

# Water Resources Research Center

College of Agriculture and Life Sciences, The University of Arizona

## Water Planning for the Tucson Region

Arizona Chapter of the American Society of Farm  
Managers and Rural Appraisers

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## Abstract

Scenarios for meeting the rapidly growing water demands of the Tucson region are presented. Groundwater regulations, recharge, conservation, effluent, renewable water supplies, regional cooperation and cost considerations are discussed.

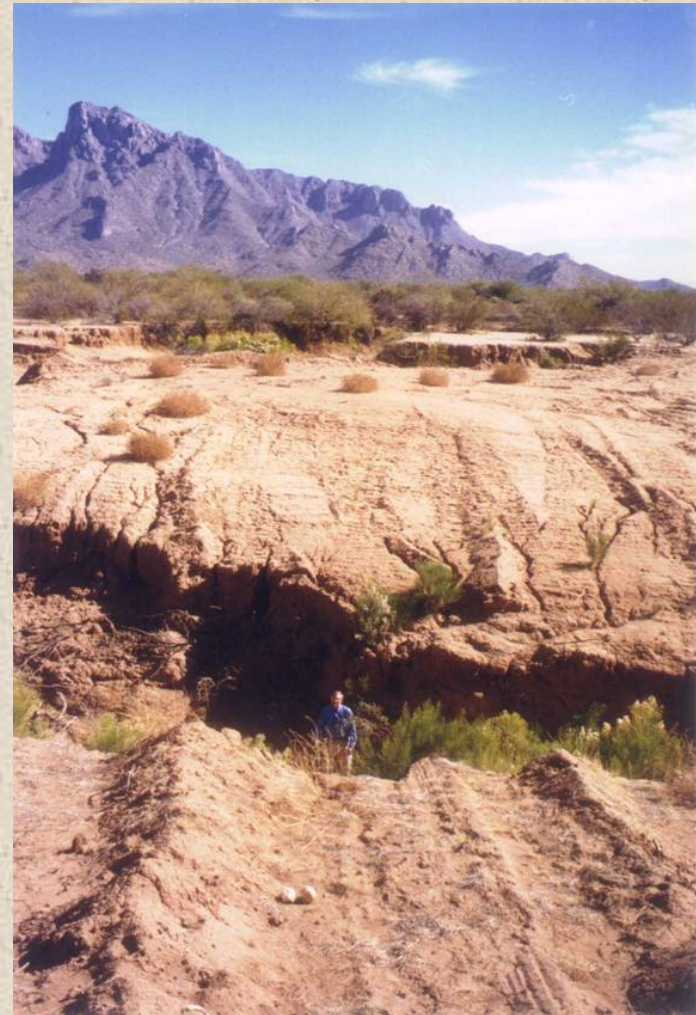
The methodology can be applied to other regions of the state. The study shows that, although there are sufficient water supplies to accommodate growth, the cost of using some of them is not quantified and there are many issues that require resolution prior to utilization of all the supplies.

# Water Resource Planning in the Tucson Region – Providing Context

- Study released July 2006: *Water Resource Availability for the Tucson Metropolitan Area*  
Available [www.cals.arizona.edu/azwater](http://www.cals.arizona.edu/azwater)
- Explanation of water management
  - Assured Water Supply Rules
  - Role of CAP water and recharge
  - The Central Arizona Groundwater Replenishment District  
Regional management considerations
- Water Availability Scenarios Work Sheet, with sensitivity analysis
- Where is the next bucket of water?

