DRAFT Demand and Supply Assessment

May 13

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Pinal Active Management Area

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1985-2025
Pinal Active Management Area

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EXECUTIVE SUMMARY

The Water Demand and Supply Assessment 1985-2025, Pinal Active Management Area (Assessment) is a compilation and study of historical water demand and supply characteristics for the Pinal Active Management Area (AMA) for the years 1985 through 2006. In addition, the Assessment calculates seven water supply and demand projection scenarios to the year 2025. The Arizona Department of Water Resources (ADWR) conducted this Assessment as preparation for the Fourth Management Plan for Pinal Active Management Area as required by the 1980 Groundwater Management Code (Code).

The statutory management goals established for each of the five AMAs are the foundation for the implementation of the groundwater management programs established by the Code. The statutory management goal of the Pinal AMA is to allow development of non-irrigation uses and to preserve existing agricultural economies for as long as feasible, consistent with the necessity to preserve future water supplies for non-irrigation uses. Preserving future supplies for non-irrigation uses has been interpreted as ensuring a long-term, reliable supply of water for municipal and industrial uses. The Code identified management strategies which relied, in part, on continuing mandatory conservation by the major water using sectors identified in the management plans to reduce total groundwater withdrawals in the AMAs, and on increasing the use of renewable water supplies in place of groundwater supplies. Five management periods were identified for the development of these Management Plans, which were to assist in moving the AMA closer to its management goal by 2025.

A review of historical annual water demand and supply in the Pinal AMA from 1985 to 2000 shows that groundwater overdraft has fluctuated somewhat, but has steadily increased through 2000 due to increased demands and continued reliance on groundwater by the agricultural sector. After the year 2000, groundwater overdraft in the Pinal AMA continued to fluctuate, but did not increase above the historical high. The increased utilization of CAP water, especially in the agricultural sector, and increased conservation activities across all water using sectors are attributable in part to this result. In addition, the incidental recharge of irrigation water continues to benefit the aquifer, even as agricultural demand decreases, due to the lag time for this water to reach the aquifer. However, with reductions in the volume of the agricultural CAP pool water in the future and assumed reduction in the volume of excess water available to store, use of CAP water by the agricultural sector is not likely to continue at current volumes into the future. To evaluate this, ADWR utilized several different possible scenarios within the Assessment.

The three baseline scenarios for future water use in this Assessment indicate that the volume of groundwater remaining in storage for future uses within the AMA is dependent on the demand in the agricultural sector and may result in increased groundwater overdraft in the Pinal AMA in the future. Three additional shortage scenarios examine the effects of a possible shortage of CAP supplies due to possible climate effects for several years before 2025, which could significantly exacerbate groundwater overdraft. A seventh scenario demonstrates that increasing the use of available reclaimed water supplies has little impact on the rate of groundwater pumping.

The purpose of this Assessment is to identify the success through 2006 with achievement of the Pinal AMA management goal. By developing future projections, ADWR can analyze different supply and demand mechanisms that may affect the AMA's ability to preserve the agricultural economy for as long as feasible while ensuring a long-term, reliable supply of water for municipal and industrial uses. While ADWR recognizes these future projections are not exact representations of what will occur in the future, they do identify a range of possibilities that provide valuable information that benefits decisions regarding water management in the Pinal AMA. Most importantly, the information in this Assessment will be used to assist ADWR in working with the communities within the Pinal AMA to develop management strategies to assist the AMA in meeting its goal by the end of the Fourth Management Plan.

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LIST OF ACRONYMS

1MP	First Management Plan
2MP	Second Management Plan
3MP	Third Management Plan
4MP	Fourth Management Plan
5MP	Fifth Management Plan
ADES	Arizona Department of Economic Security
ADWR	Arizona Department of Water Resources
AMA	Active Management Area
AWBA	Arizona Water Banking Authority
AWBA plan	Arizona Water Banking Authority Ten Year Plan of Operation
AWS	Assured Water Supply

BMP	best management practice
CAAG	Central Arizona Association of Governments
CAGRD	Central Arizona Groundwater Replenishment District
CAIDD	Central Arizona Irrigation and Drainage District
CAP	Central Arizona Project
CAWCD	Central Arizona Water Conservation District
CAWS	Certificate of Assured Water Supply
Code	Groundwater Code
CRM	Colorado River Management
DAWS	Designation of Assured Water Supply
DCDC	Decision Center for Desert Cities
EID	Evergreen Irrigation District
GIU	General Industrial Use Permit
GPCD	gallons per capita per day
GRIC	Gila River Indian Community
GSF	Groundwater Savings Facility
HIDD	Hohokam Irrigation and Drainage District
IGFR	Irrigation Grandfathered Right
IPCC	International Panel of Climatic Change
M&I	Municipal and Industrial
MAG	Maricopa Association of Governments
MSIDD	Maricopa-Stanfield Irrigation and Drainage District
MWD	Metropolitan Water District
NIA	Non-Indian agriculture
NOI	Notice of Intention to Drill
PAG	Pinal Association of Governments
PCWAA	Pinal County Water Augmentation Authority
SCIDD	San Carlos Irrigation and Drainage District
SNWA	Southern Nevada Water Authority
Template	Master Data Template
TON	Tohono O’odham Indian Nation
Type 1 Right	Type 1 non-irrigation grandfathered right
Type 2 Right	Type 2 non-irrigation grandfathered right
USF	Underground Storage Facility

PART I INTRODUCTION TO THE ASSESSMENT

1. INTRODUCTION

1.1 Purpose of the Pinal Active Management Area Assessment

The *Water Demand and Supply Assessment 1985 – 2025, Pinal Active Management Area* (Assessment) is a compilation and study of historical water demand and supply characteristics for this area from 1985 to 2006. It reviews past conditions and makes projections to the year 2025 using seven scenarios. The Arizona Department of Water Resources (ADWR) conducted this Assessment as preparation for the planning and public interaction that will precede the drafting of the *Fourth Management Plan for Pinal Active Management Area, 2010 - 2020* (4MP) as required by the *1980 Groundwater Management Code* (Code). For more information regarding the Code, management plans, ADWR's mission, and the governmental and institutional setting for this Active Management Area (AMA), refer to the *Third Management Plan for Pinal Active Management Area 2000 – 2010* (3MP).

The Assessment is divided into five parts, as described below:

- The Introduction, which provides a general overview of the Pinal AMA, the statutory management goal, the Assured Water Supply requirements, the Central Arizona Project, the Central Arizona Groundwater Replenishment District, the Underground Storage Program, and the Arizona Water Bank;
- The Budget Components and Calculation of Overdraft, which defines the major components of the water budget used in this Assessment and how overdraft is calculated;
- The Historical Water Demand for each water use sector (Municipal, Industrial, Agriculture, and Indian Tribes); and Overdraft;
- The Projected Demand by Sector and Overdraft using assumptions formulated by ADWR based on historical use, population projected by the Department of Economic Security (ADES), and others; and
- The Fourth Management Plan process that will follow this Assessment.

1.2 General Overview of the Pinal AMA

Five AMAs (Phoenix, Pinal, Prescott, Santa Cruz and Tucson) have been designated as requiring specific, mandatory management practices to preserve and protect groundwater supplies for the future (*See Figure 1-1*). The Pinal AMA is about 4,000 square miles in area and was established in 1980 upon enactment of the Code. Over the past 30 years, water users in the Pinal AMA have increased the use of renewable supplies, facilitated by the completion of the Central Arizona Project (CAP) canal, allowing use of Colorado River water either directly or indirectly through artificial recharge and recovery projects. For a detailed overview of the geography, hydrology, climate, and environmental conditions in the Pinal AMA, refer to the *Arizona Water Atlas, Volume 8 Active Management Area Planning Area* (ADWR, 2010).

1.3 The Management Goal of the Pinal AMA

The Code established management goals for each of the AMAs, focused primarily on the reduction of groundwater dependence. The statutory management goal of the Pinal AMA is to preserve existing agricultural economies in the AMA for as long as feasible consistent with the necessity to preserve future water supplies for non-irrigation uses. This goal was established as

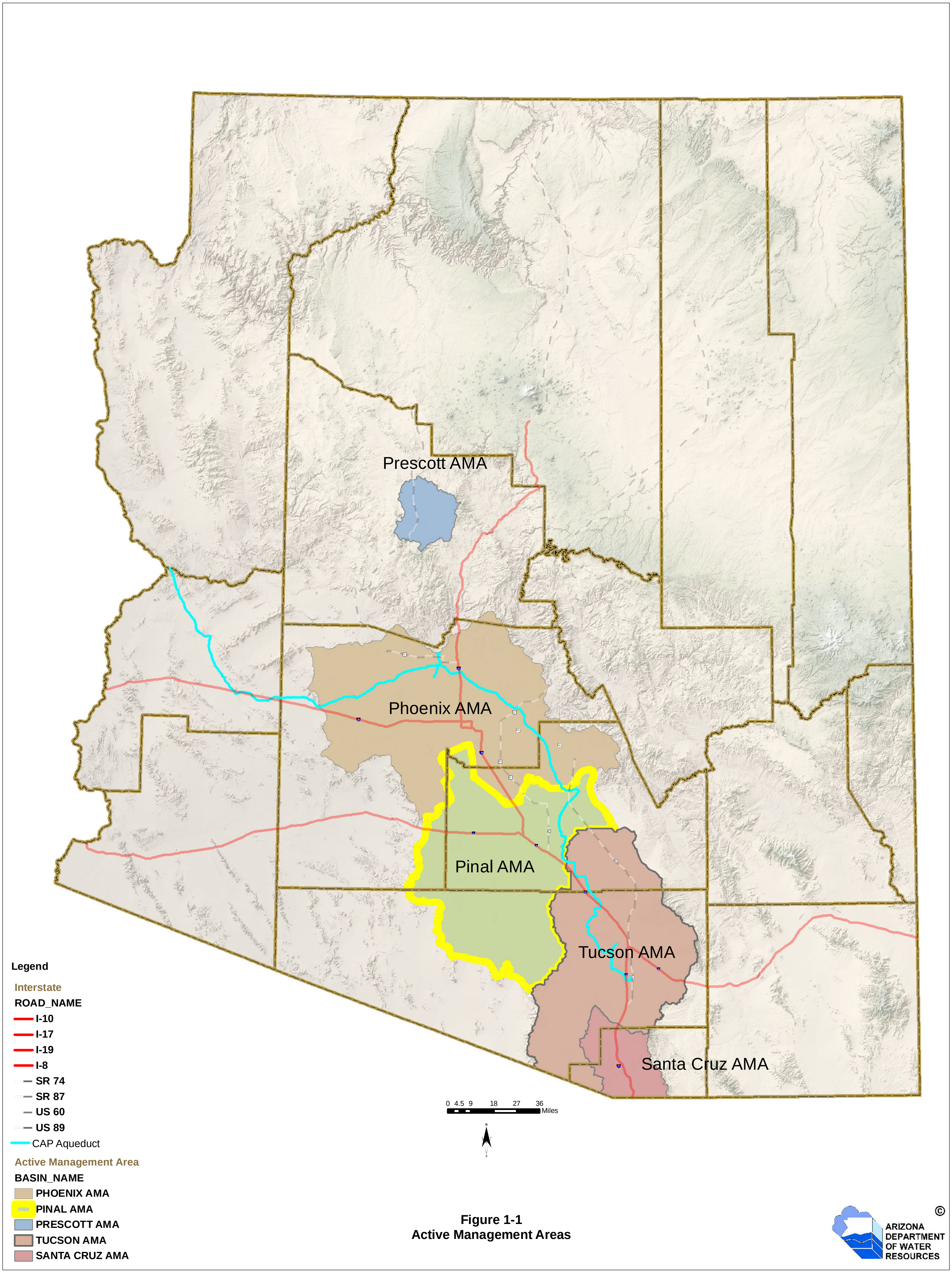


Figure 1-1
Active Management Areas

part of the Code, and is intended to guide the water management strategies to address the long-term implications of groundwater overdraft.

1.4 Groundwater Management in the AMAs

To address groundwater depletion in the state's most populous areas, the state legislature created the Code in 1980 and created ADWR to implement it. The goal of the Code is twofold: 1) to control severe groundwater depletion, and 2) to provide the means for allocating Arizona's limited groundwater resources to most effectively meet the state's changing water needs. This effort to manage Arizona's groundwater resources was so progressive that in 1986 the Code was named one of the ten most innovative programs in state and local government by the Ford Foundation and Harvard University. When granting the award, it was noted that no other state had attempted to manage its water resources so comprehensively. Accordingly, Arizona built consensus around its policy and then followed through to make it work in practice.

Areas where groundwater depletion is most severe are designated as AMAs. There are five AMAs. These areas are subject to regulation pursuant to the Code. Each AMA has a statutory management goal. In the Phoenix, Prescott, and Tucson AMAs, the primary management goal is to achieve safe-yield by the year 2025. In the Pinal AMA, where the economy is primarily agricultural, the management goal is to preserve that economy for as long as feasible, while considering the need to preserve groundwater for future non-irrigation uses. Recognizing that the Santa Cruz AMA is currently at the safe-yield status, the goal of the Santa Cruz AMA is to maintain safe-yield and prevent local water tables from experiencing long-term decline. Each AMA carries out its programs in a manner consistent with these goals while considering and incorporating the unique character of each AMA and its water users.

Since groundwater use in AMAs is regulated, withdrawal of groundwater in these AMAs requires a permit from ADWR. On most of these wells, state law assesses withdrawal fees and requires annual groundwater withdrawal and use reports to be filed.

In order to withdraw and use groundwater, an individual must complete the following steps:
1. Obtain a groundwater withdrawal authority;
2. Obtain a well permit and employ a licensed well driller;
3. Measure and report annual groundwater withdrawals; and
4. Meet conservation program requirements under the AMA Management Plans.

The following groundwater withdrawal authorities are used to allocate groundwater resources and to limit demand for groundwater in the AMAs.

1. Irrigation Grandfathered Rights

Within AMAs, anyone who owns land that was legally irrigated with groundwater at any time from January 1, 1975 to January 1, 1980 and has been issued a Certificate of Irrigation Grandfathered Right (IGFR) by ADWR has the right to use groundwater for the irrigation of that land. The term irrigation is limited to the growing of crops for sale, human consumption or livestock feeding on two or more acres.

2. Type 1 and Type 2 Non-Irrigation Grandfathered Rights

A Type 1 non-irrigation grandfathered right (Type 1 right) is associated with land permanently retired from farming and converted to a non-irrigation use. This right, like an irrigation grandfathered right, may be sold or leased only with the land. The maximum amount of groundwater that may be pumped each year using a Type 1 right is three acre-feet per acre. Groundwater withdrawn pursuant to a Type 2 non-irrigation grandfathered right (Type 2 right) can generally be used for any non-irrigation purpose. The right is based on historical pumping of groundwater for a non-irrigation use from a non-exempt well (pumping capacity of greater than

35 gallons per minute) and equals the maximum amount pumped in any one year between 1975 and 1980. Type 2 rights can be sold separately from the land or well. These rights are most often used for industrial purposes such as sand and gravel facilities, golf courses and dairies. Type 1 and Type 2 right holders are generally required to comply with the conservation requirements associated with the Industrial Conservation Programs in the Management Plans.

3. Service Area Rights
Service area rights allow cities, towns, private water companies and irrigation districts to withdraw and transport groundwater to serve their customers. Most persons within an AMA receive water through service area rights. Entities with service area rights must comply with the Municipal Conservation Program requirements in the Management Plans.

4. Groundwater Withdrawal Permits
Groundwater withdrawal permits allow new withdrawals of groundwater for non-irrigation uses. Currently, seven types of withdrawal permits are allowed under the Code. A General Industrial Use Permit (GIU), the most commonly used type of permit, allows the withdrawal of groundwater for industrial uses outside the service area of a city, town or private water company. Generally, users of these permits are required to comply with the Industrial Conservation Program requirements in the Management plans.

Wells
Two types of applications for well drilling authority exist. A Notice of Intent (NOI) to Drill is required to be filed with ADWR for all wells, which are to be drilled outside the AMAs, and exempt wells which will be located inside an AMA. Exempt wells are typically small domestic wells, pumping not more than 35 gallons per minute. Under the Code, exempt wells are not required to meter or report water use and are not regulated by ADWR, other than being required to file an NOI. For non-exempt wells within an AMA, an application for a Drilling Permit is required.

Water Measurement, Groundwater Withdrawal Fees and Reporting Requirements
Groundwater withdrawn from non-exempt wells must be measured using an approved measuring device or method. In addition, all groundwater withdrawn from non-exempt wells is subjected to an annual groundwater withdrawal fee. Fees collected for augmentation, conservation assistance, and monitoring and assessing water availability are used to finance the augmentation and conservation assistance programs that are part of the Management Plans for AMAs, plus funding the Arizona Water Banking Authority (discussed below).

Annual water withdrawal and use reports are required to be filed for most groundwater withdrawn within an AMA. Accurate records of the right holder's withdrawals, transportation, delivery and use of groundwater must be kept by the right holder and reported to ADWR on a yearly basis.

Management Plans and Conservation Requirements
Management Plans reflect the evolution of the Code, assisting in moving Arizona toward its long-term water management goals. Management Plans are required from each AMA for five sequential management periods extending from 1980 through 2025. The First Management Plan (1MP) applied from 1985-1990. The Second Management Plan (2MP) was in effect until 2000, and the Third Management Plan (3MP) from 2001 until 2010. ADWR is in the initial stages of formulating the Fourth Management Plan (4MP), through the development of this Assessment, originally scheduled for release in 2010. The provisions of the 4MP will be in effect beginning two years after the adoption date of the 4MP, through 2020. A Fifth Management Plan (5MP) will be developed for the years 2020 through 2025.

Most entities withdrawing groundwater from a non-exempt well are required, pursuant to the Management Plan, to participate in one of the following: the Agricultural Conservation Program, the Municipal Conservation Program or the Industrial Conservation Program.

Holders of an IGFR who withdraw water from a non-exempt well are subject to the Agricultural Conservation Program, which determines conservation requirements based on water duties and maximum annual groundwater allotments or through Best Management Practices (BMPs). A key component of the Code prohibits the establishment of new IGFRs – eliminating new acres from being put into agricultural production.

Under the Municipal Conservation Program, municipal water providers are required to meet conservation requirements based on reductions in total per capita use or through implementation of BMPs. Additionally; municipal providers are required to limit the amount of lost and unaccounted for water in their delivery system.

All Type 1 and Type 2 right holders and some GIU permit holders are subject to the Industrial Conservation Program. Conservation requirements are based on the best available technology for the end use and range, based on the permit or right type, from BMPs to specific groundwater allotments for water users such as turf-facilities.

Compliance and Enforcement Program

ADWR developed a compliance and enforcement program to ensure that conservation requirements are being met. The annual water withdrawal and use reports previously mentioned are one part of this program. Additionally, ADWR conducts audits to determine if water users comply with conservation requirements. If a water user is out of compliance, ADWR sends out a notice of non-compliance, conducts post audit meetings with the water user, and attempts to negotiate a settlement for the excess groundwater used.

Conservation and Augmentation Assistance Programs

In 1991, the 2MP was modified to include a program for conservation assistance to water users within an AMA. The goal of the Conservation Assistance Program is to assist water users in achieving the Management Plan requirements, leading ultimately to a realization of the management goal of the AMA.

The 2MP and the 3MP also include an Augmentation Assistance Program designed to provide augmentation grants for construction and pilot recharge projects designed to directly increase water supplies or water storage, conservation assistance, and planning, research and feasibility studies.

The Conservation Assistance and Augmentation Assistance Program grants are funded by groundwater withdrawal fees collected from those who pump groundwater in each AMA.

