obligation may be predicated on availability of supply and upon compliance with the City's General Plan. In areas where Tucson Water is obligated to serve, but the area is not considered to be a suitable growth area, the criteria couldn’t be used to deny water service but could be used to evaluate requests for land use changes.

- **Is the new development within a suitable growth area?** The previous Growth technical report identified four areas most suitable for development – infill into the existing built environment, Houghton Corridor, Southlands and the Southwest area. Some of these areas are within the Tucson Water obligated service area and some are not.

- **How will the addition of more customers affect the need to acquire additional water?** In the four scenarios modeled in the previous growth paper, the population build-out for the Tucson Water Obligated Service Area ranges from approximately 330,000 in the status quo scenario to just over 500,000 in the transit-oriented development model. The Phase 1 report indicated that based on conservative (high) gallons per capita per day numbers, Tucson Water can serve 366,000 more people with currently available renewable water resources. Population build-out is a factor the City of Tucson should consider in deciding if Tucson Water should extend service beyond its obligated area and how this will affect the need for, timing of, and quantity of additional water resources that may need to be acquired.

- **Will the proposed new development be fiscally sustainable from a public service and infrastructure perspective?** The City of Tucson has a concern that when development occurs adjacent to but outside City limits, residents drive into the City and use City infrastructure and services but the City doesn’t receive the full set of revenues needed to pay for this. The primarily services affected are roads and public safety and the primary revenues forgone are property tax, state shared revenue, impact fees, and sales tax. It is in the interest of City residents to look at future growth from a fiscal sustainability perspective, not only how infrastructure needed to serve growth gets funded but how the ongoing provision of public services and maintenance of facilities are funded. The City must ensure that future growth areas are self-sustaining and are not overly subsidized by current residents.

- **Is the timing of development in this area logical considering City and County planned infrastructure and public facilities?** “Leapfrog” development, and development further away from the existing environment is difficult and more costly to serve from an infrastructure and public service perspective compared with infill development and development taking place closer to the existing built environment.

- **Will the new development create new jobs and economic opportunities?** A significant amount of industrial land lies just outside of the City limits along the I-19, Valencia Corridor, and the airport areas. How water will be provided to these areas, and future industrial and economic development hubs must be considered.

- **Will the new development be designed to include smart growth and sustainable urban form concepts?** See the previous growth technical paper for a detailed discussion of this topic.

- **What are the implications of the water service options for this development if Tucson Water declines to serve?** The service policy does not necessarily inhibit growth outside of Tucson Water’s Obligated Service Area. In many areas, developers can seek service from private water companies or drill wells. The down side of this is that these private companies and the
associated growth may not have the infrastructure required to directly utilize renewable supplies in hydrologically sustainable ways. This could require new growth to increasingly rely on the CAGRD, with the attendant possibility that groundwater pumping and aquifer replenishments can occur in locations within the TucsonAMA which are not in hydrologic proximity. As noted below, it is possible that these circumstances could be mitigated through regional wheeling and recharge.

Updates to City General and County Comprehensive Plans

The 2007 report by the University of Montana called Bridging the Governance Gap: Strategies to Integrate Water and Land Use Planning, calls for integrating water resources availability and impacts into individual land use development decisions. Themes identified in the Phase I Report for this study reinforce the need to develop water management models that balance human, environmental and economic needs for water and to strengthen the connection between land use planning, water resources and infrastructure planning. The City and County already include potable, reclaimed, wastewater and stormwater impacts when considering proposals for individual development projects. For the County, wastewater and stormwater impacts have been a standard part of development reviews. For potable and reclaimed water, the County recently improved the process for considering these resources and impacts through an amendment to the County’s Comprehensive Plan Water Element.

But in addition to considering water resources and infrastructure at the individual development decision level, it would be more effective if the City and County also included water resources and infrastructure in long-range land use planning efforts. The City and County will be updating the City General Plan and County Comprehensive Plan (our long-range land use planning documents) by 2011. The last Technical Paper called for these plans to include the joint agreement on growth areas in and adjacent to the City of Tucson. These plans could then also include policies requiring sustainability goals for these growth areas, followed by land use planning and public infrastructure planning that includes assessments of water resources and infrastructure available or needed to serve these areas and the impacts of using these resources, along with the financial planning for public infrastructure.

Sustainability Assessments

Sustainability assessments provide a set of tools for evaluating options for integrated water resource management to help achieve sustainability goals. These methods are applicable at various scales - from comprehensive long range planning, to master planning and infrastructure development projects, to CIP budget development projects. Examples of where they have been applied locally and internationally are provided below.