# Growth in People and Economic Activity Resulted in Groundwater Overdraft Problem in some parts of Arizona

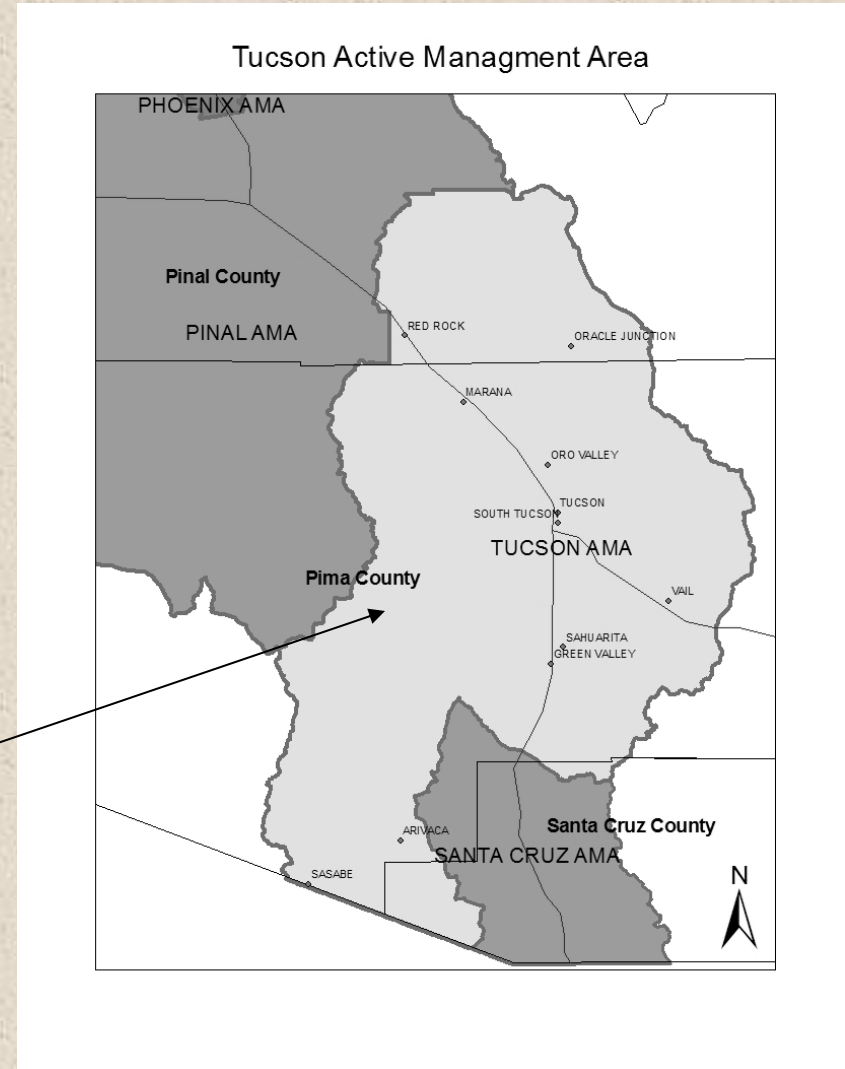
- Groundwater pumped from aquifers faster than it is replenished by nature
- Problem: declining water tables, with numerous associated implications: water quality, cost of pumping, land subsidence and fissuring.



# State's Response: 1980 State of Arizona Groundwater Management Act (GMA)

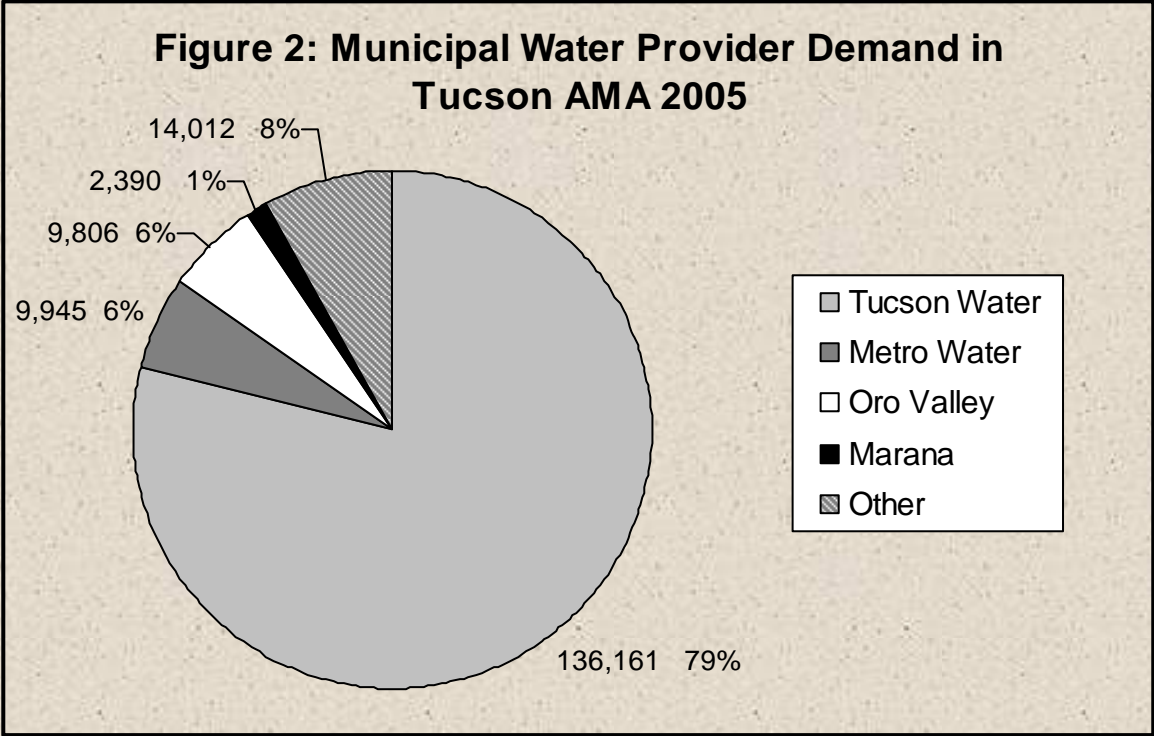
- Established areas where groundwater management was required – **Active Management Areas**, each with a statutory **management goal**
- GMA required the adoption of **Assured Water Supply Rules**, which require municipal growth to depend primarily on renewable supplies.
- **Conservation** programs for each water using sector and management plans are developed by the Arizona Department of Water Resources every 10 years.
- **No expansion of agricultural land** beyond what was irrigated during the late 1970s.
- Statutes and Management Plans establish regulatory framework, but the decisions how to meet the regulations are made by the water user/water supplier.