1.5 The Assured Water Supply Program

The Assured Water Supply (AWS) program, created as part of the Code, is designed to preserve groundwater resources and to promote long-term water supply planning in the AMAs. This is accomplished by regulations that limit the use of groundwater by new subdivisions. Every person proposing to subdivide land within an AMA must demonstrate the availability of a 100-year AWS.

In 1995, ADWR adopted AWS Rules to implement the AWS program. Under the AWS Rules, developers can demonstrate a 100-year supply by either satisfying the criteria described below and obtaining a Certificate of Assured Water Supply (CAWS) from ADWR, or by obtaining a written commitment of service from a water provider with that has a Designation of Assured Water Supply (DAWS).

An AWS demonstration must include proof that the proposed subdivision will meet the following criteria, that the water supply or supplies: 1) will be of adequate quality; 2) will be physically, legally, and continuously available for the next 100 years; 3) will be consistent with the management goal for the AMA; 4) will be consistent with the Management Plan for the AMA; and 5) financial capability will be demonstrated to construct the necessary water storage, treatment, and delivery systems. The Arizona Department of Real Estate will not issue a public report that allows the developer to sell lots without a demonstration of an AWS within an AMA. For more information on the AWS Program, please visit the ADWR website at www.azwater.gov/AzDWR/WaterManagement/AAWS.

The AWS requirement is only one important tool to help attain the management goal of the AMA. Because the AWS requirements only apply to new subdivisions (existing uses and other non-subdivision new uses are exempt from the assured water supply requirement under the Code), its ability on its own to bring the AMA into safe-yield is limited.

1.6 Central Arizona Project

The CAP is designed to bring about 1.5 million acre-feet of Colorado River water per year to its three-county service area (Maricopa, Pima and Pinal counties). The CAP carries water from Lake Havasu near Parker, Arizona to the southern boundary of the San Xavier Indian Reservation southwest of the City of Tucson. It is a 336-mile long system of aqueducts, tunnels, pumping plants and pipelines and is the largest single resource of renewable water supplies in the state of Arizona. The Central Arizona Water Conservation District (CAWCD) manages and operates the CAP.

For more information on the CAP, please visit the www.cap-az.com.

1.7 The Central Arizona Groundwater Replenishment District

One of the most important criteria for demonstrating an AWS is the consistency with management goal. The consistency with management goals section of the AWS Rules limits the quantity of mined groundwater that an applicant may use to demonstrate an AWS – ultimately decreasing the ability to mine groundwater to zero acre-feet –, which assists in preserving future water supplies for non-irrigation uses. In 1993, the legislature created a groundwater replenishment authority to be operated by CAWCD throughout its three-county service area. This replenishment authority of CAWCD is referred to as the Central Arizona Groundwater Replenishment District (CAGRD). In 1999, the legislature expanded CAWCD's replenishment authorities and responsibilities by passing the Water Sufficiency and Availability Act. Membership in the CAGRD provides a means by which an AWS applicant can satisfy the requirement that the proposed water use be consistent with the water management goals of the AMA. The effect of this groundwater pumping limitation is to prevent new development from relying solely on mined groundwater to serve its water demands. Development, however, is not eliminated for those landowners and water providers who have no direct access to CAP water or other renewable supplies. If a water provider or a landowner has access to groundwater and desires to rely exclusively on groundwater to demonstrate a 100-year water supply, it may do so, provided it joins the CAGRD. As a member of the CAGRD, the landowner or provider must pay the CAGRD to replenish any groundwater pumped by the member, which exceeds the pumping limitations imposed by the AWS Rules. For more information on the CAGRD, please visit the CAGRD website at www.cagrd.com.

1.8 The Underground Storage & Recovery Program

For decades, more groundwater has been pumped from Arizona's aquifers than has naturally recharged back into the aquifers. This imbalance has left some aquifers significantly depleted. Using renewable supplies and recharging water underground reduces this imbalance. *Artificial recharge* is a means of storing excess water supplies so that they may be used in the future. Artificial recharge is an increasingly important tool in the management of Arizona's water supplies, particularly in meeting the goals of the Code. Storing water underground to ensure an adequate supply for the purpose of satisfying current and future needs is both a practical and cost-effective alternative to direct use of renewable supplies.

In 1986, the Arizona Legislature established the Underground Water Storage and Recovery program to allow persons with surplus supplies of water to store that water underground and recover it later. In 1994, the Legislature enacted the Underground Water Storage, Savings, and Replenishment Act, which further refined the recharge program.

A person who wishes to store, save, replenish, or recover water through the recharge program must apply for permits through ADWR. Depending on what the applicant intends to accomplish, different types of permits may be required.

An *Underground Storage Facility (USF) Permit* allows the permit holder to operate a facility that stores water in the aquifer. A Constructed USF Permit allows water to be stored in an aquifer by using some type of constructed device, such as an injection well or percolation basin.

A *Managed USF Permit* allows water to be discharged to a naturally water-transmissive area such as a streambed that allows the water to percolate into the aquifer without the assistance of a constructed device.

A *Groundwater Savings Facility (GSF) Permit* allows renewable water supplies, owned by the water storer, to be delivered to a separate recipient who agrees to curtail groundwater pumping on a gallon-for-gallon basis, thus creating a groundwater savings.

A *Water Storage Permit* allows the permit holder to store water at a USF or GSF. In order to store water, the applicant must provide to ADWR evidence of its legal right to the source water proposed for recharge. Water storage must occur at a permitted facility, as described above.

A *Recovery Well Permit* allows the permit holder to recover long-term storage credits or to recover stored water annually. Recovery can occur inside the area of impact of the stored water (the area where the water artificially recharged into the aquifer actually occurs) or outside the impact area of the stored water; however, recovery must occur in the same AMA where the water was stored. For more information on the Underground Storage and Program, please visit the ADWR website at www.azwater.gov/AzDWR/WaterManagement/Recharge.

1.9 The Arizona Water Banking Authority

The Arizona Water Banking Authority (AWBA) was established in 1996 to increase utilization of the state's Colorado River entitlement and develop long-term storage credits for the state. The AWBA stores or "banks" unused Colorado River water to be used in times of shortage to firm (or secure) water supplies for Arizona. These water supplies help to benefit municipal and industrial users and communities along the Colorado River, fulfill the water management objectives of the state, store water for use as part of water rights settlement agreements among Indian communities, and assist Nevada and California through interstate water banking. Through these mechanisms, the AWBA aids in ensuring long-term water supplies for Arizona.

Each year, the AWBA pays the delivery and storage costs to bring Colorado River water into central and southern Arizona through the CAP canal. The water is stored underground in existing aquifers (direct recharge) or is used by irrigation districts in lieu of pumping groundwater (indirect or in-lieu recharge). For each acre-foot stored, the AWBA accrues credits that are redeemable in the future when Arizona's communities or neighboring states need this backup water supply.

1.10 Special Management Zones

In 2006, a new special zone was created in the Pinal AMA as part of the implementation of the Gila River Water Rights Settlement Act. These zones are mapped in *Figure 5-9* and are discussed further in *Section 5.4.2*.

PART II BASIC BUDGET COMPONENTS AND CALCULATION OF OVERDRAFT

2. BUDGET DATA OVERVIEW

The historical data contained in this Assessment were compiled from Annual Water Withdrawal and Use Reports (annual reports) filed by water users since 1984; other components required to estimate both historical and projected overdraft came from the *Pinal Active Management Areas Regional Groundwater Flow Model Phase Two: Numerical Model, Calibration Sensitivity, and Recommendations* (Corkhill and Hill, 1992). The detailed dataset compiled during this effort is stored in the *Pinal Master Data Template* (Template) (ADWR, 2011). The Template is an inventory of the demand and supply for the AMA. The data housed in the Template has been summarized in a budget format, referred to as the Summary Budget. Both the Template and Summary Budget are available online at:
www.azwater.gov/AzDWR/WaterManagement/Assessments .

In order to be consistent across the years and sectors, staff took extensive efforts to re-evaluate demand and supply data from the individual annual reports submitted by water providers, irrigation districts, industrial facilities, farms and recharge facilities to populate the Template and Summary Budget, rather than relying on previously compiled totals. The years considered as the historical period for this Assessment are 1985 to 2006. During those 21 years, the data required by annual reports has become more complicated as the statutes, rules and Management Plans have changed, and as water management itself has become more complex. Meanwhile, the methods used to store, retrieve and compile the data have become more sophisticated. This evolution of data development and retrieval may cause the more recently compiled totals for demand or supply to be slightly inconsistent with previously published numbers in previous Management Plans. While data reporting details and data retrieval have changed over the years, annual water use data have been reported in a relatively consistent manner for over 21 years. This long period of consecutive annual reporting provides the opportunity for ADWR to analyze past use and project future water demand using the longest period of record yet available. The data regarding future potential demand and supply were projected using various methods, as explained in detail beginning in Part III (Historical Water Demands and Overdraft). Appendices 1-9 contain additional information regarding how these numbers were developed.

3. THE BASIC BUDGET COMPONENTS

The basic components of the Summary Budget are demand, supply, artificial recharge, and offsets to overdraft. Each of these components, necessary for calculating overdraft, is discussed in detail in the following sections.

3.1 Demand

Demand consists of the beneficial use of water for cultural purposes by the Municipal, Industrial, and Agricultural sectors and use on Indian reservations. Demand also includes natural system uses such as riparian demand.

3.1.1 Municipal Demand

Municipal water use includes water delivered for non-irrigation uses by a city, town, private water company or irrigation district. Municipal demand is composed of the Large Provider, Large Untreated Provider, Small Provider, Institutional Provider and Domestic Exempt subsectors. The demand of Individual Users, such as turf-related facilities, is also included in the Municipal demand since municipal providers often serve them. These subsectors are listed and defined below in the order of magnitude of use.

Large Provider Demand: Large provider demand is the sum of residential, non-residential, and lost and unaccounted for water delivered by a large provider. A large provider is a municipal provider serving more than 250 acre-feet of water for non-irrigation use per year.

The components of Large Provider Demand are:

Large Provider Residential Deliveries: A non-irrigation use of water, delivered by a large provider, related to the activities of single family or multifamily housing units, including interior and exterior water use.

Large Provider Non-residential Deliveries: Water supplied by a large provider for a non-irrigation use other than a residential use. Deliveries to individual users are included in this category. Individual users are facilities that receive water from a municipal provider for non-irrigation uses to which specific Industrial conservation program requirements apply, including turf-related facilities, large-scale cooling facilities, and publicly owned rights-of-way.

Large Provider Lost and Unaccounted for water: The difference between the total water withdrawn, diverted or received for use within the water provider's water service area and the sum of the residential and non-residential metered deliveries to customers.

Large Untreated Providers: Large untreated water providers are municipal providers that as of January 1, 1990 were serving untreated water to at least 500 persons or supply at least 100 acre-feet of untreated water during the calendar year.

Small Provider demand: Small provider demand consists of deliveries by a municipal provider for non-irrigation use related to the activities of single family or multifamily housing units. Small provider demand may also include deliveries to non-residential customers and individual users. A small provider is a municipal provider that supplies 250 acre-feet or less of water for non-irrigation use per year.

Institutional Providers: Institutional providers are those municipal providers who supply 90 percent or more of their total water deliveries to prisons, hospitals, military installations, airports, or schools.

Domestic Exempt: Domestic Exempt Water use is non-irrigation water supplied by exempt wells (pumping not more than 35 gallons per minute) for domestic purposes to persons not on a large or small provider distribution system.

Population Numbers: Although not used directly to calculate water use during the historical period, population numbers are included in the Template and are broken out by persons served by large providers, small providers, institutional providers and those who use domestic exempt wells. Population is used directly in the projected scenarios to estimate Municipal use.

3.1.2 Industrial Demand

Industrial use is a non-irrigation use of water, not supplied by a city, town, or private water company, including animal industry use and expanded animal industry use. In general, Industrial users withdraw water from their own wells that are associated with Type 1 and Type 2 rights, GIUs or other withdrawal permits. In the Pinal AMA, Industrial demand is composed of the following subsectors: Dairy, Turf, Feedlots, Sand and Gravel, Metal Mines, Large Scale Power Plants, and Other. These subsectors are defined below.

Dairy: Dairy demand is the water use at facilities that house an average of 100 or more lactating cows per day during a calendar year.

Turf: Turf demand is the water use by cemeteries, golf courses, parks, schools, or common areas within housing developments with a water-intensive landscaped area of 10 or more acres. Turf-related facilities that use any groundwater, regardless of whether they are Industrial users or are served by a municipal provider (individual users) have a maximum annual water allotment based on the size and age of the facility. The use by golf courses is further broken out in the Template, as it is the largest turf user. Golf course demand is water use at turf-related facilities that are used for playing golf that have a minimum of nine holes including any practice areas.

Feedlot: Feedlot demand is the water use at a facility that houses and feeds an average of 100 or more beef cattle per day during a calendar year.

Sand and gravel: Sand and Gravel demand is the water use at a facility that produces sand and gravel and that uses more than 100 acre-feet of water from any source per year.

Metal Mines: Metal mining demand is the water use at a facility at which mining and processing of metallic ores is conducted, and which uses or has the potential to use more than 500 acre-feet of water per year.

Large-Scale Power Plants: Demand at large-scale power plants, which are industrial facilities that produce, or are designed to produce, more than 25 megawatts of electricity.

Other Industrial: Other Industrial demand is the non-irrigation use of water not supplied by a city, town, or private water company, including animal industry use and expanded animal industry use that are not included in any of the specific Industrial subsectors described above.

3.1.3 Agricultural Demand

Agricultural demand is composed of the use of water by IGFRs for agricultural uses not on Indian Reservations, and its associated lost and unaccounted for water. Agricultural use is the application of water to two or more acres of land to produce plants or parts of plants for sale or human consumption, or for use as feed for livestock, range livestock or poultry. In the Pinal AMA, and the other AMAs, only land associated with a certificate of IGFR can legally be irrigated with groundwater. During the early 1980s, ADWR issued these certificates based on the types of crops and the number of acres planted from 1975 to 1980. Land not irrigated during this period may not be irrigated, except under certain circumstances. The sub-categories of Agricultural demand and lost and unaccounted for water are explained below:

Non-Exempt IGFRs: Non-exempt IGFR use is the water use on land to which an IGFR is appurtenant and is greater than ten acres in size, or greater than two acres in size and part of an integrated farming operation. A person using groundwater pursuant to a non-exempt IGFR must comply with conservation requirements established in the Management Plan for each management period. Historically, the Base Conservation Program requirements were allotment-based: the number of IGFR acres was multiplied by the average water duty (the quantity of water reasonably required for crops grown on the IGFR acres between 1975 and 1980); the result was then divided by an assigned irrigation efficiency listed in each Management Plan (ADWR, 1999). Beginning in 2003, an optional BMP program was developed for non-exempt IGFRs as an alternative to allotments in the Base Conservation Program (ADWR, 2003).

Exempt IGFRs: In 1994, IGFRs less than ten acres in size and not part of an integrated farming operation were exempted from conservation requirements and reporting obligations. Water use by these rights located in the Pinal AMA was estimated to be approximately 1,500 acre-feet per year.

Agricultural Lost and Unaccounted for Water: This lost water is the total amount of water pumped or diverted minus the demand.

3.1.4 Indian Demand

Indian Demand is composed of *Municipal* and *Agricultural* Demand on Indian Reservations, as described below. Indian water use is exempt from state regulation; however, it is included in this Assessment because of the physical impacts on the aquifer.

Municipal Indian Demand: Indian Municipal demand is the residential and non-residential water use on reservations.

Agricultural Indian Demand: Indian Agricultural demand is the water use required to grow crops on reservations.

3.1.5 Riparian Demand

A natural demand on the AMA's regional water supply is riparian demand. The majority of the riparian demand in the Pinal AMA is the water used as a result of evapotranspiration by riparian vegetation along the Gila and Santa Cruz Rivers and major tributaries.

3.2 Supply

Historically water users in the Pinal AMA have relied heavily on groundwater. However, over the past 30 years, utilization of renewable supplies has increased significantly. The following is a list of water supplies used during the period of 1985 to 2006 to meet the demands of the sectors in the Pinal AMA.

Groundwater: Groundwater is water from below the earth's surface.

Direct Use CAP: Direct use CAP is water distributed via the CAP canal and put to direct beneficial use.

Recovered CAP: Recovered CAP is water originally distributed via the CAP canal, then stored in either a USF or a GSF, then recovered under the authority of a recovery well permit. When recovered, this water legally counts as CAP water. In graphs in this Assessment that depict water use by source, recovered CAP is included with direct use CAP in the category "CAP".

Reclaimed Water: Reclaimed water is water that has been collected in a sanitary sewer for subsequent treatment in a facility that is regulated as a sewage system, disposal plant or wastewater treatment facility. Such water remains reclaimed water until it acquires the characteristics of groundwater or surface water.

Recovered Reclaimed Water: Recovered reclaimed water is water that was stored in either an USF or a GSF, and then recovered under the authority of a recovery well permit. When recovered, this water legally counts as reclaimed water. In graphs in this Assessment that depict water use by source, recovered reclaimed water is included with reclaimed water in the category "reclaimed water".

Surface water: Surface water is the waters of all sources, flowing in streams, canyons, ravines or other natural channels, or in definite underground channels, whether perennial or intermittent, floodwater, wastewater or surplus water, and of lakes, ponds and springs on the surface.

In-lieu groundwater: In-lieu groundwater is water used in-lieu of groundwater pumped or delivered at a GSF. The entities that provide the alternative supplies to the GSF are permitted to pump an equivalent volume of water at some time in the future, via a recovery well permit. Because this recovered water retains the legal characteristics of the water originally used at the GSF (such as reclaimed water or CAP), the initial use by the recipients at the GSF (usually irrigation districts or individual farmers) is groundwater and as such is depicted as In-lieu groundwater in the Summary Budget.

Table 3-1 lists the water supplies that are in use, or have been used by each sector at some point from 1985 through 2006. These water supplies used historically in the Pinal AMA are the same supplies anticipated to be used in the future, although the various sectors may utilize them in different amounts than in the past.

Table 3-1 Historical Sector Use of Water Supplies Through 2006
Pinal Active Management Area

Source	Municipal	Industrial	Agriculture	Indian
Groundwater	√	√	√	√
Direct Use CAP	√		√	√
Recovered CAP	√	√		
Reclaimed Water	√	√	√	
Recovered Reclaimed Water	√	√		
Surface water	√	√	√	√
In-lieu groundwater			√	

3.3 Artificial Recharge

Artificial Recharge is a means of *artificially* adding water to the aquifer. In the Pinal AMA, artificial recharge is accomplished through the use of USFs and GSFs (described in Section 1.8). Water stored at these sites becomes long-term storage credits for the storers, which can be recovered later. At the time these long-term storage credits are used (recovered), the recovered water retains the legal characteristic of the water supply stored at the recharge facility (such as reclaimed water or CAP). Water may also be stored at USFs on an annual basis so that it is stored and recovered during the same calendar year and does not accrue a long-term storage credit.

Underground Storage Facilities (USFs): A USF is a facility that stores water in the aquifer. There are two types: *Constructed* and *Managed.* A Constructed USF is one in which water is stored in an aquifer by using some type of constructed device, such as an injection well or percolation basin. A Managed USF is a facility at which water is discharged to a naturally water-transmissive area such as a streambed that allows the water to percolate into the aquifer without the assistance of a constructed device. Historically, USFs in the Pinal AMA have stored primarily reclaimed water.