Southwest Infrastructure Plan (SWIP) - The SWIP planning effort represents a new approach in the County to align infrastructure planning with the County’s sustainability goals. The SWIP effort supported the County’s adopted sustainability goals and principles through the creation of strategies for infrastructure systems and components such as transportation, parks and recreation, flood control and drainage, and wastewater management. The effort included an assessment of needed community supporting infrastructure such as parks, schools, fire, flood control and drainage, wastewater, and urban form issues such as how to encourage mass transit.

The sustainability assessment conducted as part of the SWIP provides a framework with which to evaluate specific development proposals for the southwest subregion from planning through design and construction. In addition to establishing goals and principles, the framework provides a set of
analytic tools for evaluating the efficacy of specific proposals relative to their responsiveness to sustainability policies.

**Australian Sustainability Assessment Framework** - Some promising methods and ideas for how to systematically foster more sustainable and integrated land use and water resources planning can be found in the Australian water industry. In 2008, the Australian Water Services Association published a report documenting their application of a sustainability assessment methodology for evaluating the overall sustainability of alternative options for urban water systems. This includes large-scale options for cities as well as configurations of water sensitive urban developments or single developments. Their sustainability framework is based on best practices in sustainability assessments, including appropriate levels of interaction with public and government stakeholders. Their approach includes both triple bottom line analytic and participatory aspects of sustainability assessment. It employs such analytic tools as life cycle assessment and life cycle costing, ecological footprint analysis, water quality risk assessment, and use of multi criteria assessment and decision aiding as a means for stakeholder engagement.

**Coordinating Water Infrastructure Planning in Suitable Growth Areas**

The Growth Technical Paper looked at population growth, urban form, and land use planning, and presented four potential growth areas within or adjacent to the City of Tucson: Southlands, Houghton Corridor, Southwest Area, and infill and redevelopment. The following discussion reviews these potential growth areas from a water resource and public infrastructure and service perspective. The areas are also contrasted to illustrate how water related infrastructure impact land use.

**Southwest area** - The Southwest Area has been an area of intense, rapid development in Pima County from 2000 to 2007. The area has access to water services by Tucson Water and the Diablo Water and the Pima County Avra Valley Wastewater Treatment Facility. Tucson Water facilities include the Central Well Field, major distribution lines and the planned Southern Avra Valley Storage and Recovery Project. The County recently upgraded the Avra Valley Wastewater Treatment Facility increasing the capacity to 4.0 million gallons/day (MGD). Current demand at the treatment plant is 1.76 MGD.

The critical water resources in the future for this area that have yet to be addressed will be potable and reclaimed water supply. While there is, or will be, major water infrastructure including recharge capacity owned by Tucson Water, much of this area is outside of Tucson Water’s obligated service area and therefore under the City’s current Interim Water Policy Tucson Water will not provide service. The questions then are whether the City will consider applying criteria to determine when to serve in such agreed upon growth areas, will Tucson Water become a provider in this area, and who will develop and operate a reclaimed water system in this area?

**Southlands** - The Southland area currently lacks gravity access to wastewater treatment and conveyance systems. A topographic ridge line separates this area from the metropolitan system and the Corona de Tucson sub-regional treatment facilities lies a significant distant upstream. Tucson Water has well fields in the area and major transmission lines. Pima Mine Road Recharge Project (PMRRP) is located up gradient which is a CAWCD and Tucson developed recharge project. Therefore access to renewable potable water is available, and much of the area includes undeveloped State Trust land that is within Tucson Water’s Obligated Service Area.

---

1 Sustainability Framework: Part A: Methodology for evaluating the overall sustainability of urban water systems, Prepared by: Centre for Water and Waste Technology, University of New South Wales; Authors : Sven Lundie, Nicholas Ashbolt, Daniel Livingston, Elizabeth Lai, Erik Karrman, Jennifer Blaikie and John Anderson, WSAA Occasional Paper No. 17, February 2008
The Verano development is a 5 square mile development proposed within the Southlands area. At buildout the overall target unit count will be 6,847 with a mix of retail and industrial. A total of 955 acres will be set aside primarily for riparian and native plant purposes. As part of the project conceptual plans are being developed to locate and design a wastewater treatment facility that would be partially constructed by the developer, but owned and operated by Pima County. In the future, areas within the Tucson City limits will be served by this treatment plant, including the large expanses of undeveloped StateTrust land. The developer is also planning for a reclaimed water system to serve the development and help restore portions of the Flato Wash area. This would be an opportunity for reclaimed water to be available in the Southlands region and an area for possible collaboration between Pima County and Tucson Water. Recharge is also planned. The development is outside of the Tucson Water obligated service area and therefore Tucson Water has declined to serve. Water service is currently proposed to be provided by Red Rock Water Company.