# Active Management Areas in Arizona



Note: Management goals may differ by AMA

# Relative Size of Large Water Providers in the Tucson Region



Total water demanded in 2005 was 172,314 AF. (Figures for Marana, Metro Water and Other are projections for 2005)  
Figures for Tucson Water and Oro Valley are actual use.  
Source: CAGR Plan of Operation November 2004 and Communication with Tucson Water and Oro Valley.

# Water Budget Calculations

<b>Table 4: Water Scenarios Based on Third Management Plan</b>			
	1998	2003	2025
<b>Municipal Sector (Includes Exempt Wells)</b>			
Total Demand	163,198	185,199	247,100
Total Supply	163,198	185,199	247,100
Groundwater	153,535	124,113	63,000
CAP	200	50,998	146,400
Effluent	9,463	9,811	37,700
Surface Water	0	277	0
<b>Agricultural Sector</b>			
Total Demand	94,809	102,959	54,200
Total Supply	94,809	102,959	54,200
Groundwater	70,882	85,617	41,200
Groundwater (in lieu)	22,947	17,342	10,000
CAP	0	0	0
Effluent	980	0	3,000
<b>Industrial Sector</b>			
Total Demand	57,544	47,430	75,400
Total Supply	57,544	47,430	75,400
Groundwater	56,844	45,721	70,700
CAP	0	160	0
Effluent	700	1,549	4,700
<b>Indian</b>			
Total Demand	100	14,196	16,000
Total Supply	100	14,196	16,000
Groundwater	100	788	200
CAP	0	13,408	15,800
Effluent	0	0	0
Other Demand Riparian	3,705	3,705	3,705
<b>Total Demand</b>	<b>315,651</b>	<b>349,784</b>	<b>392,700</b>
<b>Total Groundwater Use</b>	<b>308,013</b>	<b>277,286</b>	<b>188,805</b>
(Less) Net Natural Recharge	62,045	62,045	62,045
(Less) Net Incidental Recharge	81,972	43,257	32,516
(Less) Cuts to the Aquifer	2,341	8,362	45,200
<b>Total Overdraft</b>	<b>161,655</b>	<b>163,622</b>	<b>49,044</b>
Net Artificial Recharge	22,688	56,919	13,500



# The Assured Water Supply Rules

- AWS Rules adopted in 1995
- Designation versus certification
- Use of renewable supplies
  - Direct versus indirect use
  - Can utilize groundwater to serve new growth if the groundwater is replenished
  - Membership in the Central Arizona Groundwater Replenishment District (CAGRDR)
- Water suppliers and developers must plan for future growth.
- Need for additional water supplies.