Groundwater Savings Facilities (GSFs): A GSF is a facility, such as an irrigation district or specific farm, to which a renewable supply is delivered to a recipient who agrees to curtail groundwater pumping and use the water in-lieu of that groundwater. Typically, a separate entity holds the Water Storage Permit (and has the legal right to the renewable supply) and accrues long-term storage credits for each acre-foot of water used in-lieu of the groundwater. Historically, GSFs in the Pinal AMA have stored CAP.

Artificial recharge plays an important role in meeting the management goal. Pursuant to the AWS requirements, development associated with CAWS and DAWS must prove 100-year water supplies that are consistent with the Pinal AMA management goal. This dictates that most or all of these supplies must come from renewable sources. For example, using CAP water can meet or offset a provider's obligation to use renewable supplies. However, there are some factors that affect a water user's ability to utilize CAP water directly, including having a CAP allocation and/or access to excess or leased CAP supplies, proximity to the main CAP distribution system, and access to treatment facilities and distribution systems to directly treat and deliver CAP water to customers.

Many municipal providers may not have physical or legal access to CAP water. For these providers, membership in, and replenishment by, the CAGRD is an option for meeting the consistency with the management goal requirement for an AWS. Entities who are seeking to demonstrate an AWS can voluntarily join the CAGRD to meet the consistency with management goal requirement. The CAGRD must replenish any groundwater used in excess of the allowable groundwater volume (excess groundwater) used by its members within three years after the amount of excess groundwater use is reported, and does so through replenishment (storage) at a USF or GSF.

Some of the water stored at a USF or GSF is also debited to assist the AMA in achieving the statutory management goal. CAP water stored for long-term storage credits is debited a five percent cut to the aquifer, unless it is stored directly into specific CAGRD accounts that do not incur the debit. Annual or long-term reclaimed water storage at a Constructed USF or a GSF does not have a cut to the aquifer; however, reclaimed water stored at a Managed USF is debited 50 percent. These cuts to the aquifer help replenish the AMA aquifers and assist in ensuring that supplies are available for future municipal and industrial demands. Cuts to the aquifer are included in the Summary Budget as an offset to overdraft.

Another mechanism that can be used to assist the AMA in achieving its management goal is unrecoverable recharge (or groundwater augmentation). Although this is rarely, if ever, used, an entity could recharge water for the benefit off the AMA, without accruing long-term storage credits. The stored water does not retain its original legal characteristic but would simply become part of the available groundwater supply for the benefit of all water users in the AMA.

Underground storage and recovery is an important water management tool, but it does not always directly offset overdraft. Although CAGRD replenishment is factored into the Summary Budget, and cuts to the aquifer assist in reaching safe-yield, many of the recharge activities (such as accrual of long-term storage credits) are not factored into the Summary Budget. Even though local water levels may rise in the areas of hydrologic impact of artificial recharge, that water is in effect already spoken for – it has been stored with the intent of recovering it later.

3.4 Offsets to Overdraft

Offsets to overdraft are quantities of water that recharge the aquifer, either as a result of the natural system or cultural activity, and therefore "offset", at least in part, groundwater pumping. These include net natural recharge, incidental recharge, cuts to the aquifer, supplies identified in the AWS Rules, CAGRD replenishment, reclaimed water discharge, and conservation.

3.4.1 Net Natural Recharge

The natural components that affect groundwater overdraft include mountain front recharge, streambed infiltration of runoff, and underflow (subsurface migration of water) into and out of the Pinal AMA. These components are described in more detail below.

Mountain Front Recharge: Mountain front recharge is natural recharge that originates as precipitation falling in the mountains of the Pinal AMA. Precipitation falling in the mountains is a relatively small component of natural inflow to the Pinal AMA (Corkhill, 2005).

Streambed Infiltration: Streambed recharge occurs when precipitation creates flow events that infiltrate into the normally dry beds of the Gila and Santa Cruz Rivers and their tributaries (Corkhill, 2005).

Groundwater Inflow: Groundwater Inflow is water that flows into the Pinal AMA as groundwater flows through Waterman Wash to the west and the Gila River Indian Community to the north. Groundwater enters the Eloy subbasin from the Aguirre Valley Subbasin to the south, from the Tucson AMA south of Picacho Peak, and from the Tucson AMA to the east from Cactus Forest (ADWR, 1999).

Groundwater Outflow: Groundwater outflow occurs when groundwater exits the Pinal AMA in the north end of the Eloy Subbasin north of the Town of Florence and south of Sacaton on the Gila River Indian Community (ADWR, 1999).

The sum of mountain front recharge, streambed infiltration, and groundwater inflow minus groundwater outflow gives the total *Net Natural Recharge*. The amount of Net Natural Recharge can vary from year to year with the amount of precipitation and the timing and magnitude of storm events; however, the rates for mountain front recharge and streambed infiltration used in this Assessment are averages based on historical rates and are held constant through the historical and projected periods (*See Table 3-2*). Average rates for groundwater inflow and groundwater outflow were based on the *ADWR Pinal Regional Groundwater Flow Model* (Corkhill and Hill, 1992).

Table 3-2 Components of Net Natural Recharge 1985, 1995 and 2006

Element of Net Natural Recharge	**Acre Feet/Year**
Mountain Front Recharge	1,000
Streambed Infiltration	36,200
Groundwater Inflow	57,350
Groundwater Outflow	-11,800
Total Net Natural Recharge	**82,750**

All volumes are in acre-feet.

3.4.2 Incidental Recharge

Another offset to groundwater overdraft is incidental recharge. Incidental recharge is a by-product of water used for human activities; one example is percolation of irrigation water below the root zone of irrigated crops. ADWR assigns incidental recharge rates for Municipal, Industrial and Agricultural demands (both on and off Indian Reservations) and for canal seepage (*See Table 3-3)*.

For purposes of this Assessment, incidental recharge for the Municipal and Industrial sectors is assumed to occur in the year the water is applied. However, for the Agricultural sector, the incidental recharge is assumed to gradually reach the water table over a 20-year period, based on information from the ADWR Pinal Regional Groundwater Flow Model (Corkhill and Hill, 1992) and a study by Burgess and Niple (Burgess & Niple, 2004).

The final component of incidental recharge is Canal Seepage, which is the water that seeps annually into the aquifer from canals. Canal seepage for the historical period varies from year to year depending on a number of variables including the volume of water delivered by each irrigation district, and whether the district's canals are lined or unlined. Canal seepage, as opposed to system losses, is that portion of losses that is estimated to infiltrate into the aquifer.

Table 3-3 Incidental Recharge Rates Used in the Summary Budget
1985, 1995, and 2006
Pinal Active Management Area

Source of Incidental Recharge	Percent of Total Demands or Volume Applied to Source of Recharge		
	1985	1995	2006
Municipal Demand			
Municipal Demand	4% of Muni Demand		
Agricultural Demand			
Agriculture	336,234	439,533	182,918
Indian Agriculture			
Industrial Demand			
Turf-related Facilities, Sand and Gravel Operations, and Metal Mines	12%		
Other Industrial Facilities	4%		
Dairies, Feedlots and Power Plants	0%		
Canal Seepage	66,391	64,708	27,488

Note: Agricultural incidental recharge is calculated in the ADWR Pinal Regional Groundwater Flow Model on a cell-by-cell basis. Indian Agricultural recharge is combined with Agricultural incidental recharge through 2006. Volumes are in acre-feet.

3.4.3 Cuts to the Aquifer

Pursuant to Underground Storage and Recovery Program, permitted artificial recharge, in many cases, requires that a certain percentage of the recharged volume is non-recoverable, to benefit the aquifer. These required non-recoverable volumes are called *cuts to the aquifer* and help offset groundwater overdraft. CAP water stored at constructed facilities carries a five percent cut to the aquifer; reclaimed water stored at Constructed USFs carries no cut to the aquifer; and reclaimed water stored at Managed USF carries a 50 percent cut to the aquifer. In addition to the 50 percent cut to the aquifer, reclaimed water delivered to a Managed USF can also offset a portion of the riparian demand in the wash or river where the project is located. The amount of reclaimed water used by the riparian vegetation is calculated and then subtracted from the total amount delivered before the 50 percent cut is calculated for the facility.

3.4.4 Assured Water Supply and CAGRD Replenishment

The AWS Rules require use of primarily renewable supplies, such as CAP water and reclaimed water by DAWS and CAWS issued after 1995. However, pursuant to the AWS Rules, a certain volume of groundwater is allowed to be used. These groundwater allowances are intended to help municipal providers transition from groundwater to renewable supplies. Groundwater use by a DAWS or CAWS can be classified into two categories: allowable groundwater or excess groundwater.

When a CAWS or DAWS is issued, a groundwater allowance account is established. ADWR credits additional allowable groundwater to these accounts based on a number of factors. The AWS Rules allow for a limited volume of groundwater to be pumped based on formulas for each AMA in the AWS Rules. The volume of this allowable groundwater use is reduced over time to zero in 2055 in the Pinal AMA. The AWS Rules also allow for a limited volume of poor quality groundwater, used pursuant to an approved remedial action plan, to be added each year to the groundwater allowance through the year 2025. Additionally, groundwater withdrawn in areas that have been identified by ADWR as “waterlogged” are exempt from the conservation requirements, and may be deemed by ADWR to be consistent with the management goal. The AWS Rules also allow for a DAWS or CAWS to add to the groundwater allowance by extinguishing (or retiring) grandfathered rights (IGFRs, Type 1 and Type 2 rights) within the same AMA. The calculation of these extinguishment credits are contained in the AWS Rules and are calculated differently for each AMA. Finally, a DAWS, regardless of date issued, is annually allocated an incidental recharge volume (four percent of the water provider’s total demand in the previous calendar year), which is credited to their groundwater allowance account. Groundwater use reported pursuant to the provider’s or subdivision’s allowable groundwater volume, is considered consistent with the management goal of the AMA.

In contrast, excess groundwater is not considered consistent with the management goal, and must be replaced by a renewable supply. A provider may choose to utilize their own renewable supplies or can voluntarily join the CAGRD. The CAGRD has the obligation to replenish the amount of excess groundwater reported by member service areas (providers with a DAWS) or member lands (subdivisions issued CAWS) with renewable supplies. CAGRD replenishment must take place within three years after excess groundwater is reported. Excess groundwater must be replenished within the AMA where it was withdrawn, but is not required to be replenished in the same *location* within the same AMA as where it was withdrawn. Excess groundwater is debited in the year it is utilized; however, while the CAGRD has three years to replenish the excess groundwater, for purposes of this Assessment, replenishment by the CAGRD is an offset to overdraft in the same year the groundwater is debited.

3.4.5 Reclaimed Water Discharge

Historically, a modest volume of reclaimed water has been released into the Santa Cruz River from the City of Casa Grande’s wastewater treatment plant. This component has been accounted for in the use sector water budget, not the more regional figure associated with the Santa Cruz river itself.

3.4.6 Contribution of Conservation and Renewable Supplies

Conservation of water supplies, including groundwater, is not explicitly accounted for in the Summary Budget. However, because less groundwater is withdrawn, conservation intuitively provides a clear benefit toward achieving the water management goal. Each water use sector (Municipal, Agricultural and Industrial) has associated conservation requirements that are described in the *Third Management Plan for Pinal Active Management Area, 2000-2010*.

Direct use of renewable supplies also offsets the amount of groundwater that would otherwise be used, and assists in achieving the goal. Management Plan provisions provide incentives for use of renewable supplies including surface water, CAP water, and reclaimed water to meet conservation requirements.

4. CALCULATING OVERDRAFT IN THE SUMMARY BUDGET

The management goal of the Pinal AMA is to maintain the agricultural economy for as long as feasible while preserving water supplies for future non-irrigation uses; therefore, monitoring the effects of the cumulative impacts of demand on the aquifer is critical. The components listed in Section 3 above are included in the Summary Budget and are critical in identifying the AMA's success toward achieving the statutory management goal. If the AMA is consistently using more groundwater than is naturally or artificially replenished it is in a state of overdraft. If more water is being naturally or artificially recharged than is being is withdrawn, the AMA is in a state of safe-yield or surplus. Although the management goal of the Pinal AMA is not to achieve safe-yield, determining the years the AMA is either in safe-yield or overdraft enables ADWR to evaluate if, and what, additional tools may assist the AMA in achieving its management goal.

Table 4-1 lists the various inputs to and withdrawals from the aquifer that are used to estimate groundwater overdraft. Inputs, which are considered additions to the aquifer, include incidental recharge contributed by the various sectors, net natural recharge, cuts to the aquifer as required by the Underground Storage and Recovery statutes, and replenishment by the CAGRD as required by the AWS Rules (See Section 3.4 for a discussion on these components). Withdrawals from the aquifer include withdrawals of groundwater by various water use sectors, riparian demand, and groundwater outflow. In addition, when a farmer uses CAP or reclaimed water in-lieu of groundwater pumping at a GSF, that use is considered a withdrawal because at some unknown point in the future, the storer, such as a municipal provider, will withdraw water from the aquifer.

Table 4-1 Overdraft Inputs and Withdrawals
Pinal Active Management Area

Inputs	Withdrawals
Sector Incidental Recharge	Sector Pumpage
Municipal	*Municipal*
Industrial	*Industrial*
Agriculture	*Agriculture*
Indian Agriculture	*Indian Agriculture and Municipal*
Canal Seepage	Riparian Demand
Net Natural Recharge	
Reclaimed Water Discharge	
CAGRD Replenishment	
Artificial Recharge Cut to the Aquifer	

Note: Estimated Overdraft (with and without the Groundwater Allowance) = Inputs – Withdrawals

Annual groundwater overdraft, or surplus, is calculated by subtracting withdrawals from the inputs, or recharge. If groundwater withdrawals exceed the offsets or inflows, there is overdraft. If groundwater withdrawals are less than the offsets or inflows, there is surplus. Part III describes and quantifies the historical water use and overdraft or surplus for the Pinal AMA for the historical period of 1985 to 2006.

PART III HISTORICAL WATER DEMANDS AND OVERDRAFT

5. HISTORICAL WATER DEMANDS BY SECTOR

The proportion of water demand among the sectors has changed (primarily in the Agricultural and Indian Agricultural sectors) since 1985. In 1985, Municipal demand accounted for less than two percent of the total AMA demand, Agricultural demand accounted for an additional 92 percent and Industrial demand accounted for less than one percent. The remaining five percent of AMA demand was Indian demand. In 1995, Municipal demand still accounted for less than two percent of the total AMA demand, Agricultural demand was down to 83 percent of the total AMA demand and Industrial demand was also still less than one percent. The remaining 15 percent was for Indian demand. The proportion of use by sectors in 2006 was similar to 1995: Municipal demand was three percent, Industrial was two percent, Agriculture was eighty percent and Indian Agriculture remained at fifteen percent (ADWR, 2011).

Historically, water users in the Pinal AMA have been groundwater dependant. Although the use of CAP water increased and groundwater use decreased during the first part of the historical period, demand has been slowly increasing as Municipal, Industrial, and Indian uses grow, and the agricultural economy continues to fluctuate. Groundwater remains the primary source of supply for water users in the AMA. The Agricultural sector, the largest water-using sector in the Pinal AMA, began receiving direct delivery of CAP water in 1987. Peak delivery occurred in 2003. Indian agricultural users are also increasingly taking advantage of utilization of CAP water. To a somewhat lesser extent, municipal and industrial users in the AMA have started using small volumes of CAP water. Historical demand and supplies for each sector are discussed in more detail below.

5.1 Municipal Sector Demands and Supplies

The Municipal sector in the Pinal AMA includes six categories of water users: Large, large untreated, small, and institutional providers, domestic exempt well users and individual users. The Arizona Corporation Commission regulates four of the six large providers and ten of twenty-nine small providers in the Pinal AMA as private water companies. The other providers are cities, towns, domestic water improvement districts, community facilities districts, cooperatives, mobile home parks, and providers serving specific locations such as colleges and small correctional facilities.

5.1.1 Municipal Demands

Municipal water demand has more than doubled in the Pinal AMA since 1985 (*See Table 5-1*). Large providers, including two that were recently established, account for most of this increase. Institutional provider water use has also dramatically increased since 1985 as inmate numbers have grown and prison facilities have expanded. In contrast, small provider demand has remained fairly constant. *Figure 5-1* shows the locations of the large and small provider service areas.

5.1.2 Municipal Supply

Groundwater is still the largest source of supply used in the Municipal sector. Since CAP water became available and was first used in 1994, its use has increased. Direct use of reclaimed water has also increased. Supplies utilized by municipal providers are illustrated below in *Figure 5-2*.

Table 5-1 Municipal Water Demand
1985, 1995 and 2006
Pinal Active Management Area

Municipal Use Category	**1985**	**1995**	**2006**
Large Providers			
Number	4	4	6
Total Use	12,694	12,923	25,105
Groundwater Use	9,530	12,647	22,387
Small Providers			
Number	23	23	29
Total Use	2,426	2,079	2,042
Groundwater Use	2,426	2,079	2,042
Institutional Providers			
Number	2	3	3
Total Use	913	2,104	2,538
Groundwater Use	913	2,104	1,530
Urban Irrigation			
Number	2	2	2
Total Use	115	735	526
Groundwater Use	115	176	179
Domestic Well Use			
Number	928	1,144	2,214
Total Use	622	1,282	2,757
Groundwater Use	622	1,282	2,757
AMA Total Use	**13,607**	**19,122**	**32,968**
AMA Total Groundwater Use	**13,607**	**18,288**	**28,895**

Note: All water volumes are in acre-feet. Thunderbird Adventist is included as a Large Untreated Provider in the Third Management Plan but uses less than 100 acre-feet on untreated water in some years and so was included in the small provider category.