The southern portion of this area to Wilmot Road has been slated for annexation by the Town of Sahuarita, much of which is also undeveloped State Trust land. Wilmot Road may become more industrial in nature due to land fills, prisons, and airport flight restrictions. The Town does not currently have access to renewable water supplies. East of Wilmot becomes less dense as conservation lands predominate. Corona de Tucson will remain a focus of development with its own wastewater treatment plan and water commitments by Tucson Water.

Houghton Corridor – the HAMP planning area has a projected buildout population of approximately 88,000 people. The area includes a significant amount of State Trust land, and planning of the State Trust land has been put on hold due to the decline in the housing market, and budget cuts to the State Land Department. Much of this area is within the City of Tucson and Tucson Water Obligated Service area, and therefore will have access to renewable water resources. The portions of this area outside of the City and the Tucson Water Obligated Service Area are served by various water companies that do not have access to renewable supplies and therefore pump groundwater. There may be opportunities for Tucson Water and Pima County to jointly develop water, reclaimed water, and water reclamation facilities in this area that are beneficial to both entities.

Infill and Redevelopment – There are areas within the City of Tucson and within Unincorporated Pima County suitable for infill and redevelopment that already have access to sewer and water infrastructure, however rehabilitation and upgrading of these systems over time needs to be planned for and funded.

Maximizing the Use of Effluent at Outlying Wastewater Facilities

To help generate new water resources outside of the Tucson Water Obligated Service Area, the City and County could explore opportunities to work cooperatively in agreed upon future growth areas to develop and operate reclaimed water systems and recharge facilities at the County’s subregional wastewater reclamation facilities. This could increase renewable water resources providing additional water to serve new developments in these areas. This would improve potable, reclaimed, and wastewater resource planning by taking a full-cycle water planning perspective, including making suitable use of locally generated effluent and reclaimed water resources.
Opportunities Requiring Cooperation among Others in the Region

CAP Expansion

Several municipal water providers in the Tucson Active Management Area have a Central Arizona Project (CAP) water allocation. They are Tucson Water, the Town of Oro Valley, Town of Marana, Metropolitan Domestic Water Improvement District, Flowing Wells Irrigation District, Community Water Company of Green Valley, Green Valley Domestic Water Improvement District, Avra Valley Water Co-Op, Spanish Trail Water Company and Vail Water Company. Of these water providers, only Tucson Water is serving CAP water through its Clearwater Program. The remaining water providers are either recharging CAP water or not taking delivery at this time. Opportunities to deliver CAP water are being explored in the Green Valley area and in the Northwest. The price tag associated with the infrastructure needed to take direct delivery of CAP has been the major impediment to direct delivery.

Green Valley CAP Proposals – Extension of the CAP pipeline to Green Valley has been under consideration for some time. In 1998 ADWR commissioned a feasibility study for the construction of a CAP water delivery system that would extend south of Pima Mine Road and deliver CAP water to Green Valley water users. The study evaluated several alignments and cost scenarios ranging from delivery of 13,000 acre-feet to Sahuarita Road to delivery of 88,500 acre-feet to Elephant Head Road. In 2007 Pima County prepared an evaluation of sustainable water supply options in Green Valley, including a review of existing and project water use and updated cost estimates of the 1998 feasibility study estimates to account for inflation. This report estimated that a preferred scenario would deliver 88,500 acre-feet of CAP water at an estimated cost of $120 million or $167 per acre-foot of water delivered. The amount of 88,500 acre-feet is the estimated water needs for all sectors including municipal, turf, metal mining and agriculture.

However, only two municipal water providers, Community Water Company of Green Valley and Green Valley Domestic Water Improvement District, have a CAP allocation. Together, they have a combined CAP allocation of approximately 5,000 acre-feet. The estimated range of capital costs to deliver CAP water to Green Valley is $16 to 34 million. Amortizing these costs and including CAP water treatment and CAP municipal and industrial rates it would cost about $400 to $800 per acre-feet to switch from direct delivery of CAP water in 2005.