# Importance of Renewable Supplies and Dams to Arizona

- Central Arizona Project

- Salt River Project



Hoover Dam



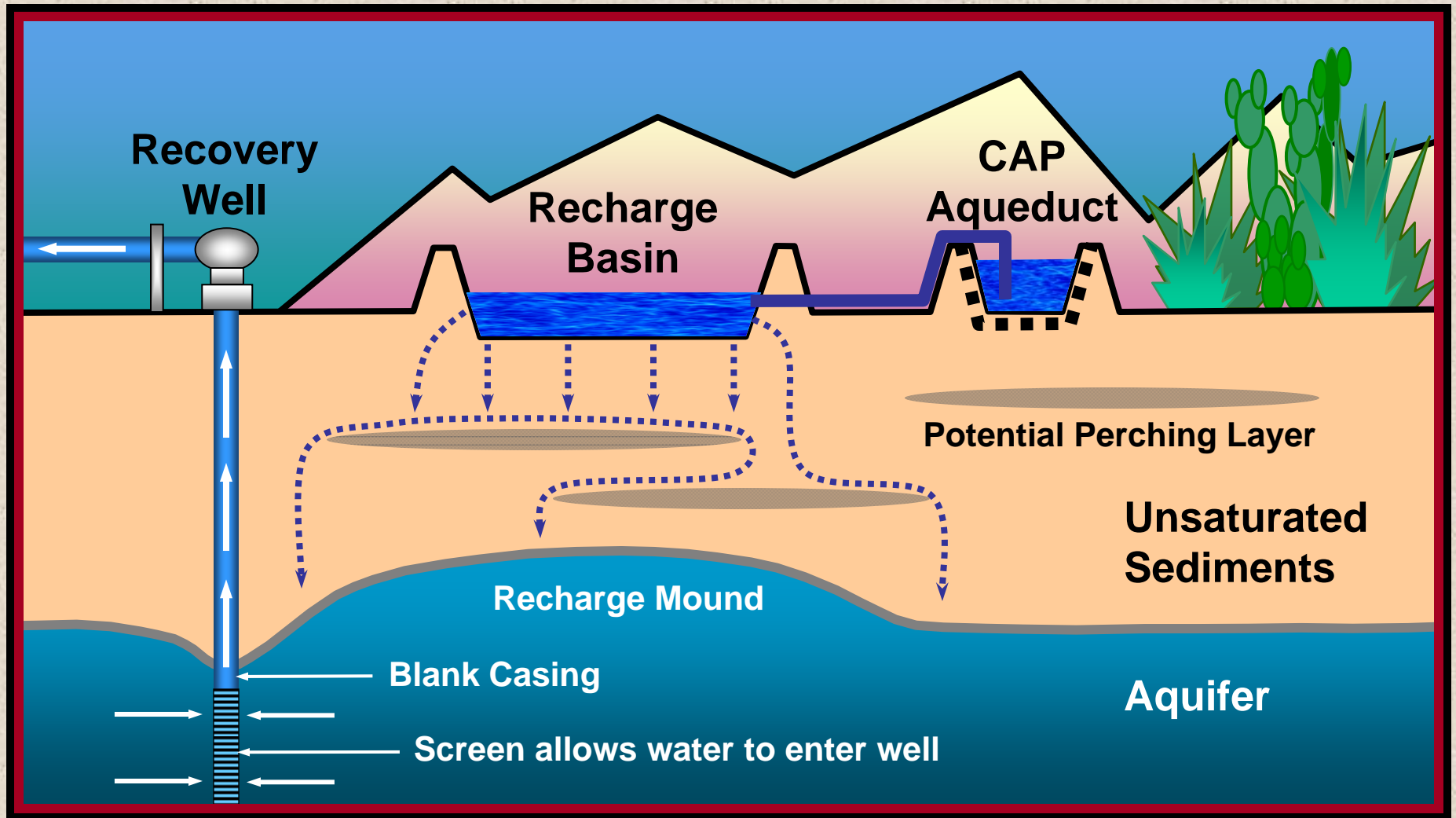
Roosevelt Dam

Photos courtesy of CAP and SRP

# Importance of Recharge



Photo courtesy of Tucson Water



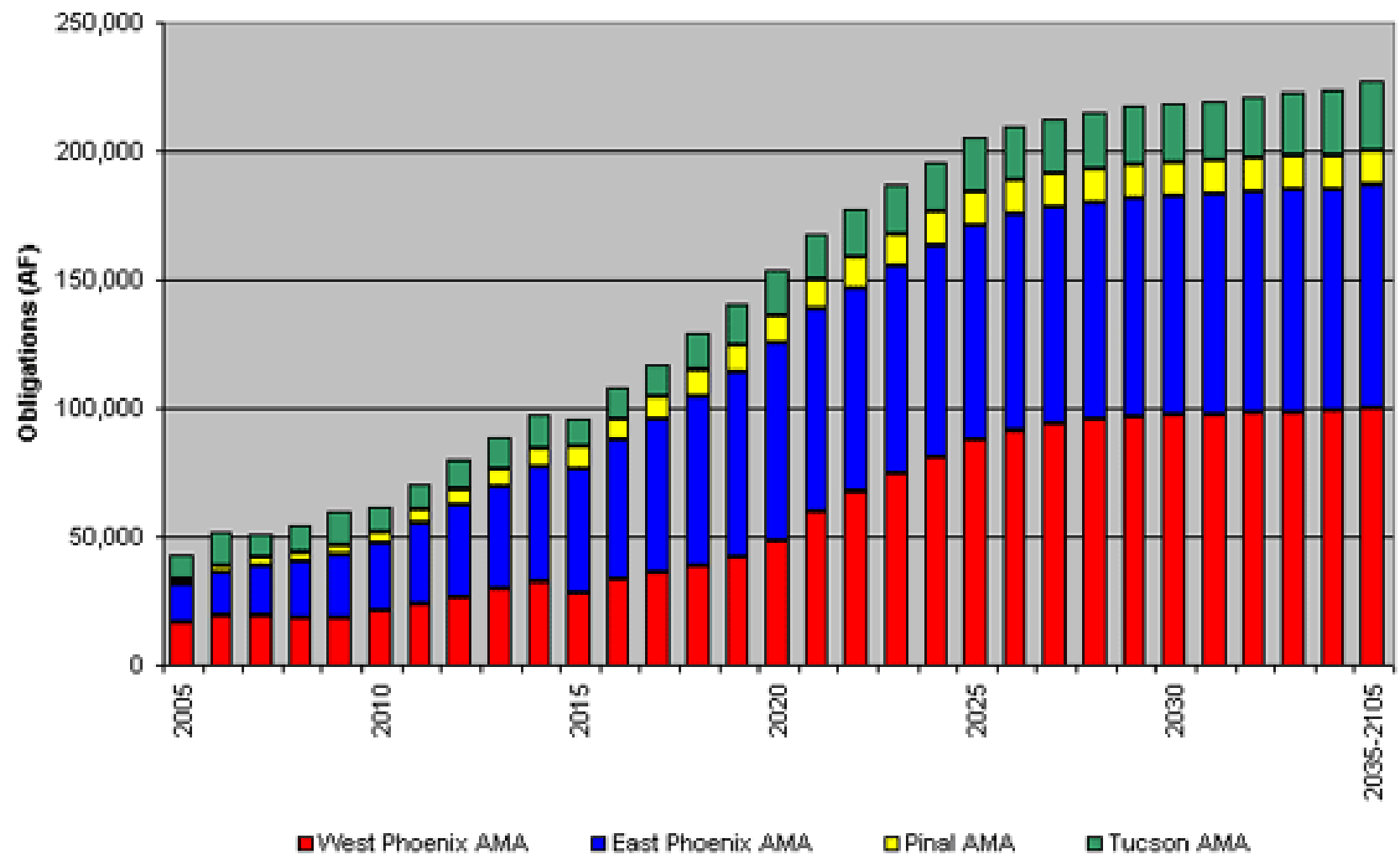
Graphic courtesy of Tucson Water

# CAGR

- Created in 1993 so that there would be a mechanism for compliance with AWS Rules
- Has grown beyond expectations
- 2004 Plan of Operation shows projected Replenishment Obligation for the Tucson AMA of 26,700 af annually by 2035
- Projected replenishment obligation for all three CAGR counties is about 227,000 af annually
- Will have to obtain water supplies to meet this obligation, which may grow larger.
- Paper on CAGR available at [www.cals.arizona.edu/azwater/](http://www.cals.arizona.edu/azwater/)

# CAGR

Projected CAGR Obligations



# Illustrative Scenarios to quantify the population that can be served by known water supplies

- For 2030
- Comparison of population that can be served to PAG population projection of approximately 1.5 million people
- These calculations are meant to be illustrative only. They are based on many assumptions and are not intended to be forecasts or projections.
- See Notes to Worksheet in Report
- Mechanisms to utilize all these supplies are not in place
- **In addition, the worksheet scenarios do not quantify the public investments required to actually utilize the identified water sources. Additional public investments may be required to utilize the resources.**