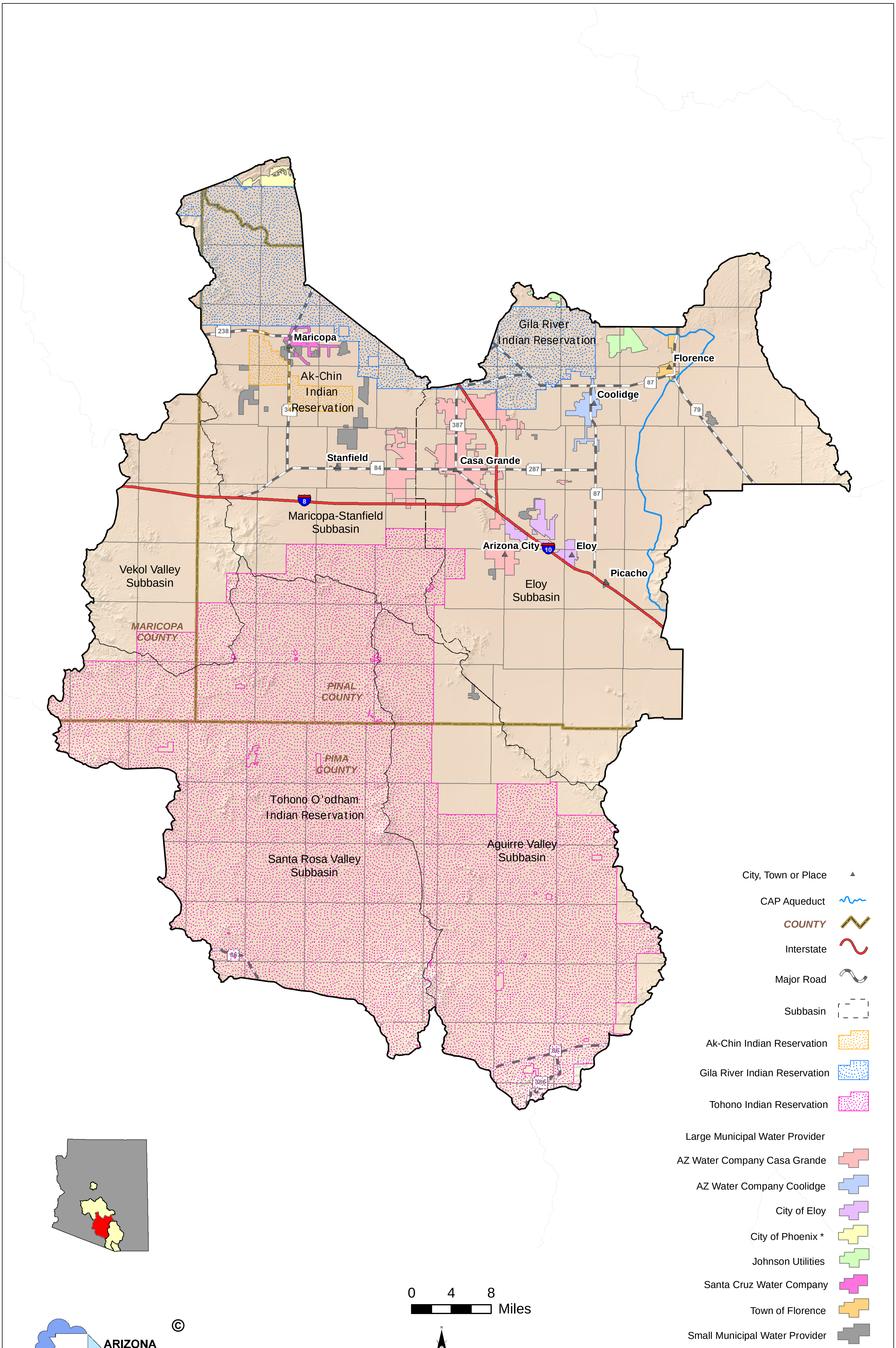
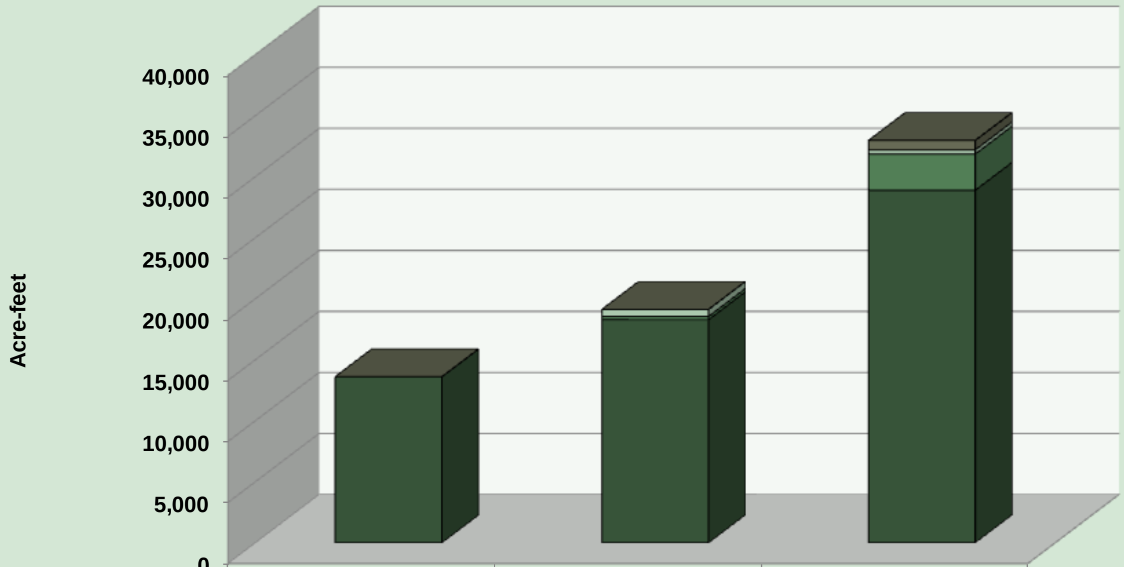


Figure 5-1
Pinal AMA
Municipal Water Providers

*Note: The City of Phoenix serves water inside the Pinal AMA, however, any groundwater served is withdrawn within the Phoenix AMA

**Note: The Santa Cruz Water Company serves the 387 Water Improvement District

Figure 5-2 Historical Municipal Supplies, 1985, 1995 and 2006
Pinal Active Management Area



	1985	1995	2006
TOTAL	13,607	19,122	32,968
Reclaimed Water	0	0	765
Surface Water	0	558	347
CAP	0	276	2,961
Groundwater	13,607	18,288	28,895

5.1.3 Large Municipal Providers

Large Provider Water Use Characteristics

There are currently six large municipal providers and three institutional providers in the Pinal AMA (*See* Figure 5-1). As shown in *Table 5-1*, large municipal providers still meet most of their demand with groundwater. CAP use, which began in 1994, has been steadily increasing. Large municipal providers' primary use of CAP water is storage and recovery, although some untreated direct use also occurs. To date, no municipal CAP water is treated at a water treatment plant and delivered. Reclaimed water supplies have been used since 1999. Some reclaimed water is stored and recovered; a small amount is delivered for direct use. The two prisons regulated as institutional providers rely exclusively on groundwater. The third institutional provider, a resort and golf course, uses untreated CAP water and some reclaimed water to meet turf-related demands.

Large Provider Demand and Supply

Large provider demand has increased steadily since 1985, almost doubling between 1985 and 2006. In the Template, the three institutional providers, Arizona State Prison – Florence, Arizona State Prison – Eyeman, and Francisco Grande Utility Company are included in the large provider category. However, they are discussed as a separate category of municipal use and are separated out from the large provider demand category in this Assessment.

Arizona Water Company – Casa Grande has historically been the largest water provider in the Pinal AMA, representing 60 percent of the large municipal provider demand and over 40 percent of the total Municipal sector demand in 1985. In 2006, it represented 55 percent of the large municipal provider demand and more than 42 percent of the total Municipal sector demand. In

2006, Arizona Water Company's demand was met with nine percent CAP water and the rest of the demand was met with groundwater.

The Santa Cruz Water Company is the second largest municipal provider in the Pinal AMA based on the amount of water served in 2006. The water company was established in 2002 and was noticed as a large provider in 2007. The service area has grown rapidly from an initial water demand of 276 acre-feet to a demand of 4,278 acre-feet in 2006. This represents 17 percent of the large municipal provider demand. Santa Cruz Water Company started using reclaimed water in 2005. By 2006, reclaimed water met 9 percent of the provider's demand. The remaining demand was met with groundwater. The Santa Cruz Water Company began serving the nearby 387 Water Improvement District in 2006 because the 387 District was experiencing water quality problems. The 387 District's service area right was inactivated in 2009. The Santa Cruz Water Company supplies and reports all water used in the area that was formerly the 387 District's service area.

The *Town of Florence,* which is the third largest provider in the Pinal AMA, has experienced fluctuating but increasing demand. In 1999, the Town of Florence water system merged with the Florence North system. In 1985, the two systems combined demand was 970 acre-feet. In 2006, the demand of the combined system was 2,399 acre-feet, an increase of nearly 150 percent. Beginning in 1999, Town of Florence started storing CAP and reclaimed water. Small amounts of both supplies have been recovered since 1999. In 2006, Florence met 84 percent of its demand with groundwater, 13 percent with recovered CAP and nearly four percent with reclaimed water. The Town of Florence does not serve the inmate population of the prison located within the town.

Although the *City of Eloy's* demand has fluctuated from year to year, it has steadily increased from 1,636 acre-feet in 1985 to 2,238 acre-feet in 2006. Similar growth in demand is seen in the *Arizona Water Company – Coolidge which increased* from 1,350 acre-feet in 1985 to 2,032 acre-feet in 2006. *Johnson Utilities* is a private water company with relatively limited demand in the Pinal AMA. In 2006, its demand was approximately 220 acre-feet. Johnson Utilities and Arizona Water Company – Coolidge have relied on groundwater to meet their demands, however, City of Eloy has stored and recovered CAP and reclaimed water. Although Eloy relied entirely on groundwater in 1985, by 2006 less than 66 percent of Eloy's demand was met with groundwater, 23 percent was met with CAP and more than 11 percent was met with recovered reclaimed water.

Factors Affecting Large Provider Water Use

Groundwater supplies in the Pinal AMA are plentiful and relatively inexpensive compared to the infrastructure costs associated with treating and delivering CAP water or treated wastewater. The Pinal AMA lacks a large surface water reservoir for municipal purposes, and there are no surface water treatment facilities that can treat either surface water or CAP water. As a result, renewable supplies must either be stored and recovered or delivered as untreated water for landscape irrigation. CAP water is stored through GSFs and reclaimed water is stored at USFs. As of 2006, the volume of reclaimed stored is only been a small fraction of the volume of permitted storage.

The Pinal AMA, with its unique water management goal, is treated differently in the AWS Rules than the safe-yield AMAs. The AWS Rules grant an allowance of groundwater to new subdivisions obtaining a CAWS or to water providers obtaining a DAWS. In the three safe-yield AMAs, the groundwater allowance is a finite volume that once used, is not renewed. In the Pinal AMA, where the water management goal is not safe-yield, a much larger allowance of groundwater was granted by the AWS Rules. Until the AWS Rules were modified in September 2007, the groundwater allowance in the Pinal AMA was perpetual, renewing every year with any unused allowance from the previous year rolling over to the next. This generous allowance of groundwater did not encourage providers to switch to renewable supplies. As of September 2007, more than 50,000 acre-feet per year of groundwater allowance for new subdivisions was issued. This allowance will continue to renew annually in perpetuity. Any new development without a sufficient groundwater allowance to meet the water management goal under the AWS Rules can enroll in the CAGRD and continue to utilize groundwater. Only the excess portion of groundwater use, which is reported to the CAGRD each year, must be replenished.

The full impact of the building boom has not yet been reflected in the increases in water demand between 1985 and 2006. Water demand represented by approved developments that have not broken ground is far greater than current municipal sector use. Between 2000 and 2006, overall municipal demand increased less than 10,000 acre-feet. During that same period, over 100,000 acre-feet per year of new subdivision build-out demand was issued a CAWS, and more than 90,000 acre-feet per year of additional demand was included in DAWS (*See Table 5-2)*.

Table 5-2 Designated Water Providers
Pinal Active Management Area

Municipal Provider	Date Designation Issued or Modified	Projected Estimated Demand	Year of Projected Estimated Demand
City of Casa Grande	8/4/2003	4,113	2013
City of Eloy	2/20/2007	49,159	2015
Johnson Utilities	12/1/2008	1,595	2017
Santa Cruz Water Co.	12/27/2007	23,979	2013
Town of Florence	1/24/2005	12,310	2014

Note: Volumes are in acre-feet.

Institutional Providers

Institutional Provider Water Use Characteristics

There are three institutional providers in the Pinal AMA; of these two are prisons. Institutional provider demand has increased more than 175 percent from 1985 to 2006, from 913 acre-feet in 1985 to 2,538 acre-feet in 2006.

Arizona State Prisons - Florence and *Eyeman* are institutional providers that have grown significantly since 1985. Their combined demand in 1985 was 913 acre-feet. By 2006, it had increased to 1,530 acre-feet, or over 6 percent of large municipal provider demand.

Francisco Grande Utility Company is unique as an institutional provider. It serves only the Francisco Grande Resort, a turf-related facility. In 2003, the golf course began receiving untreated CAP water wheeled from Arizona Water Company. The golf course uses a small amount of direct use reclaimed water.

Institutional Provider Demand and Supply

The two prisons rely on groundwater to meet their demands. Francisco Grande uses CAP for golf course irrigation.

Factors Affecting Use

Demand will increase as existing prisons expand or new prisons are constructed.

5.1.4 Small Municipal Providers

Small Provider Water Use Characteristics

The number of small municipal providers has averaged 25 since 1985 and demand has remained relatively unchanged (*See Table 5-1*). During the recent building boom, four new small providers established service areas. Small providers rely solely on groundwater.

Small Provider Demand and Supply

Between 1985 to 2006, small provider demand has fluctuated, but has ranged between 1,585 and 3,322 acre-feet. In 2006, small provider demand was 2,042 acre-feet and represented six percent of total municipal demand.

Small providers within the Pinal AMA use 100 percent groundwater; none have CAP allocations.

Factors Affecting Small Provider Water Use

Small providers have little incentive to initiate use of renewable supplies. New subdivisions, served by small providers that have not obtained a DAWS, must obtain a CAWS. If the CAWS is issued, the subdivision can meet the consistency with the management goal requirement through a combination of using their groundwater allowance, extinguishment credits, and/or by joining the CAGRD as a member land. As with large providers, the generous groundwater allowances granted in the AWS Rules will last many subdivisions into the near future.

5.1.5 Urban Irrigation

The number of large untreated water providers has not increased, nor will it increase because to qualify as a large untreated water provider the provider must have been delivering untreated water prior to January 1, 1990. Large untreated water providers are limited to delivering four acre-feet per acre per year.

Urban Irrigation Demand and Supply

Large untreated water provider demand was approximately 115 acre-feet in 1985; it had increased to approximately 735 acre-feet by 1995. Demand fluctuated from year to year between 1996 and 2006. The highest demand, approximately 3,364 acre-feet, occurred in 2002; the lowest demand occurred in 1985.

Surface water is the primary supply for urban irrigation, but its availability varies. Groundwater is the second most common supply. A small amount of CAP water has also been used, but this is atypical for this municipal subsector. In years when surface water supply has been less than average, groundwater has been the second most used source of supply; CAP water use has also been higher in low surface water supply years.

Factors Affecting Urban Irrigation Use

Surface water supply has the greatest effect on water use in the urban irrigation sector. In addition, the limitations on adding no more large untreated water providers to the AMA will limit the use in this subsector.

5.1.6 Exempt Well Demand and Supply

The number of exempt wells has increased steadily from 928 in 1985 to 2,214 in 2006. In recent years, exempt well demand has surpassed small provider demand.

Exempt Well Demand and Supply

Exempt well owners are not required to report volume used or number of people relying on the exempt well. Because of this, exempt well demand and population was calculated by subtracting the known populations of the large providers, small providers, and Indian communities from the 2000 US Census population for the AMA. The Pinal County historical growth rate was used to regress from the year 2000 exempt well population to an estimate of the 1985 exempt well population. The same growth rate was used to estimate exempt well population from 2001 through 2006. This method yielded exempt well populations of 2,666 people in 1985 and 11,814 people in 2006.

The exempt well water demand can only be estimated because the statutes do not require reporting by exempt wells. In previously published documents, ADWR has used an assumption of between 0.5 and 1.0 acre-feet per well per year. For this Assessment, ADWR used a different approach. The interior and exterior demand models for new single-family development (ADWR, 2003) and the 2000 US Census average persons per household for Pinal County were used to estimate exempt well demand. This method estimated that exempt well demand is 0.34 acre-feet per household.

Exempt wells are assumed to use 100 percent groundwater.

Factors Affecting Exempt Well Use

Because exempt wells are unregulated, there is no requirement or incentive to use renewable water supplies. Under the AWS Rules, dry lot subdivisions of twenty or fewer lots are not required to meet the consistency with management goal requirement. A dry lot subdivision is a development where each lot purchaser is responsible for drilling and maintaining their own private domestic exempt well. Consequently, new exempt wells added to the AMA in small subdivisions or through un-subdivided lot splits do not join the CAGRD and their withdrawals of groundwater are not replenished.

5.1.7 Individual User Water Use Characteristics

Water demands for individual users are included in the demands for large, small and institutional providers – although they have their own conservation requirements under the Industrial Conservation Program in the Management Plans. Of the twelve individual users in the Pinal AMA, nine are schools and three are golf courses. Francisco Grande Resort, a golf course regulated as an individual user, is served by the Francisco Grande Utility Company. However, in recent years Arizona Water Company has provided potable water to the resort and untreated CAP and reclaimed water to the golf course. The total individual user demand in 2006 was 1,458 acre-feet, of which 88 percent was CAP water, six percent was reclaimed water and five percent was surface water. The remainder was groundwater.

5.2 Industrial Sector Demands and Supplies

The Code defines industrial use as a non-irrigation use of water not supplied by a city, town, or private water company, including animal industry use and expanded animal industry use. In general, industrial users withdraw water from their own wells that are associated with grandfathered groundwater water rights (Type 1 and Type 2 rights) or withdrawal permits (*See Table 5-3*). Although industrial users are primarily dependant on groundwater, some use renewable supplies such as CAP water or reclaimed water. Historically, industrial uses in the Pinal AMA have include dairies, turf-related facilities, cattle feedlots, sand and gravel operations, metal mining, and more recently, electric power generation. For more information regarding Industrial users, refer to Section 3.1.2.

5.2.1 Overview of Industrial Rights and Authorities

Type 1 and Type 2 rights are the predominant withdrawal authority used by Industrial users. Industrial users can also withdraw water pursuant to groundwater withdrawal permits such as GIU permits or Mineral Extraction permits (limited permits used for mining operations or sand

and gravel operations). All of these rights and permits have an allotment associated with them that limits the amount of water that can be withdrawn on an annual basis. In addition to these associated right and permit allotments, certain types of industrial facilities are subject to conservation requirements that may impose additional restrictions on the amount of water that can be used at a facility.

Industrial use is dependent on population growth and the economy. In some cases, the difference between the actual water use and the total allotment is substantial (*See Table 5-3)*, and is generally explained as a result of the allocation process used to establish Type 2 rights. This process assigned users allotments based on the highest annual groundwater withdrawal between the years 1975 and 1980. In the year 2006, approximately 35 percent of the Pinal AMA's industrial rights and permit volumes are utilized.

Table 5-3 Industrial Groundwater Rights and Withdrawal Summary 2006

User Category	Right or Permits	Number of Facilities	Right or Permit Volume	Groundwater Use	Total Water Use
Dairies	Type 1 & Type 2; GIU Permit	25	16,195	8,400	8,400
Turf-Related Facilities	Type 1 & Type 2; GIU Permit	27	12,028	3,194	6,286
Feedlots	Type 2 & GIU Permit	8	4,954	3,033	3,033
Sand and Gravel Facilities	Type 2 – Mineral Extraction; Mineral Extraction Permit	15	6,245	1,199	1,199
Metal Mines	*Type 1; Dewatering and Mineral Extraction Permits*	3	4,512	0	0
Large-Scale Power Plants	Type 1	1	70	0	96
Other Industrial Facilities	Type 1 & Type 2; GIU Permit	130	12,929	1,225	1,229
Total		**209**	**56,933**	**17,051**	**20,243**

Note: All water values are in acre-feet.

5.2.1 Industrial Demand and Supply by Subsector

The Industrial sector in the Pinal AMA was relatively small and stable between 1985 and 1995. Total Industrial water use in the Pinal AMA was 4,955 acre-feet in 1985 and 5,697 in 1995 and represented less than one percent of the Pinal AMA's total water demand (*See Table 5-4*). During that period, turf facilities and cattle feedlots dominated the Pinal AMA's industrial water use. However, the picture changed dramatically in the next decade when dairy water use grew exponentially (*See Figure 5-4, Figure 5-5,* and *Figure 5-6*) and total water demand for the Industrial sector increased to 20,243 acre-feet.