By comparison, the costs for Community Water to pump groundwater is $162 per acre-foot and using CAGRD for replenishment, groundwater costs would increase to about $462 per acre-foot. However, because CAGRD’s costs in Green Valley are assessed to the subdivisions as member lands, the CAGRD replenishment costs are paid directly by the homeowners through a property tax assessment.

There are two proposals in the Green Valley area that have been introduced: one from Community Water Company of Green Valley (CWC) and one from Farmers’ Investment Corporation (FICO). Both proposals would extend the CAP pipeline from its present terminus at Pima Mine Road to the Green Valley area. CAP water would be stored underground at either a future underground storage facility or an existing, unused groundwater savings facility and recovered and delivered to water customers.

The CWC proposal consists of a 36-inch diameter pipe that would be regionally owned and provide up to 30,000 acre-feet of CAP water to the Green Valley area. CWC and Green Valley Domestic Water Improvement District have a combined CAP allocation of 5,000 acre-feet. The remaining potential CAP water would from the CAGRD replenishment obligation, excess CAP water and Indian CAP water. This proposal would be funded by Augusta Resource, contributing $15 million for the pipeline.
The second Green Valley CAP proposal, advanced by FICO, would extend the CAP pipeline from the CAP terminus at Pima Mine Road to a groundwater savings facility on FICO properties where CAP water would be used for agriculture in lieu of groundwater pumped. This proposal would be funded by developer interests. Both proposals are under consideration.

Northwest CAP Project - Water providers in the northwest are working on a project to deliver CAP water to their customers by 2014. The water providers, Metro Water, Oro Valley, Marana and Flowing Wells have a combined CAP allocation of 28,000 acre-feet. The project includes treatment, delivery and reliability storage. The providers have conducted pilot studies to select water treatment processes and are conducting a routing study for a delivery system to each of the four water service areas. Estimated capital costs for treatment and delivery are $200 million or $7,143 per acre-foot. The providers are also working with the Bureau of Reclamation for reliability storage for periods when the CAP system is in maintenance. The reliability storage component would be federally funded and the treatment and delivery components would be funded by the participating water providers.

South East-Vail Water Company, whose service area is southeast of the Tucson Metropolitan area, has a 1,857 acre-foot CAP water allocation. Vail stores some of its CAP water at a GSF located northwest of the Tucson Metropolitan area and recovers from groundwater wells within its service area. Vail Water Company is also a CAGRD member service area, so CAGRD can replenish groundwater on behalf of the water company and it includes the replenishment costs in its customers’ water rates. There are no recharge facilities in the vicinity and the CAP canal is 27 miles from the service area. The lack of infrastructure to deliver renewable and potable water means this area must pump groundwater and the groundwater replenishment occurs some distance away hydrologically disconnected from where pumping occurs. The Vail service area is adjacent to Cienega Creek and continued groundwater pumping could impact valuable riparian habitat. An recent estimate (from An Economic Analysis of the Institutional, A Spatial and Temporal Dimensions of the Central Arizona Groundwater Replenishment District: Implications for Arizona’s Water Future by Taylor Shipman, Masters Thesis, University of Arizona, 2008), projected the capital costs to extend the CAP pipeline to the Vail Water service area to range between $25 to $40 million. Amortizing these costs and including CAP water treatment and CAP municipal and industrial rates, it would cost about $2,910 per acre-feet to switch from direct delivery of CAP water in 2005. By comparison, the costs for Vail to pump groundwater is $104 per acre-foot and using CAGRD for replenishment, its groundwater costs would increase to about $500 per acre-foot.

Another alternative to building a direct CAP delivery system to the Vail Service area is to establish a partnership between Vail Water company and Tucson Water to wheel Vail’s CAP water to its service area. Key considerations would include how much Tucson Water would charge Vail to extend its delivery system, to recover the proportionate share of costs from the CAP turnout in Avra Valley, to recharge and recover at CAVSARP and SAVARP and to delivery to the far east end of the Tucson basin. An additional possibility is to partner with Spanish Trail Water Company, who has a 3,037 acre-foot CAP allocation, and attenuate the capital, operation and maintenance costs of direct CAP delivery.