# Scenarios Worksheet from Report

<b>2030 Scenarios Worksheet*</b>	<b>M&amp;I + DOI Effluent + Higher GPCD</b>	<b>Half (M&amp;I + DOI) Effluent + Higher GPCD</b>	<b>M&amp;I + DOI Effluent + Lower GPCD</b>	<b>Half (M&amp;I + DOI) Effluent + Lower GPCD</b>
See Notes for Assumptions	Year 2030	Year 2030	Year 2030	Year 2030
<b>PAG Pima County Population Projection<sup>1</sup></b>	1,496,045	1,496,045	1,496,045	1,496,045
Estimated 2005 Population = 916,026				
<b>Water Supplies/Sources in Acre Feet</b>				
CAGR with Tucson Water <sup>2</sup>	35,600	35,600	35,600	35,600
Allowable GW <sup>3</sup>	41,100	41,100	41,100	41,100
Exempt Well GW <sup>4</sup>	4,000	4,000	4,000	4,000
Undesignated GW <sup>5</sup>	22,000	22,000	22,000	22,000
Effluent <sup>6</sup>	67,409	33,705	67,409	33,705
Effluent DOI <sup>7</sup>	28,200	14,100	28,200	14,100
Municipal & Industrial CAP <sup>8</sup>	195,810	195,810	195,810	195,810
<b>Total Annual Supply in Acre Feet<sup>9</sup></b>	394,119	346,315	394,119	346,315
Total Annual Supply in Gallons <sup>10</sup>	128,424,070,269	112,846,926,140	128,424,070,269	112,846,926,140
Assumed Total GPCD <sup>11</sup>	165	165	150	150
Water Per Person per annum <sup>12</sup>	60225	60225	54750	54750
<b>Scenario Population<sup>13</sup></b>	2,132,405	1,873,756	2,345,645	2,061,131
<b>Scenario Population less Projected Population<sup>14</sup></b>	636,360	377,711	849,600	565,086
<b>Ratio of Scenario Population to Projected Pop<sup>15</sup></b>	1.43	1.25	1.57	1.38



# Sensitivity Analysis

<b>Table 8: Ratio of Scenario Population to Projected Population</b>	Full Use M&I and DOI Effluent	Half Use M&I and DOI Effluent
Base Scenario with a GPCD of 150 (Taken from Table 7)	1.57	1.38
Base Scenario with a GPCD of 165 (Taken from Table 7)	1.43	1.25
Base Scenario with a GPCD of 175 (All Other Calculations Same as Table 7)	1.34	1.18
10% Increase in PAG 2030 Pop. and a GPCD of 175 (All Other Calculations Same as Table 7)	1.22	1.07
No State Land CAP (14,000 af) with a GPCD of 165 (All Other Calculations Same as Table 7)	1.37	1.20
No State Land CAP (14,000 af) with a GPCD of 150 (All Other Calculations Same as Table 7)	1.51	1.32

# Water Supplies Appear of Sufficient Quantity, for a while, but issues remain

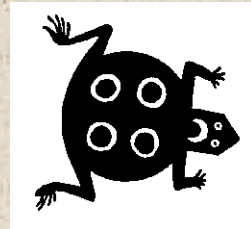
- Will there be direct delivery of CAP water?
- Will Arizona's ability to take direct delivery of CAP water be increased due to cost-effective desalination of seawater
- How will effluent be utilized?
  - Costs
  - Perception
- To what extent will there be reliance on the CAGRDRD
  - Will the CAGRDRD compete and/or supplement?
- Time horizon for AWS Designations is 100 years
- Other parts of the state dealing with the same issues
- How much will conservation be a factor?

## Contributions of the Study

- Explained how water regulations affect the utilization of water supplies, especially groundwater
- Engaged the business community and broader community in discussion of future water resource availability
- Has resulted in some actions and improved understanding of long-range water planning.

## Concluding Remarks

- When the well's dry, we know the worth of water. – *Benjamin Franklin, Poor Richard's Almanac, 1746*
- The frog does not drink up the pond in which he lives. – *American Indian Proverb*



# Questions/Discussion

## ***Water Resource Availability for the Tucson Metropolitan Area***

**July 2006**

**[www.cals.arizona.edu/azwater/](http://www.cals.arizona.edu/azwater/)**

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