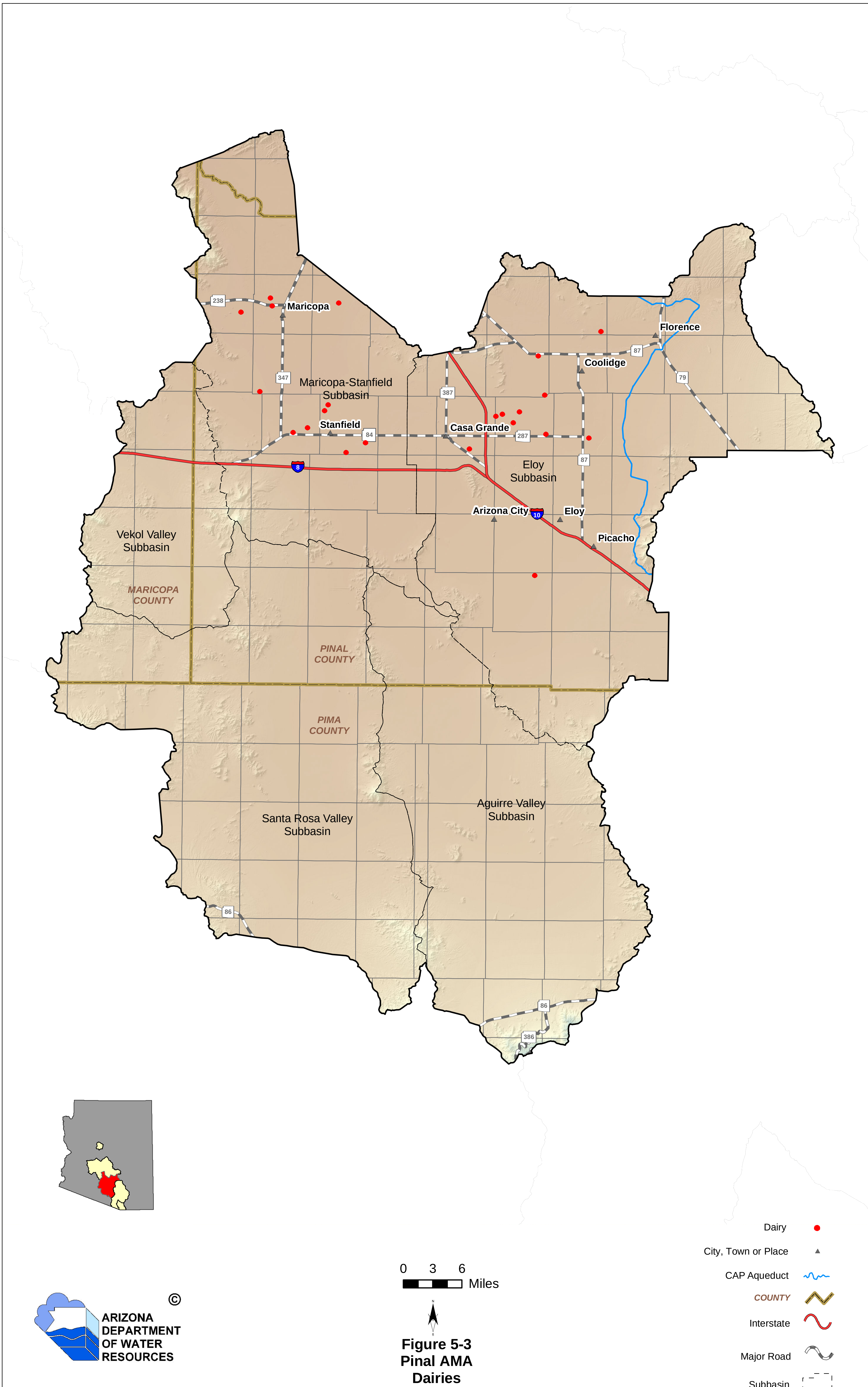


Figure 5-3
Pinal AMA
Dairies

Table 5-4 Industrial Water Demand by Subsector
1985, 1995 and 2006

Type of Facility	1985	1995	2006
Dairies	245	1,030	8,400
Turf-Related Facility	*1,280*	2,289	6,286
Feedlots	2,370	1,334	3,033
Sand and Gravel Operations	557	253	1,199
Metal Mines	25	29	0
Large Scale Power Plants	0	0	96
Other Industrial Users	478	712	1,229
Total	**4,955**	**5,647**	**20,243**

Note: All values are in acre-feet.

Historically, groundwater has been the primary supply for industrial water use in the Pinal AMA; however, CAP and reclaimed water are a small but increasing percentage of the total supply (*See Figure 5-4*). Each sub-sector of Industrial water demand and supply are discussed below.

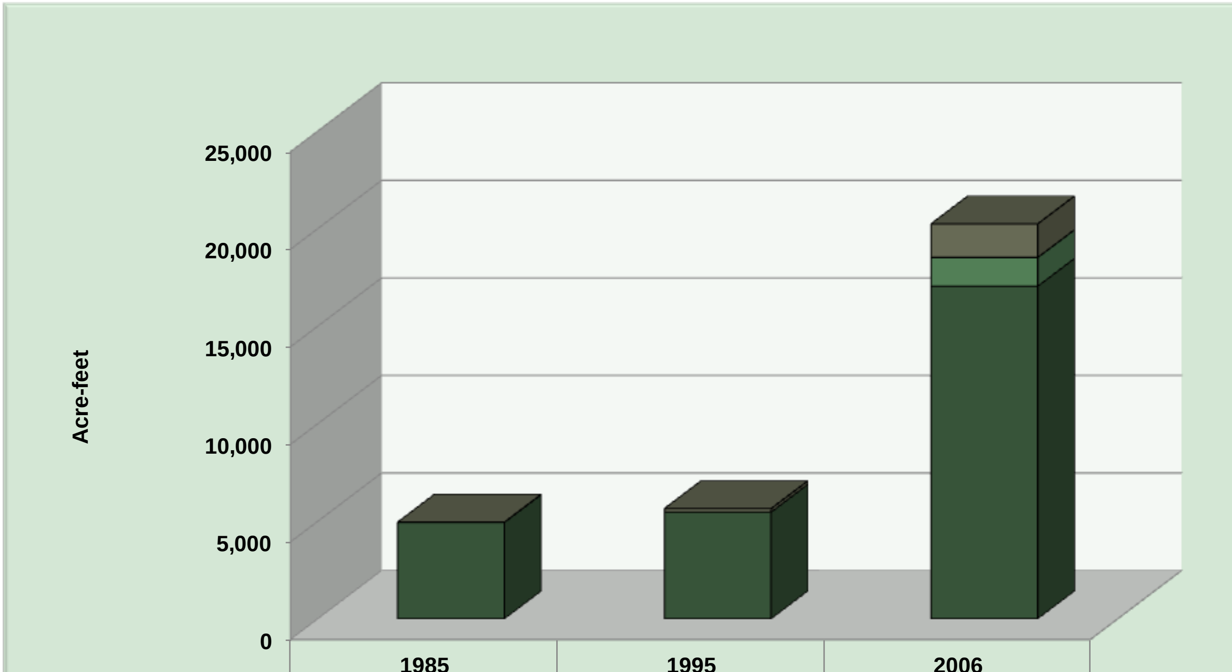
Dairies

Dairies have always been an important component of the Pinal AMA industrial sector. In 1995, nine dairies used a total of 1,030 acre-feet of water. By 2006, water use by dairies had increased dramatically, and annual use had reached approximately 8,400 acre-feet. This represents over 40 percent of the AMA's total industrial water demand. The growth in dairy subsector water use over the last decade was due primarily to the relocation of a number of Phoenix dairies to the Pinal AMA, however ADWR data indicates that this trend has recently leveled off and no new dairies are planned. Rapid urbanization and high land prices in the Phoenix area forced many dairy operations to move south into Pinal County and between 2000 and 2006, 16 dairies were constructed in the Pinal AMA bringing the total to 25. Historically, all dairy water use in the Pinal AMA has been groundwater. Dairies located in the Pinal AMA are shown in *Figure 5-3*.

Turf-Related Facilities

A turf-related facility is defined in the *Third Management Plan for the Pinal Active Management Area 2000 - 2010* as a facility with 10 or more acres of water intensive landscaped area. Turf-related facilities in the Pinal AMA are generally parks, schools, golf courses and subdivision common areas. In 2006, there were 40 turf-related facilities in the Pinal AMA. Total water use by all turf-related facilities was 6,286 acre-feet in 2006. Thirteen of these facilities received all or a portion of their water from municipal providers and were classified as *individual users.* Their use is included in the water demand for the Municipal sector. The remaining 27 turf-related facilities are Industrial users that either were in existence before the Code and use Type 2 rights or were developed after the Code on retired agricultural land using Type 1 rights or have a groundwater withdrawal permit such as a GIU permit. This industrial subsector has grown significantly from using 1,280 acre-feet of water in 1985 to using 6,286 acre-feet in 2006. By 2006, dairies had replaced the turf-related facility subsector as the greatest Industrial demand subsector in the Pinal AMA.

Figure 5-4 Historical Industrial Supplies 1985, 1995 and 2006
Pinal Active Management Area



	1985	1995	2006
TOTAL	4,955	5,647	20,243
Reclaimed Water	9	176	1,715
Surface Water	0	0	15
CAP	0	0	1,462
Groundwater	4,946	5,471	17,051

Figure 5-5 Proportion of Industrial Demand by Subsectors 1985
Pinal Active Management Area

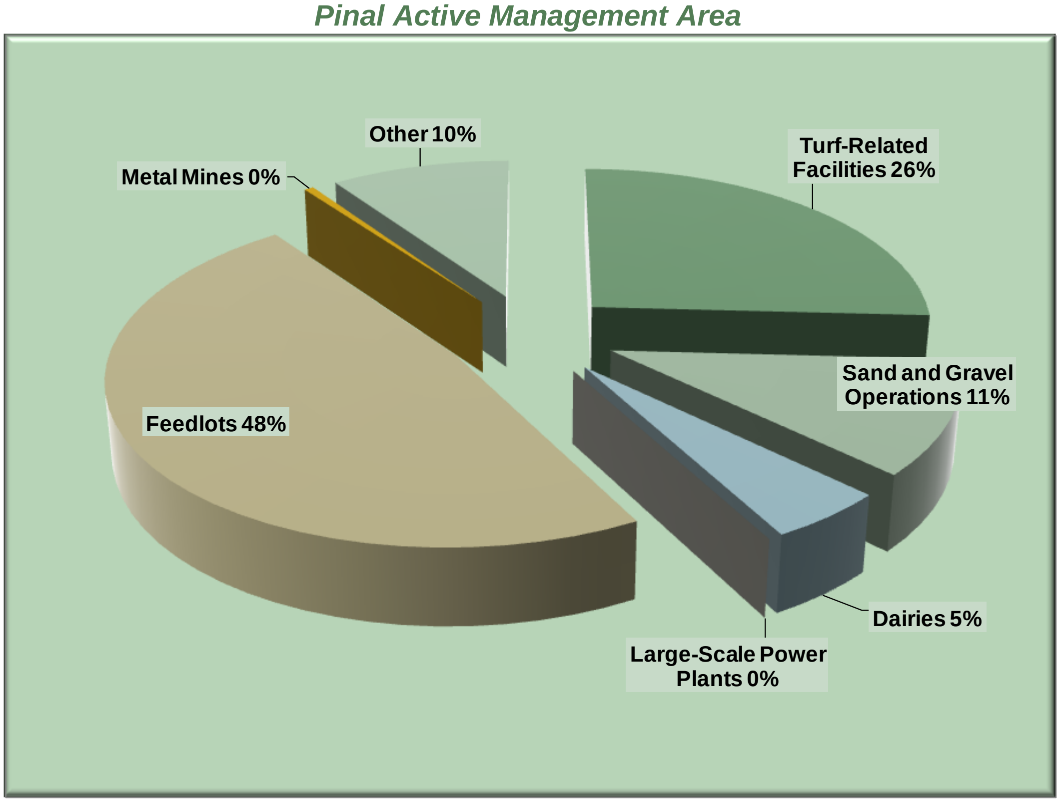
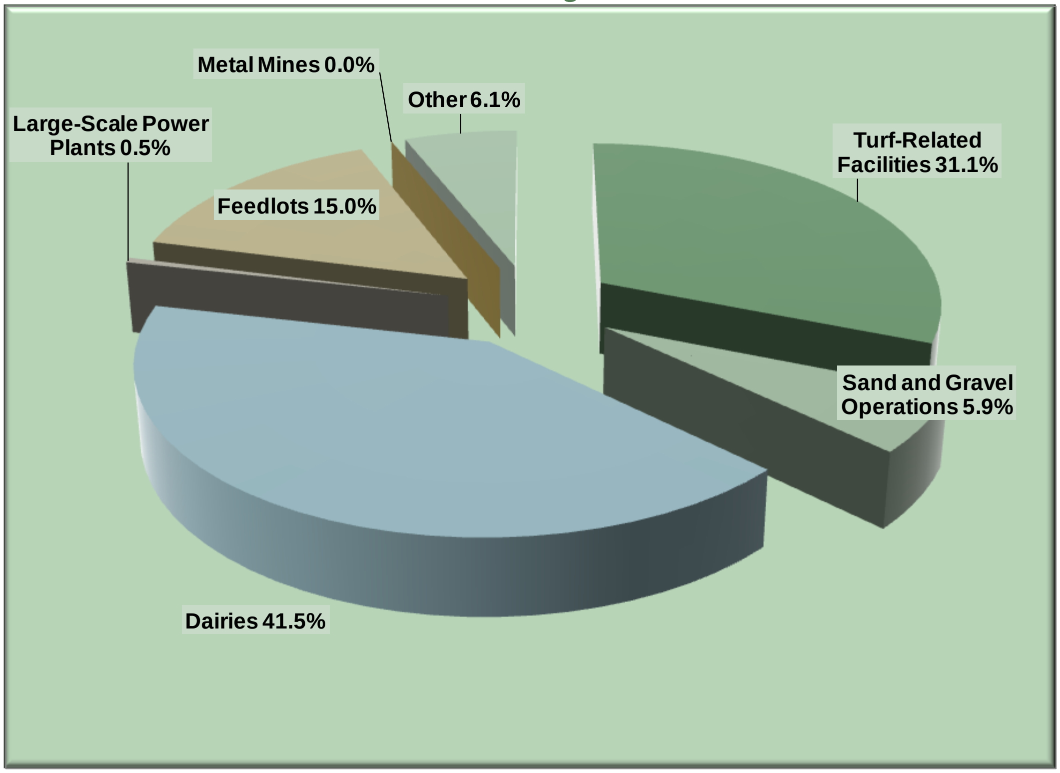


Figure 5-6 Proportion of Industrial Demand by Subsectors 2006
Pinal Active Management Area



In 2006, there were twelve golf courses in the Pinal AMA. Nine were considered Industrial users and the other three were municipally served (or individual users). Golf courses in the Pinal AMA used 4,852 acre-feet of water in 2006. Approximately 30 percent of this use was groundwater. Turf-related facilities that use any groundwater, regardless of whether they are Industrial users or served by a municipal provider, must comply with a maximum annual water allotment based on the size and age of the facility.

Feedlots

In 1985, 2,370 acre-feet of water was used by feedlots in the Pinal AMA. In 2006, there were eight feedlots in the Pinal AMA using 3,033 acre-feet of water. There are no new feedlots expected within the AMA.

Sand and Gravel

Sand and gravel facilities in the Pinal AMA used 253 acre-feet of water in 1995 and 1,199 acre-feet in 2006. In 2006, there were fifteen active sand and gravel operations in the AMA. Water in this subsector is primarily used to wash aggregate before sale; a small amount is used to clean trucks and equipment. Increase in sand and gravel production and associated water use is closely tied to population growth and urbanization. Sand and gravel operations in the Pinal AMA have historically relied solely on groundwater.

Metal Mining

Metal mining has always been present in the Pinal AMA, however, it has not been a significant subsector use and it has remained relatively static for decades. There are currently three mines in the Pinal AMA. The Lakeshore mine, owned by Freeport McMoRan, is located on the Tohono O’odham Reservation. When in operation it uses approximately 1,000 acre-feet of water per year (ADWR, 1994). The other two mines in the Pinal AMA are in-situ mines that have been relatively inactive in the last decade. Generally, in-situ mining uses less water than the open pit mining found in the Tucson AMA. Historically, metal mining in the Pinal AMA has relied on groundwater.

Large Scale Power Plants

In 2006, there were two electric power plants located in the Pinal AMA; both were built after 1995. One of these power plants, APS Sundance, is considered an industrial user because it does not receive water from a municipal source. The SRP power plant (formerly Reliant) used 1,030 acre-feet of municipally served CAP water in 2006.

Historically, power plants in the Pinal AMA have used CAP water. This subsector used 96 acre-feet of water in 2006.

Other Industrial

"*Other*" Industrial is a water use category that typically includes a variety of commercial and manufacturing uses that to do not fit into the subsectors listed above. Other Industrial water use has increased between 1985 and 2006. Water use in this subsector was 478 acre-feet in 1985 and 1,229 acre-feet in 2006.

5.3 Agricultural Sector Demands and Supplies

5.3.1 Overview of Agricultural Rights and Allotments

As mentioned previously, only land associated with a certificate of IGFR can legally be irrigated with groundwater within an AMA (*See Figure 5-7)*. IGFRs are categorized as either non-exempt or exempt. Non-exempt IGFRs have specific conservation requirements established in the Management Plan for each management period. Exempt IGFRs, which are ten acres or less and not part of an integrated farming operation, are no longer required to comply with specific conservation requirements. For more information on IGFRs, refer to Section 3.1.3.

Since the Code generally prohibits newly irrigated acres, the total number of IGFR certified acres has decreased over time as lands have urbanized (*See Table 5-5)*. The decrease in allotments was due in part to the reduction in acreage, but it was also due to reductions in assigned irrigation efficiencies, as a result of Management Plan requirements. Historically, use has been substantially lower than allotments; in the future, use may exceed allotments because of flexibility accounting provisions in the Base Program. For more information on flexibility accounting, refer to the *Third Management Plan for Pinal Active Management Area, 2000 – 2010* (ADWR, 1999) (ADWR, 2003).

5.3.2 Agricultural Demands and Supplies

Agriculture is the largest demand sector in the Pinal AMA although Municipal and Industrial uses have increased somewhat since 1985. In 1985, the Agricultural sector demand equaled 92 percent of the total AMA demand. In 2006, this sector's demand was at 80 percent.

Cropping patterns have changed significantly over the historical period because of changes in global and regional market conditions and local growing conditions. From 1985 through 1995, the primary crops grown in the AMA were cotton, wheat, and alfalfa. Upland cotton acreage has remained fairly constant; however, Pima cotton production declined rapidly in the early to mid-1990s because of pest problems. Alfalfa and other hay production has increased greatly in response to the expansion of the dairy industry in the Pinal AMA; corn and grain sorghum have also become important feed crops.

Table 5-5 Agricultural Total Water Use, Certified Irrigation Acres and Allotments By Non-Exempt Irrigation Grandfathered Rights 1985, 1995, and 2006 Pinal Active Management Area

Year	Total Water Use	Certified Irrigation Acres	Allotments
1985	749,342	281,962	1,213,480
1995	833,935	277,901	1,070,722
2006	761,983	265,598	838,898

Note: All values are in acre-feet.

Extinguishment of IGFRs pursuant to the AWS Rules between 1985 and 2006 accounts for 8,694 acres in the Pinal AMA that can no longer be used for agricultural productions. Extinguishment of these rights generated 13,014 acre-feet of extinguishment credits, which can be used to help meet the consistency with management goal criteria of proving a 100-year AWS.