CAGRD was created to replenish groundwater for those that have no access to renewable water. Having the CAGRD in place gives water providers a lower cost alternative as opposed to direct delivery of CAP water. However, as CAGRD’s replenish costs increase and water providers reach ADWR’s maximum groundwater level decline of four feet per year, the feasibility of transitioning to direct delivery of CAP water will improve. The rate at which CAGRD’s replenishment costs increase will influence the transition to CAP water.
Legislative Changes to CAGRD

A legislative proposal, SB1288, was introduced in 2009 to provide the Central Arizona Water Conservation District (CAWCD) the authority to issue revenue bonds to acquire, lease or exchange water to meet CAGRD’s replenishment obligations. Debt service expenses would be paid by the CAGRD members. The development of the legislative proposal involved a stakeholder group that included diverse representation from the Phoenix, Pinal and the Tucson areas. While the proposed legislation provides a financial means for CAGRD to acquire replenishment water, it still does not address the hydrological disconnect between where water is withdrawn and where it is replenishment.

Other potential changes to the CAGRD that local parties in the region could advocate for are:
- Connect CAGRD with renewable water through use of effluent from CAGRD Member Lands or Member Service Areas to meet replenishment obligations.
- Mitigate effects of hydrologic disconnect by 1) locating replenishment closer to pumping or 2) demonstrating that groundwater decline as a result of member pumping will be less than 400 feet in the next 100 years
- Place limitations on enrollment and/or replenishment obligations
- Work with and cooperate with non-members to secure additional supplies
- Conduct more frequent review of CAGRD Plan of Operation to assess that replenishment obligations can be met

Wheeling and Recharge Agreements

Since the early 1980’s, Tucson Water has been planning and building infrastructure for the introduction of CAP water into the Tucson area basin. This infrastructure includes recharge and recovery basins currently permitted to recharge 160,000 acre-feet per year. This infrastructure extends through the southwest area to high in the Tucson Mountains. From high in the Tucson Mountains east to Golf Links and Houghton, northeast to River Rd & Kolb, north into the Catalina Foothills near Sunrise & Swan, north again into the Catalina Foothills near 1st Ave & Rudasill and northwest to Thornydale Rd & Oasis Rd. The planning and building occurred at time when Tucson Water envisioned supplying CAP water to the entire basin. Several entities have subsequently established themselves as alternative suppliers, e.g. Town of Oro Valley, Town of Marana, Metropolitan Water Conservation District, but Tucson Water has nonetheless established major infrastructure capable of delivering water over a large expanse of the Tucson area basin. Presently, the Tucson Water touches the boundaries of all major suppliers in the basin. This major infrastructure plus Tucson Water’s access to groundwater supplies makes Tucson Water a major asset to the Tucson basin in that is can deliver/wheel water over the entire area.

Presently wheeling water through the Tucson Water system to Oro Valley and Metropolitan Water Co. is being considered. The advantage of wheeling water is that major portions of the infrastructure are already in place and available and CAP water is delivered at a relatively high elevation, 2790 feet above sea level. By the year 2012, Tucson Water will fully utilize the recharge/recovery basins. However, with appropriate financial participation, these facilities could be expanded.

State Trust Lands

State Trust Lands have and will shape the manner in which Tucson develops and will play a critical role in land use planning. Currently State Trust Lands can be barriers to development within proximity to existing infrastructure. There is a shortage of private land suitable for development adjacent to existing urban areas and infrastructure. As a result development is occurring in remote areas where there may not be any public infrastructure including water and sewer services. For instance, State
land in the Southlands will not likely develop until Verano, a privately planned development, establishes a wastewater plant and creates value for the State through improvements to Swan Road and Wilmot Road. Consideration should be given to reforming State Trust Land statutes to allow urban design, proximity to infrastructure, and growth area designation to be considerations when Trust Land is slated for urban development. Current statutes do not allow for considerations other than economic value and return to the Trust.

In the future most of the urban development will occur on State Lands; however their allocation of CAP for such development is small, about 10,000 acre-feet/year. Development on State Trust Lands will rely on others, such as Tucson Water, to provide potable renewable water supply.

The Arizona State Land Department’s (ASLD’s) mission reads in part to “enhance the value and optimize economic return for the State Trust beneficiaries.” The ASLD’s planning process focuses on maximizing potential land values which may be at odds with local land use and water resources planning goals. Until the ASLD conducts their formal planning process, it is difficult for local governments to know what, where, and how ASLD intends to develop State Trust Lands. ASLD planning model only considers infrastructure from the point of view of cost per acre or housing unit for the purpose of appraising value and developing profitable land disposal and/or leasing strategies.

There is also significant uncertainty on the location and timing of development of State Trust Lands. ASLD guiding principal is Value Optimization of the State Trust Lands. In simple language this means the it is to ASLD’s advantage to wait to auction their lands until infrastructure has been constructed by others and there is minimum land available for development. It is at this point that the State Trust Lands are at optimal value.

In reviewing potential growth areas, it is important to distinguish between private vacant lands and State Trust Lands. The privately held lands, especially large properties, are most likely to develop in the near future, for example the Verano planned community located in the Southlands Growth Area.

**Wildcat Subdivisions**

Wildcat development within unincorporated Pima County creates significant challenges to land use and water resources planning. Pima County is restricted from regulating lot splits of 5 or fewer lots. This means that this type of development occurs outside of the regulated process, and the County has no ability to encourage appropriate planning for potable water, wastewater, stormwater or reclaimed water, in addition to the other types of public infrastructure that typically supports development (paved roads, parks, libraries, law enforcement facilities etc.) Past studies of these development patterns have found that they provide little in tax revenue to the County, but the residents in these areas still demand services. Until the State Legislature adopts legislation that can assist in bringing such development into the regulated process, the disconnect between land use and water resources planning in these areas will continue.

**6. Recommendations**

In summary, past land use decisions and water resource decisions that occurred without consideration for each other, have contributed to continuing ground water level declines, and have resulted in development occurring in areas that are not fiscally sustainable from a public infrastructure perspective. While the City and County have taken steps to include water resources considerations in individual land use decisions, more can be done to include water resource considerations in long-range land use planning efforts, such as the upcoming City General Plan and County Comprehensive Plan updates. Regarding potable water in particular, multiple water providers, multiple land use
authorities, and State rules governing the Central Arizona Ground Water Replenishment District, make integrating potable water decisions and planning into land use decisions and planning, particularly difficult. Tucson Water is currently the only water provider delivering renewable water resources due to the City’s past investments in CAP water and recharge, recovery, and delivery infrastructure. There are costs and benefits to the City’s current Interim Water Service Policy, and the City could consider adopting criteria regarding if and when Tucson Water should serve outside of the current obligated services area. There are also costs and benefits to Tucson Water entering into wheeling or recharge agreements with other water providers. Efforts in the region to extend CAP infrastructure to address the common hydrological disconnect between where ground water is pumped and where replenishment occurs, are underway, but the cost of this infrastructure has been a major obstacle.

Recommendations to address the need for better integration of water resources and infrastructure planning and land use planning, are as follows:

1. The City and County should identify agreed upon growth areas in upcoming City General Plan and County Comprehensive Plan updates, and include policies for these growth areas requiring the (1) establishment of fiscal, environmental and urban form sustainability goals, (2) coordinated, advanced land use planning, (3) water resources planning, including the availability and impacts of providing potable, reclaimed, wastewater and stormwater services within these areas (3) other public infrastructure and service planning, and (4) financial planning and phasing of infrastructure, ahead of development pressures. For infill areas, policies should focus on planning for and funding needed investments and improvements that must go along with higher densities and redevelopment. The City and County should also review the elements in the General Plan and Comprehensive Plan, and make sure each are consistent with each other to the maximum extent possible.

2. The County should continue to implement the recent amendment to the Water Element of the Comprehensive Plan therefore providing the Board of Supervisors with the necessary water resources information concerning individual development requests.

3. The City should consider the following criteria (described earlier in the paper) in evaluating individual requests to Tucson Water to extend services outside of the existing obligated service area, as well as to assist the City in considering long-range land use planning efforts whether to serve large areas not yet requesting service.
   - Suitable growth area or infill into existing built environment
   - Affect on water resources
   - Fiscal sustainability of development
   - Appropriateness of timing/phasing of development
   - Economic impact/benefits
   - Urban form sustainability
   - Environmental implications of no service

   The City should also continue to implement the “water checkbook” method of communicating to Mayor and Council how much renewable water Tucson Water has available to support proposed new developments or businesses.

4. Outside of the Tucson Water Obligated Service Area, the City and County should explore the following approaches:
- To help generate new water resources outside of the Tucson Water Obligated Service Area, the City and County should work cooperatively to explore, in agreed upon future growth areas, the development and operation of reclaimed water systems and recharge facilities at the County's sub-regional wastewater reclamation facilities.

- The City should continue to pursue discussions with other water providers regarding potential to wheeling and/or recharge agreements.

- The City and County should work with other jurisdictions and together support regional solutions, such as the expansion of CAP infrastructure and legislative changes to the CAGRD, if such efforts are comprehensive and would result in addressing the hydrological disconnect between where water is being pumped and where it is being replenished.