5.3.3 Non-Exempt IGFR Water Use Characteristics

Demand in the Agricultural sector has averaged over 800,000 acre-feet since 1985 (*See Table 5-5*). Although it appears that use has declined since 1995, there has always been the potential for significant annual fluctuation in water use. In 1996, the highest use year on record, over a million acre-feet were used. In 2006, an average use year, 819,894 acre-feet were used. Over 90 percent of this demand was delivered by the four major irrigation and drainage districts in the Pinal AMA (*See Figure 5-8).*

Demand and Supplies by District and Non-District

The Central Arizona Irrigation and Drainage District (CAIDD) is the largest irrigation district in the Pinal AMA in terms of irrigated acreage in 2006. Approximately 60 percent of CAIDD acreage was irrigated yearly between 1996 and 2006, requiring an average of 236,000 acre-feet of water. The primary crops grown in the district are cotton, small grains, alfalfa, pecans, citrus and other specialty crops. Changes in water costs and market conditions affect overall water demand. Lower water costs that were a result of CAIDD's debt restructuring from 1994 to 1996 caused demand from 1996 to 2006 to be significantly higher than from 1985 to 1995 (CAIDD, 2008). Approximately 50 percent of CAIDD's supply is CAP water; the balance is groundwater or in-lieu groundwater.

Maricopa-Stanfield Irrigation and Drainage District (*MSIDD)*, the second largest irrigation district in the Pinal AMA in terms of acreage, included approximately 77,300 irrigation acres in 2006. Between 60 and 65 percent of MSIDD acreage was irrigated yearly between 1996 and 2006, requiring an average of 258,000 acre-feet of water. The primary crops grown in the district are cotton, small grains, alfalfa, pecans, and other specialty crops. Changes in water costs and market conditions have affected overall water demand; however, demand has stabilized as hay and feed cropping has increased to supply dairies moving into the Pinal AMA. Approximately 45 percent of MSIDD's supply is CAP water; the balance is groundwater or in-lieu groundwater.

Hohokam Irrigation and Drainage District (HIDD) included approximately 27,000 irrigation acres in 2006. Approximately 80 percent of HIDD acreage was irrigated yearly between 1996 and 2006, requiring an average of 120,000 acre-feet of water. The primary crops grown within the district are cotton, alfalfa, small grains, field grains, melons, and other specialty crops. Changes in water costs and market conditions have affected overall planted acreage and water demand.

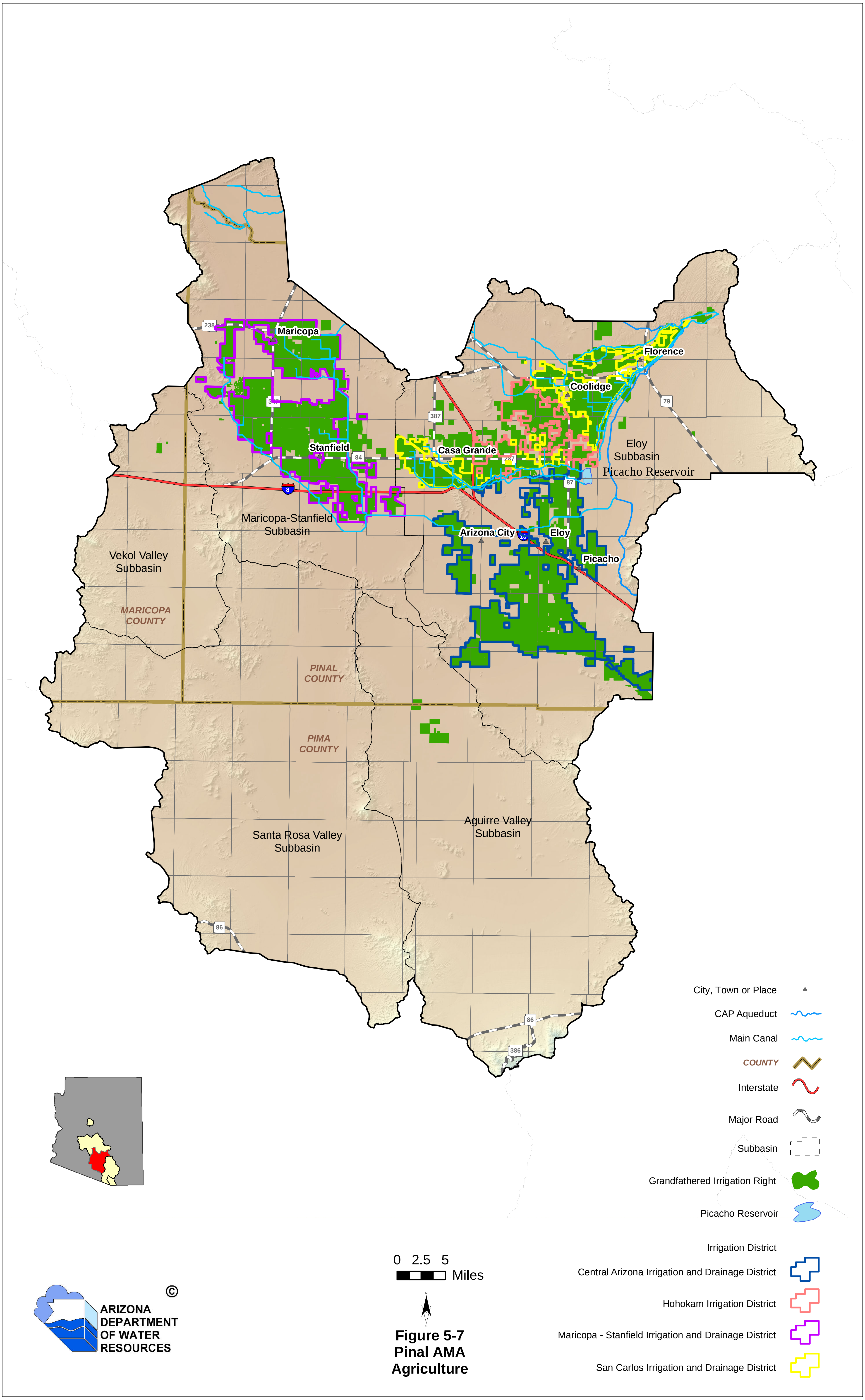
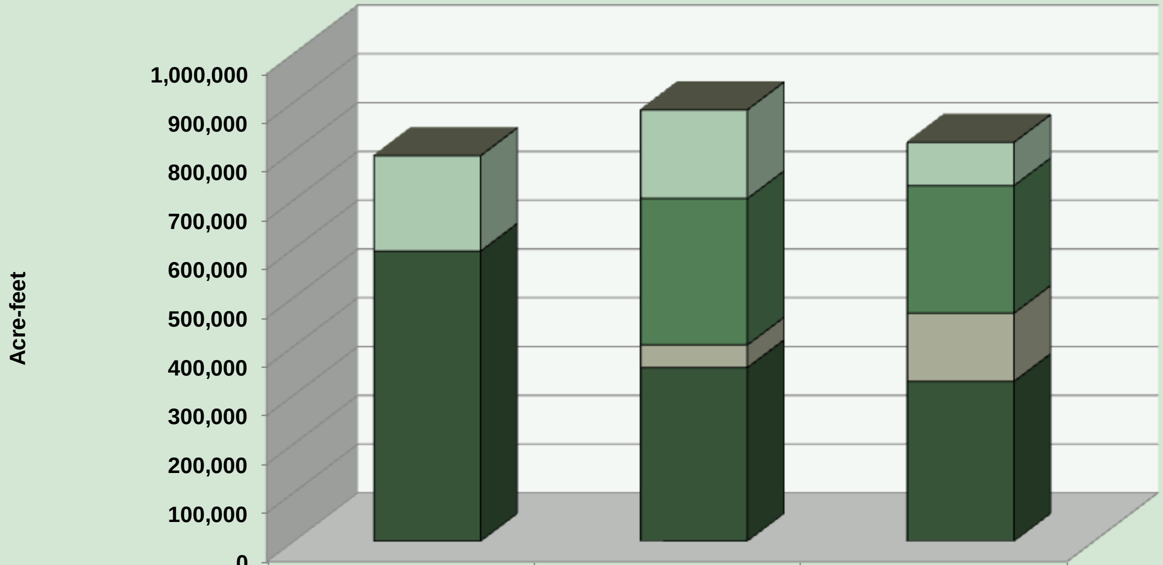


Figure 5-7
Pinal AMA
Agriculture

Figure 5-8 Historical Agricultural Supplies, 1985, 1995, and 2006
Pinal Active Management Area



	1985	1995	2006
TOTAL	792,092	885,900	819,894
Reclaimed Water	1,839	1,626	2,325
Surface Water	195,409	181,892	88,653
CAP	0	300,145	261,598
In-Lieu Groundwater	0	46,254	139,616
Groundwater	594,844	355,983	327,702

Lower water costs resulting from changes in CAP rates and variations in the local agricultural economy caused demand from 1996 to 2006 to be significantly higher than from 1985 to 1995. Approximately 30 percent of HIDD's supplies are CAP; the balance is groundwater or in-lieu groundwater.

San Carlos Irrigation and Drainage District (SCIDD) included approximately 50,000 irrigation acres in 2006. Because SCIDD's primary water source is surface water flows on the Gila River, planted acres fluctuate significantly. Between 30 percent and 75 percent of total SCIDD acres are planted annually. Water demand has varied from 175,000 acre-feet between 1985 and 1995 to 117,000 acre-feet between 1996 and 2006. The primary crops grown in the district are cotton, small grains, alfalfa, field grains, melons, and pasture. Between 30 percent and 70 percent of SCIDD's supply is surface water, while the remainder is groundwater and a small amount of reclaimed water. SCIDD has also utilized small amounts of CAP water during extremely dry years.

As of 2006, approximately 24,000 acres of agricultural land in the Pinal AMA were not served by an irrigation and drainage district. Primary crops grown include cotton, alfalfa, small grains, field grains, and specialty crops. Approximately 65 percent of this acreage was irrigated yearly between 1996 and 2006, requiring an average of 70,000 acre-feet of water. The primary source of water is groundwater pumped from private wells, however, a few farms also use reclaimed water delivered by nearby municipal wastewater treatment plants.

5.3.4 Exempt IGFR Water Use Characteristics

In 1994, IGFRs less than 10 acres in size and not part of an integrated farming operation were exempted from conservation requirements and reporting obligations; therefore, their demand since 1993 is not known. In this Assessment, these rights were projected to remain at their historic average rate of use, approximately 1,500 acre-feet. These farms rely entirely on groundwater, which is either pumped from private wells, or are served by one of six small irrigation districts that exist in the Pinal AMA.

5.4 Indian Demands and Supplies

5.4.1 Overview and Non-Regulatory Status

The Ak-Chin Indian Community and portions of both the Gila River Indian Community (GRIC) and the Tohono O'odham Indian Nation (TON) are within the Pinal AMA (*See Figure 5-9*). Their water use is exempt from regulation by the state. However, the demand characteristics of these communities are included here because they have a hydrologic impact on the aquifer.

5.4.2 Water Rights Settlements

In 2006, new special zones were created in the Pinal AMA. As part of the implementation of the Arizona Water Settlements Act, Title II, Public Law 108-451, state law was changed to include the Southside Protection Zones, A.R.S. §45-2602 - 2611, and 2622-2626. This provides that should the municipal and industrial groundwater pumping exceed certain levels, the state is obligated to replenish the groundwater. Any new management plan must include conservation requirements for the central Protection zone at least as restrictive as those in the Third Management Plan. These zones are mapped in *Figure 5-9.*

Ak-Chin Indian Community

The Ak-Chin Community was awarded, by Congressional action in 1978 and 1984, an annual entitlement of 75,000 acre-feet of CAP and other Colorado River water. In wet years, the amount awarded may increase to 85,000 acre-feet. Congress amended this 1984 Act in 1992 to authorize the Community to lease any unused CAP water to off-reservation users within the Tucson, Pinal and Phoenix AMAs (ADWR, 2010).

Gila River Indian Community

In December 2004, the President signed into law the Arizona Water Settlements Act. Title II of the Act provided approval of the Gila River Indian Water Settlement Agreement. The settlement awarded the GRIC an annual entitlement to 653,500 AF of water from various sources including CAP allocations, reclaimed (through CAP exchange), groundwater, and surface water from the Gila, Verde and Salt rivers. It also established a funding mechanism for on-reservation development of this Community's farming operations and gave leasing authority to the GRIC for its CAP water as long as the water is leased within Arizona (ADWR, 2010).

Tohono O'odham Indian Nation

Congress enacted the Southern Arizona Water Rights Settlement Act (SAWRSA) in 1982 to address the water rights claims of the San Xavier and Shuck Toak Districts of the TON. This Act awarded to the two districts an annual entitlement of 37,800 acre feet of CAP water and 28,200 acre feet of settlement water to be delivered by the Secretary of the Interior. The district may also pump up to 13,200 acre feet of groundwater annually from non-exempt wells. An amendment to the Act signed into law by the President in 2004 identified the source of the settlement water as CAP Non-Indian Agricultural priority water, which the Nation is permitted to lease within the CAP service area. This Nation's water right claims are not completely satisfied, however, as the claims of the Sif Oidak District in Pinal County have not yet been addressed. This District has a contract for 8,000 acre-feet of CAP annually but has stated the need for nearly 100,000 acre-feet. As such, the Nation has requested that a federal negotiation team be established to begin negotiations (ADWR, 2010).

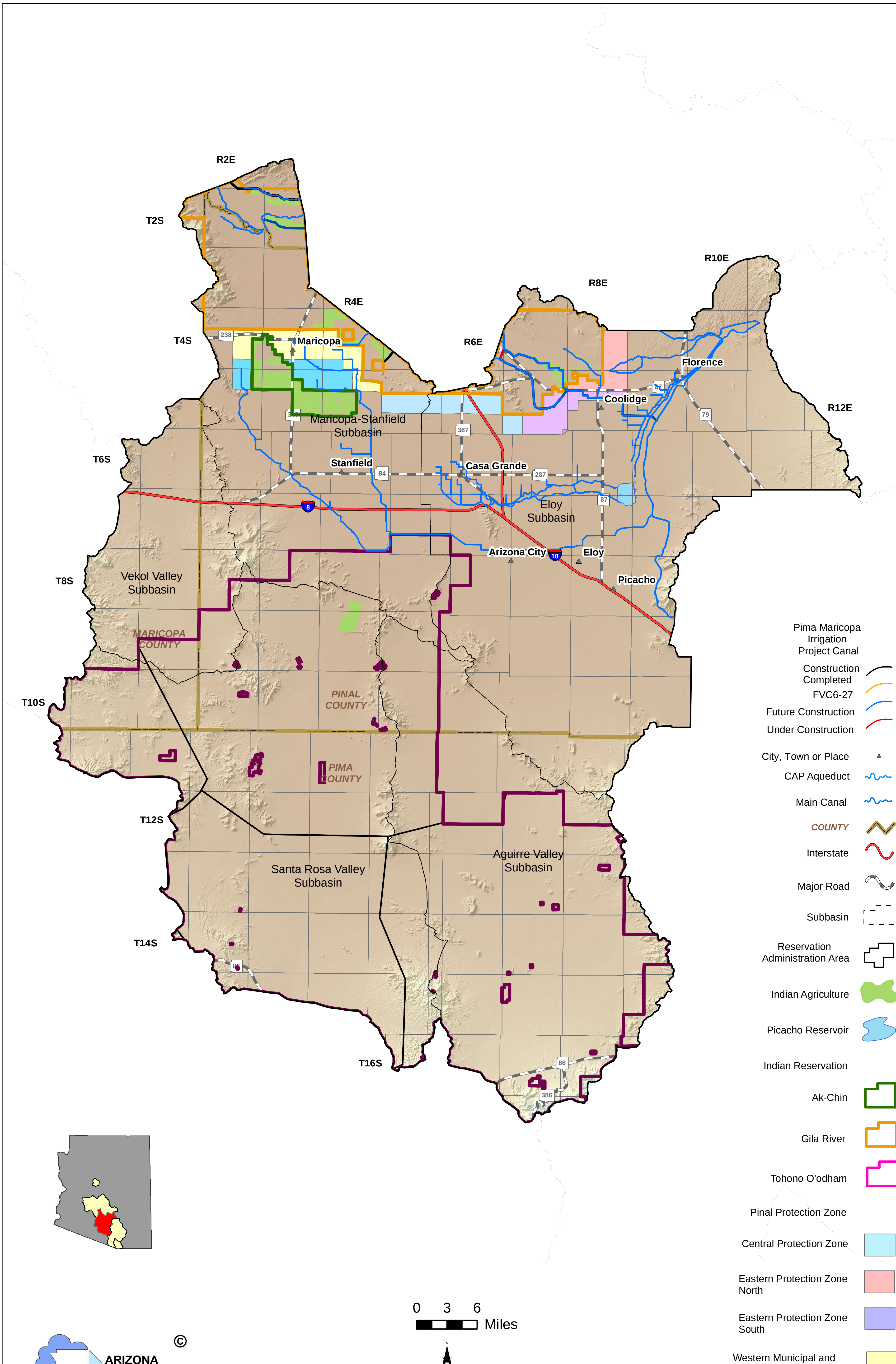


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Figure 5-9
Pinal AMA
Indian Municipal and Agricultural Areas

5.4.3 Indian Demand, Supply and Factors Affecting Use

Indian Agriculture

More than half of the total land area in the Pinal AMA lies within the boundaries of Indian reservations. Total Indian agricultural water use was 155,340 acre-feet in 2006 (See Table 5-6) and has accounted for approximately 19 percent of total agricultural water demand in the Pinal AMA since 1990. Use has remained steady because of the diverse portfolio of supplies available and the strong use of CAP water. The three Indian communities in the Pinal AMA all have active agriculture.

Table 5-6 Indian Agricultural Demand and Groundwater Use
1985, 1995 and 2006
Pinal Active Management Area

Year	Total Water Use	Groundwater Use
1985	53,200	24,080
1995	160,980	57,780
2006	155,340	61,020

Note: All volumes are in acre-feet.

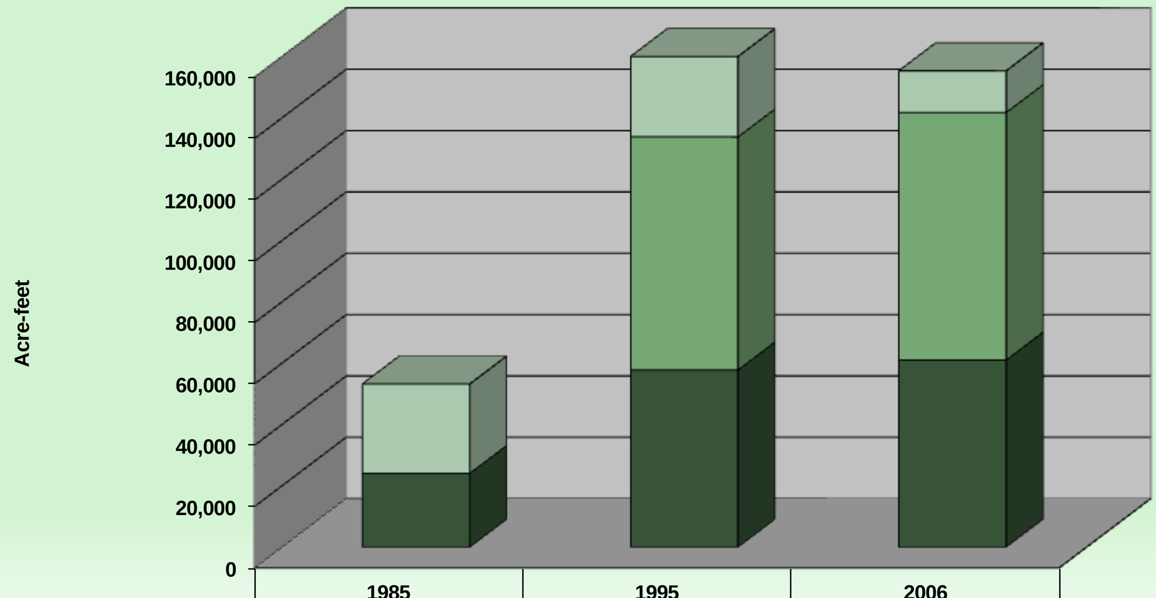
The *Ak-Chin Indian Community* has approximately 15,000 acres under irrigation (Ak-Chin Indian Community, 2009). The primary crops grown are similar to crops in the neighboring MSIDD. An average of 71,000 acre-feet of water per year was used between 1996 and 2006. Water demand has remained nearly constant since 1991 because of the availability of CAP water. All of the Ak-Chin Community's agricultural water demand is met by its 75,000 acre-foot normal-year CAP allocation. The allocation is 85,000 acre-feet in a surplus year and 72,000 acre-feet in a shortage year (CAP, 2009).

The 373,000 acre GRIC extends into both the Phoenix and Pinal AMAs along the Gila River. The GRIC currently irrigates approximately 15,000 acres. Independent farming operations irrigate an additional 22,000 acres of GRIC land. The primary crops grown on the reservation are cotton, wheat, millet, alfalfa, barley, melons, pistachios, olives, citrus, and vegetables (ITCA, 2003). An average of 60,000 acre-feet of water per year was used in the Pinal AMA portion of the reservation between 1985 and 2006. Water demand has remained nearly constant since 1985, but is expected to increase because of several projects that resulted from the recently signed water rights settlement. In 2006, demand within the Pinal AMA portion of the GRIC was met with approximately 77 percent groundwater, 19 percent surface water, and 4 percent CAP water.

The *TON* contains approximately 2,975 acres of active farmland in the Chui Chu and Vaiva Vo areas, both of which are within the Sif Oidak District. It is estimated that an average of 13,000 acre-feet of water per year was used on these farms between 1996 and 2006. In 1988, the United States purchased approximately 2,910 acres within the CAIDD as reservation trust land for the TON (CAIDD, 2008). Although this farm is not subject to the provisions of the Groundwater Code, the TON has entered into agreements with the CAIDD for annual delivery of CAP water, not to exceed the farm's original allotment of approximately 6,600 acre-feet (ADWR, 1994). Currently, the Chui Chu farms are served entirely by groundwater, even though the TON has an annual CAP allocation of 8,000 acre-feet for the area (CAP, 2009). The Vaiva Vo irrigation project is adjacent to Lake Saint Clair and the Tat Momolikot Dam, which were constructed between 1962 and 1974 by the Army Corps of Engineers for the purposes of water conservation and providing irrigation water to Vaiva Vo (Parker, 1989). The dam has since been re-tasked primarily for flood control purposes (Maricopa County FCD, 2009) (USACE, 2001). Although only 29,636 acre-feet of water were captured by the dam between 2000 and 2006, its design capacity is 198,500 acre-feet (Maricopa County FCD, 2009). There is a drain to the

Vaiva Vo irrigation project, but it is unknown if any water from the dam has ever been used for irrigation.

Figure 5-10 Indian Historical Agricultural Supplies
1985, 1995 and 2006
Pinal Active Management Area



	1985	1995	2006
TOTAL	53,200	160,980	155,340
Indian Surface Water	29,120	27,200	13,600
Indian CAP	0	76,000	80,720
Indian Groundwater	24,080	57,780	61,020

Indian Municipal

The population on reservation land in the Pinal AMA may be decreasing. ADWR used an estimate of 7,907 Indians on reservations in the Pinal AMA in the 3MP. In 2000, the US Census accounted for 6,369 Indians on reservations within the Pinal AMA. The 3MP assumed a municipal demand for Indians on reservations of 1,130 acre-feet. Settlement documents suggest a municipal demand of 785 acre-feet (*See Table 5-7*). The supply for Indian municipal demand is assumed to be groundwater.

Table 5-7 Indian Municipal Demand and Groundwater Use
1985, 1995 and 2006
Pinal Active Management Area

Year	Total Water Use	Groundwater
1985	1,130	1,130
1995	1,130	1,130
2006	785	785

Note: All volumes are in acre-feet.

5.5 Artificial Recharge

Artificial recharge consists of artificial means of adding water to the aquifer, but it also results in the increased use of renewable water supplies, such as reclaimed water, CAP and surface water, over non-renewable groundwater by allowing for flexible and effective storage and recovery of renewable water supplies. For more information regarding the role of artificial recharge and the types of facilities used, refer to Section 3.3.

5.5.1 Underground Storage Facilities

The Pinal AMA has seven permitted constructed USFs (*See Figure 5-11*). These facilities have relatively small annual permitted volumes ranging from 135 to 2,240 acre-feet per year. All Pinal AMA USFs are permitted to store only reclaimed water. The amount of water stored through 2006, by facility type, is shown in *Table 5-8*. The Town of Florence facility has been in operation since 1991 making it the oldest of the facilities. Although there have been some discussions regarding future CAP USFs in the Pinal AMA, the trend is towards smaller, developer-constructed, reclaimed water facilities accompanying wastewater treatment plants or the expansion of municipal facilities in the City of Eloy or Town of Florence.

Table 5-8 Artificial Recharge Volumes
1995, 2000 and 2006
Pinal Active Management Area

Recharge Facilities	1995	2000	2006
Groundwater Savings Facility			
Number of Facilities	3	3	4
CAP Stored	45,071	98,921	144,058
Underground Storage Facilities (Constructed)			
Number of Facilities	1	3	3
Reclaimed Water Stored	44	73	898
Total Stored	**45,115**	**98,994**	**144,956**

Note: All water volumes are in acre-feet and include water delivered to be stored minus physical losses

5.5.2 Groundwater Savings Facilities

Artificial recharge in the Pinal AMA is primarily accomplished at GSFs (S*ee Table 5-8*). The Pinal AMA currently has four permitted GSFs. All Pinal AMA GSFs are permitted to store only CAP water. Their permitted annual volumes range from 18,840 to 120,000 acre-feet. The amount of water stored through 2006, by facility type, is shown in *Table 5-9*. These permits require GSFs to use their non-Indian agriculture (NIA) pool of excess CAP water (CAP NIA settlement pool) before credits may be accrued using GSF CAP water. The CAP NIA settlement pool is a volume of CAP water that the CAWCD Board of Directors identified for use on NIA lands. The policy was adopted in May of 2000. This policy established an NIA pool of 400,000 acre-feet from 2004-2016. The pool will decline to 300,000 acre-feet in 2017 and to 225,000 acre-feet beginning in 2024 through 2030. The permits also contain limitations on total water from all sources (including all CAP sources, surface water and groundwater) and require proof that there is a direct reduction in groundwater pumping.

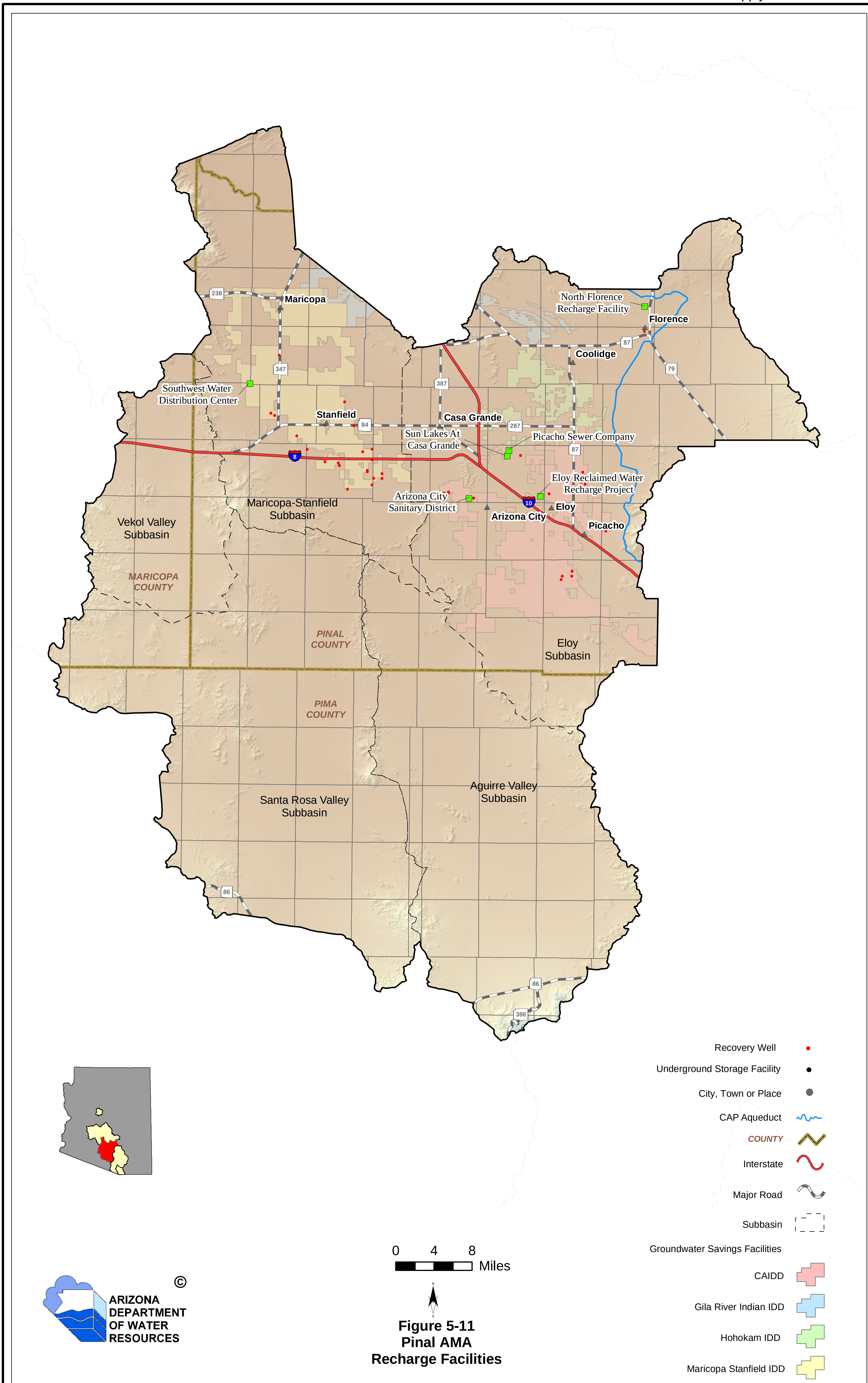


Figure 5-11
Pinal AMA
Recharge Facilities

5.5.3 Credits Accrued Through 2006

Long-Term Storage Credits

There are twenty long-term storage accounts, including the AWBA and two CAGRD replenishment accounts, in the Pinal AMA. The Pinal County Water Augmentation Authority (PCWAA) stores municipal and industrial (M&I) subcontract CAP water on behalf of its members, including the City of Eloy and the Town of Florence, and assigns those credits back to members for recovery to meet DAWS requirements. Picacho Sewer Company accrues reclaimed water credits at its USF and recovers those credits for landscape and golf course irrigation. Most long-term storage credits in the Pinal AMA are held by the AWBA and CAWCD.

Table 5-9 Artificial Recharge Credit Types and Amounts Through 2006
Pinal Active Management Area

Credit Type	*Amount (acre-feet)*
Long Term Storage Credits	
Underground Storage Facilities	3
CAP	1,145
Reclaimed	3,182
Total	4,327
Groundwater Savings Facilities	4
CAP	1,439,282
Total USF/GSF	**1,443,609**
Arizona Water Bank	
Intrastate	676,490
Interstate - Nevada	310,437
Total	**986,927**
Central Arizona Groundwater Replenishment District	
CAWCD	
CAGRD	
Conservation District Account	305
Replenishment Reserve Account	
Total	305
Total AMA Recovery	4,503
Credits Remaining in Storage	**1,439,106**

Note: Volumes are in acre-feet. Stored water is water delivered to be stored minus losses and the cut to the aquifer. “Credits Remaining in Storage” is the difference between Total USF/GSF Storage and Total AMA Recovery.

AWBA Credits

The AWBA has been storing CAP water at GSFs in the Pinal AMA since 1997. Using a variety of funding sources, the AWBA has utilized these facilities to meet goals and obligations for the Pinal AMA CAP subcontract holders as well as firming Colorado River on-river M&I supplies and, through interstate agreements, completed storage for the Southern Nevada Water Authority.

CAGRD Storage and Replenishment

CAWCD, on behalf of the CAGRD, began storing and replenishing CAP water at GSFs in the Pinal AMA in 1992 (See Section 3.4.4). Prior to the creation of the AWBA, CAWCD storage was conducted to firm M&I supplies. CAP water was also stored by CAWCD through an agreement with Metropolitan Water District of Southern California (MWD) to assist in firming a portion of their municipal supplies. In 2007, CAWCD began recovering those MWD credits within the boundaries of the GSF facilities in which they were stored. The delivery of this recovered CAP water generates an intentionally created unused apportionment on the Colorado River, allowing MWD to directly divert an equal volume from the river.

The CAGRD has stored limited volumes in the Pinal AMA to date. Because the AWS Rules for the Pinal AMA require a minimal amount of replenishment for new development, the CAGRD's current and projected obligation has not warranted substantial credit accrual at this time.

6. HISTORICAL DEMANDS AND OVERDRAFT

6.1 Summary Budget

The following discussion considers historical total demands and groundwater overdraft and surplus in the Pinal AMA from 1985 to 2006, referencing three water-use years: 1985, 1995, and 2006. The Historical Summary Budget is shown in *Table 6-1* below. The basic budget components, and how they relate to the overdraft calculation, were discussed in further detail in Sections 3 and 4. Detailed water use figures for all years between 1985 and 2006 may be found at http://www.azwater.gov/AzDWR/WaterManagement/Assessments/default.htm.

Overdraft, or surplus in 1995, depicted in *Table 6-1*, is the sum of the groundwater use (including in-lieu groundwater) for all four sectors plus the riparian demand, minus the sum of the incidental recharge values for the four sectors plus the additional offsets to overdraft (including net natural recharge, canal seepage, cuts to the aquifer, and CAGRD replenishment). For purposes of this Assessment, overdraft is depicted in two values: 1) including the groundwater allowance volume in overdraft, to identify the physical impact of these withdrawals on the aquifer and 2) excluding groundwater allowance volumes, in recognition that this volume of groundwater is considered to be consistent with the management goal under the AWS Rules.

6.1.1 Demand

In 1985, total demand for the water using sectors (Municipal, Industrial, Agriculture, and Indian) in the Pinal AMA was 864,984 acre-feet. Agricultural uses accounted for approximately 92 percent of total demand in the Pinal AMA; Indian uses accounted for 6 percent and Municipal uses for less than 2 percent. Agriculture has consistently been the dominant water use sector in the Pinal AMA, although fluctuation occurred between 1985 and 2006. Demand in the Municipal and Industrial water use sectors increased in response to rapid urbanization that occurred in the Pinal AMA between 2002 and 2006. Municipal demand showed a 142 percent increase and Industrial demand increased over 300 percent between 1985 and 2006. However, these two uses collectively accounted for only 5 percent of total demand in the Pinal AMA in 2006, while the Agricultural sector accounted for 80 percent. Indian water use increased significantly, from 54,330 acre-feet in 1985 to 156,125 acre-feet in 2006. Much of this increased demand was met with CAP water.

6.1.2 Supply

In 1985, groundwater was the primary supply used to meet demands in the Pinal AMA, accounting for nearly 74 percent of supply. Surface water, primarily in the form of Gila River surface water supplies available to San Carlos lands accounted for 26 percent of supply. By 1995, groundwater accounted for only 42 percent of supply, CAP water for 34 percent, in-lieu groundwater for 14 percent and surface water for 10 percent. In 2006, groundwater still predominated, accounting for 45 percent of supply. CAP use had increased to 36 percent of

Table 6-1 Historical Summary Budget and Overdraft 1985, 1995 and 2006 Pinal Active Management Area

SECTOR	CATEGORY	1985	1995	2006
Municipal				
Demand		13,607	19,122	32,968
Supply	*Groundwater*	13,607	18,288	28,895
	Other Surface water	0	558	347
	CAP (direct use & credits	0	276	2,961
	Reclaimed water	0	0	765
	Incidental Recharge	544	765	1,319
Industrial				
Demand		4,955	5,647	20,243
Supply	*Groundwater*	4,946	5,471	17,051
	Other Surface	0	0	15
	CAP (direct use & credits	0	0	1,462
	Reclaimed water	9	176	1,715
	Incidental Recharge	243	337	947
Agricultural				
Demand		792,092	885,900	819,894
Supply	*Groundwater*	594,844	355,983	327,702
	Groundwater (GSF)	0	46,254	139,616
	Other Surface water	195,409	181,892	88,653
	CAP (direct use, no GSF)	0	300,145	261,598
	Reclaimed water	1,839	1,626	2,325
	Incidental Recharge[1]	336,234	439,533	182,918
Indian				
Demand		54,330	162,110	156,125
Supply	*Groundwater*	25,210	58,910	61,805
	Other Surface Water	29,120	27,200	13,600
	CAP	0	76,000	80,720
	Reclaimed water	0	0	0
Other				
Demand	*Riparian*	15,421	13,349	10,602
Supply	*Cuts to the aquifer*	0	2,254	7,209
	CAGRD Replenishment	0	0	150
	Net Natural Recharge	82,750	82,750	82,750
	Canal Seepage	66,391	64,708	27,488
Groundwater Use not counted towards Overdraft	*GW Allowance*	0	0	8,822
	Excess Groundwater	0	0	134
Overdraft or Surplus	**Subtracting GW Allowance**	**167,866**	**-92,093**	**274,091**
	Without Subtracting GW Allowance	**167,866**	**-92,093**	**282,913**

Note: All volumes are in acre-feet. [1]Agricultural incidental recharge includes Indian Agricultural Incidental Recharge.

supply. In-lieu groundwater accounted for less than 2 percent and surface water decreased to 17 percent of supply. Reclaimed water was not a significant source of supply, accounting for less than one percent in 2006.

6.1.3 Offsets to Overdraft

The various offsets to overdraft for the historic period, as explained in more detail in Section 3.4, are listed in *Table* 6-2 below.

Table 6-2 Offsets to Overdraft
1985, 1995, and 2006
Pinal Active Management Area

TYPE OF OFFSET	1985	1995	2006
Incidental Recharge			
Municipal	544	765	1,319
Industrial	243	337	947
Agricultural[1]	336,234	439,533	182,918
Net Natural Recharge	82,750	82,750	82,750
Reclaimed Water Discharge	0	0	0
CAGRD Replenishment	0	0	150
Canal Seepage	66,391	64,708	27,488
Cuts to the Aquifer	0	2,254	7,209
Total	**486,162**	**590,347**	**302,781**

Note: Agricultural includes Indian and Agricultural incidental recharge. Net natural recharge includes reclaimed discharge.

Artificial recharge cuts to the aquifer are shown in greater detail in Table 6-3*.* In the Pinal AMA, no recharge projects were permitted and operational in 1985; therefore the years listed begin with 1995.

Table 6-3 Artificial Recharge Cuts to the Aquifer
1995, 2000 and 2006
Pinal Active Management Area

Recharge Facilities	1995	2000	2006
Underground Storage Facilities (Constructed)			
CAP	0	0	0
Reclaimed Water	0	0	45
Groundwater Savings Facilities			
CAP	2,254	4,946	7,164
TOTAL	**2,254**	**4,946**	**7,209**

Note: Volumes are in acre-feet.

6.2 Historical Overdraft

Figure 6-1 displays historic overdraft, or in a few years, surplus for the 1985 through 2006. Overdraft in 2006, including groundwater allowance was 282,913 acre-feet. Overdraft not including groundwater allowance was estimated to be 274,091 acre- feet. The overdraft is displayed with and without the groundwater allowance pumping included. Although groundwater allowance pumping is indeed groundwater that is not being replenished, it is allowable pumping under the AWS Rules. As described in Section 3.4.4, the groundwater allowance component to the AWS Rules illustrates a policy decision that was made to allow for growth, flexibility, and transition to the AWS Rule requirements.

Based on the total overdraft estimates used in this Assessment, the Pinal AMA is in a state of surplus in six (1986, 1987, 1989, 1993, 1994 and 1995) of the 21 years and in overdraft for the rest; however, the trend since 1996 has been overdraft in varying amounts. This state of surplus is in contrast to the 3MP budget, which depicted the AMA to be in overdraft in 1995. The primary reason for the difference in estimates of overdraft between the 3MP and this Assessment is the difference in values used for Agricultural Incidental Recharge. In the 3MP, a value of 272,087 acre-feet was the **total** amount of incidental recharge for the Agricultural, Indian Agricultural, Municipal and Industrial uses in 1995. In this Assessment, 1995 Agricultural and Indian Agricultural Incidental Recharge **alone** is estimated to be 439,533 acre-feet. In the 3MP, the Agricultural Incidental Recharge was based on the amount of water applied to cropped land in the specific year in question. In this Assessment, and as explained in Section 3.4.2, Agricultural Incidental Recharge is lagged by 20 years. “Lagged” means that water applied for agricultural purposes, which is not used by the crop or evaporated, is considered to reach the aquifer twenty years after it was applied. The high recharge amounts in 1995, and other years, are a result of the water applied in the years when more acres were in production, cotton was the predominant crop and laser-leveling was not yet in use. The ability for lagged Agricultural Incidental Recharge to cause surplus or minimize overdraft is shown in Figure 6-1. This and other factors that affected historical overdraft as determined in this Assessment are discussed in Section 6.3.

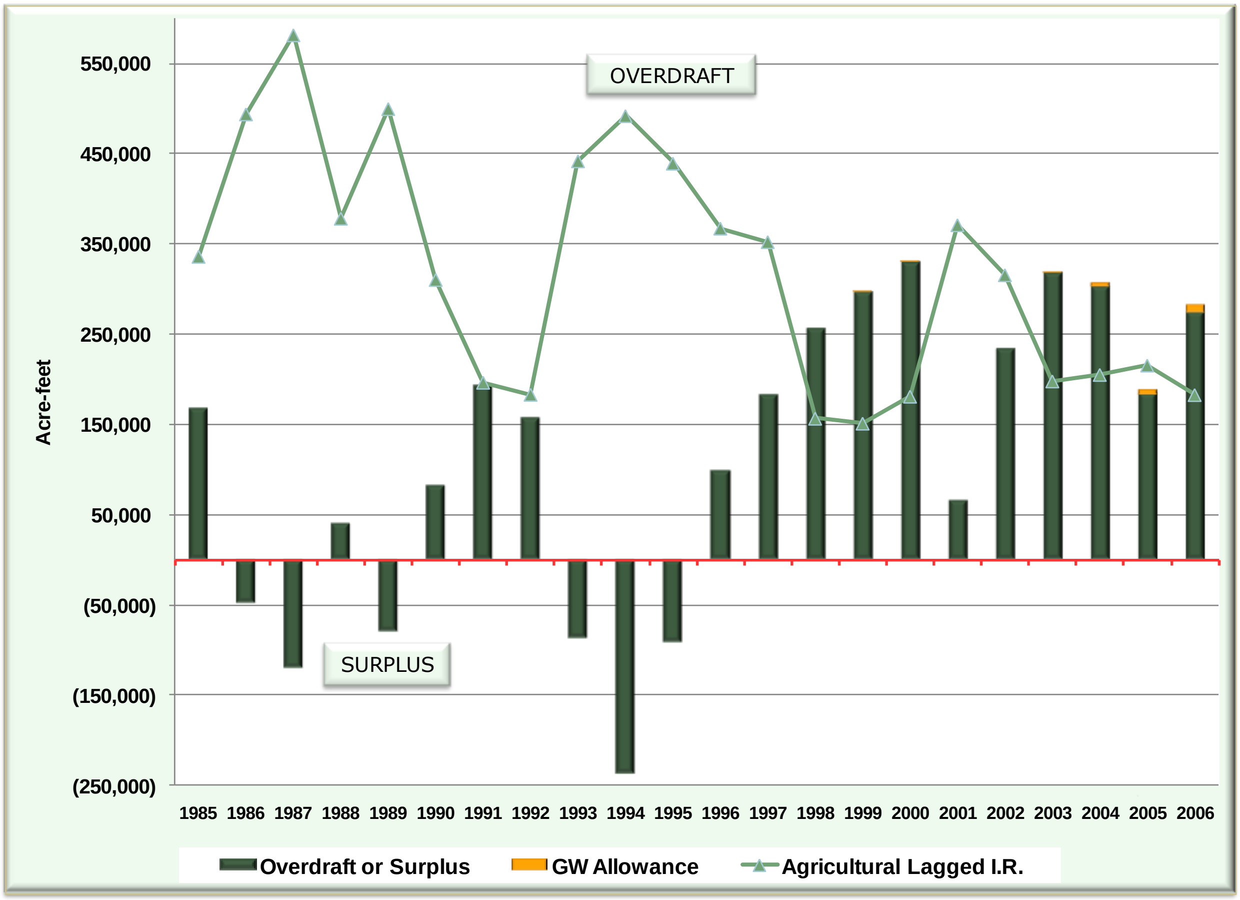
Meanwhile, Indian Demand, which is almost all for agricultural purposes, has increased from roughly 54,000 acre-feet in 1995 to 156,000 acre-feet. The amount of groundwater used by this sector has increased from about 25,000 acre-feet in 1985 to nearly 62,000 acre-feet in 2006. However, CAP use has also increased from zero in 1985 to 80,720 acre-feet in 2006.

6.3 Major Factors that Affected Historical Overdraft

Agricultural and Indian Agricultural Demand

Overdraft during the historical period correlates with use of groundwater and in-lieu water by the Agriculture sector. As noted earlier, Agricultural demand in 1985 comprised about 92 percent of the total AMA demand, or about 792,000 acre-feet. By 2006, its percentage share of total AMA demand had decreased to about 80 percent; however, since total AMA demand had grown, 80 percent of total demand equaled 820,000 acre-feet. Except for the variable annual flows of the Gila River, farming in the Pinal AMA has been primarily dependent on groundwater. The amount of groundwater pumped by this sector fluctuates, but has not reached the highest level seen during the historic period addressed in this Assessment, which was 1985 (almost 639,000 acre-feet). Much of that pumpage has been replaced by CAP and in-lieu of groundwater. Although the in-lieu of groundwater used on farms is physically CAP water, it counts as groundwater towards overdraft.

Figure 6-1 Historical Estimated Overdraft and Agricultural Incidental Recharge 1985 to 2006 Pinal Active Management Area



Lagged Agricultural Incidental Recharge

Agricultural incidental recharge is a very significant offset to overdraft in the Pinal AMA; it is the "other side of the coin" to the high groundwater and in-lieu of groundwater use by this sector. As explained in Section 3.4.2, agricultural incidental recharge is lagged by twenty years. In 1995, this offset is estimated to have been 439,533 acre-feet, based on the application of water for crops in 1975. By 2006, agricultural recharge is estimated to have been lower at 182,918 acre-feet, based on the application of water for crops in 1986. Although the Agricultural Sector is the dominant water demand sector, and is expected to remain so for many years to come, the amount of lagged agricultural recharge is decreasing over time as we move further away in time from the high agricultural use years of the 1960s, 70s and 80s, and as more acres are urbanized.

Streambed Infiltration, Canal Seepage and Groundwater Inflow

Less of an offset than Agricultural Incidental Recharge, but still noteworthy, are streambed infiltration, canal seepage, and groundwater inflow. The values used in this Assessment are compared to the values used in the 3MP in Table 6-4, using 1995 as an example.

Table 6-4 1995 Specific Offsets to Overdraft Comparison
3MP Compared to Assessment
Pinal Active Management Area

	3MP	Assessment	Difference
Streambed Infiltration	20,000	36,200	16,200
Canal Seepage	50,100	64,708	14,608
Groundwater Inflow	50,000	57,350	7,350
Total	**120,100**	**158,258**	**38,158**

All volumes are in acre-feet.

These increased amounts of offsets used in this Assessment are the result of an increased understanding of the hydrology of the AMA and also help explain why this Assessment shows surplus in 1995 and other years.

Unreplenished Groundwater and Allowable Groundwater

Most withdrawal authorities do not have a replenishment requirement. These authorities include IGFRs, Type 1 and Type 2 rights, groundwater withdrawal permits, exempt wells and service area rights operated by undesignated municipal providers who serve customers not covered by a CAWS issued after 1995. Groundwater pumped pursuant to these types of withdrawal authorities applies directly to groundwater overdraft because no replenishment is required.

Some of the groundwater that is used is by the Municipal sector is subject to replenishment, but there is still a small amount of groundwater that is not required to be replenished. In 2006, this un-replenished groundwater was approximately 19,939 acre-feet in 2006 and is associated with subdivisions platted before 1995 and commercial uses in undesignated provider service areas.

The amount of groundwater a municipal provider can serve is based on conservation requirements set forth in the management plans, but that volume can generally increase as population increases. Although the Code contained provisions for the AWS program, the AWS Rules were not adopted until 1995. The AWS Rules include the requirement that most groundwater pumping be made consistent with the water management goal of the AMA for DAWS and CAWS. However, the AWS Rules also allocate a small volume of groundwater that is allowable.

The Department's AWS Rules are an important tool in offsetting some of the groundwater demands of new subdivision within the AMAs. However, provisions in the Pinal AWS Rules have allowed large allocations of groundwater allowances and extinguishment credits which has lead to very little replenishment taking place, and mitigating much of the replenishment that would have otherwise taken place as newer subdivisions reach their build out demands. To date only several hundred acre-feet of water has been recharged as a result of the Pinal AWS Rules.

Allowable groundwater use, groundwater reported pursuant to the provider's or subdivision's groundwater allowance, is considered consistent with the management goal of the AMA. This allowable groundwater use is not replenished and therefore contributes physically to groundwater overdraft. CAWS are allocated a specific volume of allowable groundwater based on the date the CAWS is issued. DAWS issued prior to the adoption of the AWS Rules in 1995 were assigned a volume of allowable groundwater to allow them to transition to renewable supplies over time. Providers who did not exist at the date of adoption of the AWS Rules receive a zero groundwater allowance.

Table 6-5 Base Groundwater Allowance for DAWS Providers
Pinal Active Management Area

Provider Name	Base Groundwater Allowance (acre-feet	Recorded Lots Not Served Commenced Service by 1/1/2010 x .35 af/lot	Extinguishment Credits	Total
City of Casa Grande	142		0	142
City of Eloy	1,671		285	1,957
Johnson Utilities	208	371	0	579
Santa Cruz Water Company	4,562		8,693	13,255
Town of Florence	1,070		237	1,307
Total	**7,563**	**371**	**9,215**	**17,240**

Note: Volumes are in acre-feet. Note: Extinguishment Credits do not include rollover of any pre-rule change pledged extinguishment credits. Note: Figure for Recorded Lots Not Served Commenced Service by 1/1/2010 is draft.

Artificial Recharge

No permitted underground storage occurred in the Pinal AMA until 1989. Since then, artificial recharge has played an important role in allowing the state to maximize its use of Colorado River water. GSFs in the Pinal AMA have allowed for hundreds of thousands of acre-feet of CAP water to be indirectly stored in the Maricopa-Stanfield and Eloy subbasins. These facilities have also allowed for storage of the modest volumes of municipal contract CAP water belonging to the City of Eloy and Town of Florence future use, as well as several thousand acre-feet of long-term storage credits to be developed by the PCWAA.

While nearly all of the water stored in the Pinal AMA will eventually serve other users, such as California and Nevada, it has served to elevate local water tables. As agriculture is still by far the dominant water user in the Pinal AMA, this has assisted that water use sector by keeping groundwater pumping costs lower, and intuitively lessened the risk of subsidence, fissuring and aquifer compaction that might have otherwise occurred. In doing so, it has helped in meeting the first part of the AMA's management goal of preserving the local agricultural economies for as long as feasible. The second part of the Pinal AMA management goal, to preserve water supplies for future municipal and industrial uses, is largely unaddressed through artificial recharge.

PART IV PROJECTED DEMANDS AND OVEDRAFT

7. INTRODUCTION TO THE PROJECTIONS

7.1 Purpose and Approach for Projecting Demands

Part III, Historical Water Demand and Overdraft, describes the status of the past imbalance or groundwater overdraft. In order to determine if the Pinal AMA will achieve the statutory goal of preserving the agricultural economy for as long as feasible, while preserving supplies for future non-irrigation uses, future demand, supply utilization and groundwater overdraft must be projected. ADWR recognizes for this Assessment that planners and decision makers need to move away from expectations of perfect or near-perfect forecasts (Arizona State University, 2009). Instead, ADWR, in consultation with outside entities, has developed seven different scenarios, each with slightly different assumptions. This Assessment contains three baseline scenarios, three additional shortage scenarios incorporating possible climate change impacts, and one scenario that maximizes the available reclaimed water in the AMA. As defined by the Intergovernmental Panel on Climate Change, "*A scenario is a coherent, internally consistent* *and plausible description of a possible future state of the world. It is not a forecast; rather, each scenario is one alternative image of how the future can unfold."* The Sustainability of semi-Arid Hydrology and Riparian Areas (SAHRA) website for Scenario Development further explains scenarios as

> *"Descriptions of possible alternatives of the future that take into account the interaction of many different components of a complex system. Although scenarios are not forecasts or even predictions of the most-likely alternatives, they provide a dynamic view of the future by exploring various trajectories of change that lead to a number of possible alternative futures. Because unique and unanticipated conditions have more chances to occur over a long period of time, long-term scenarios have more uncertainty than short-term scenarios"* (Sustainability of semi-Arid Hydrology and Riparian Areas, 2009).

Recognizing that it is impossible to predict accurately what future demand will be, staff developed a plausible range of demand and overdraft scenarios up to and including the year 2025. Baseline Scenario One represents the lowest reasonable water demand, Baseline Scenario Three the highest reasonable water demand, while Baseline Scenario Two is a mid-level projection. None of the baseline scenarios incorporate changes in surface water supply as a result of climate change.

Debate continues over climate change- will it occur, and if so, to what extent? Several climate change models exist for the southwestern region of the United States, but at this time, are not localized enough to be useful for the purposes of this Assessment. However, ADWR could not ignore the potential effects of climate change, so an effort was made to incorporate a period of reduced surface water availability based on a similar historical occurrence in the three climate change scenarios. Assumptions behind these additional scenarios, and the impact on groundwater overdraft, are described in Section 14.1.

The seventh and last scenario developed for this Assessment is the Maximized Reclaimed Water Use Scenario. This scenario recognizes that with population growth, there will be an ever-larger amount of reclaimed water that could be re-used, and that such re-use might assist the AMA in achieving its water management goal (See Section 14.2).

The scenarios developed by ADWR for this Assessment are one set of potential results in terms of projecting future demand and groundwater overdraft. Part of the work that went into the compilation of this Assessment was the creation of a centralized data repository for the historical supply and demand information. This central repository was designed with the intent to provide ADWR with a flexible and readily updateable database that is directly connected to multiple future demand and supply scenarios. This will allow ADWR to more readily update annual report information on the demand side along with continual updates of supplies and future assumptions as conditions change. ADWR's goal is to continue modifying the assumptions each year to incorporate actual data as 2025 approaches, and to incorporate more sophisticated models, such as those currently in use or in development by the Decision Center for Desert Cities (DCDC). DCDC's research on water management decisions in central Arizona incorporates factors such as the area's rapid population growth and urbanization, complex political and economic systems, variable desert climate, and the potential of global climate change. ADWR hopes to collaborate with DCDC staff and regional water managers and other decision makers to use WaterSim, its complex integrative model, to examine the interactive effects of climate conditions, rapid growth, and policy decisions on future water supply and demand conditions. Although originally developed for the Phoenix area, it is hoped that WaterSim could be adapted for use in the Tucson and Pinal AMAs as well.

7.1.1 Water Demand Projection Techniques

For the purposes of this Assessment, staff used three methods to project demands: the per capita or per unit water use approach, the time-series approach (a sequence of data points, measured at successive times spaced at uniform time intervals in order to forecast events based on known past events), and the regression analysis approach (a statistical tool for investigation of the relationship between variables - also sometimes referred to as the econometric approach). For Municipal demand estimates, the Gallons Per Capita Per Day (GPCD) rate was multiplied by the population projection. The time-series approach was employed to statistically analyze the historical water use trend line to project future demand trends based on historical trends. The Industrial and Agricultural projected demands generally resulted from this technique. Finally, the regression analysis approach utilized the Coefficient of determination (the square of the sample correlation coefficient between the outcomes and their predicted values, varying from 0 to 1) to analyze water use related to influencing factors such as demographic changes, climate changes, and socio-economic changes. This allowed staff to estimate parameters that measure the historical relationship between water use (dependent variable) and different factors (explanatory variables or independent variables), assuming that those parameters will continue into the future.

7.1.2 User Interviews and Settlement Documents

During the development of the scenarios, staff conducted user interviews of academic, government and private sector experts. Staff also reviewed public documents such as intergovernmental agreements and Indian Water Settlements. These interviews and reviews were done in order to gain more insight regarding population growth, the potential for new water users (such as mines, power plants and golf courses), the potential for a change in how current sources are used, the addition of new sources, and changes in urbanization.

8. PROJECTED DEMANDS AND OVERDRAFT

8.1 Projected Summary Budget

The three baseline scenarios correspond generally to low, medium, and high AMA projected demands, according to sets of assumptions assembled for each water use sector. In some cases, the assumptions used to project supplies also varied among the three baseline scenarios. The methodology and assumptions used in projecting the future water use of the Municipal, Industrial, Agricultural, and Indian water use sectors under these three baseline scenarios are described in detail in Sections 7 through 10.

Incidental recharge is calculated as a percentage of the demand for each water use sector. Incidental recharge rates are based on the water use sector and nature of the water use (*See Table 3-3).* Additionally, the amount of groundwater that satisfies riparian demand within the AMA is displayed in the Projected Summary Budget and assumes the projected demand is the same as the historical demand. The Projected Summary Budget includes supply figures for the amount of water added to the aquifer pursuant to Underground Storage and Recovery projects (cuts to the aquifer); CAGRD replenishment of excess groundwater in order to satisfy the consistency with management goal requirement under the Pinal AMA AWS Rules; net natural recharge on an AMA-wide basis; reclaimed water discharges; and canal seepage.

ADWR has assigned certain volumes of groundwater for use by water providers with a DAWS and for subdivisions with a CAWS. The groundwater allowance is discussed further in Section 3.4, *Offsets to Overdraft* in the Historical portion of the Assessment. In the Projected Summary Budget, projected overdraft in year 2025 is displayed in two ways: with groundwater allowance pumping subtracted from the overdraft calculation and with it included it in the overdraft calculation (*See Table 8-1)*. The amount of allowable groundwater pumped, which is the difference between the two sets of overdraft figures, ranges from 31,899 acre-feet in Baseline Scenario One, to 67,475 acre-feet in Baseline Scenario Three.

Table 8-1 2025 Projected Summary Budget - Baseline Scenarios
Pinal Active Management Area

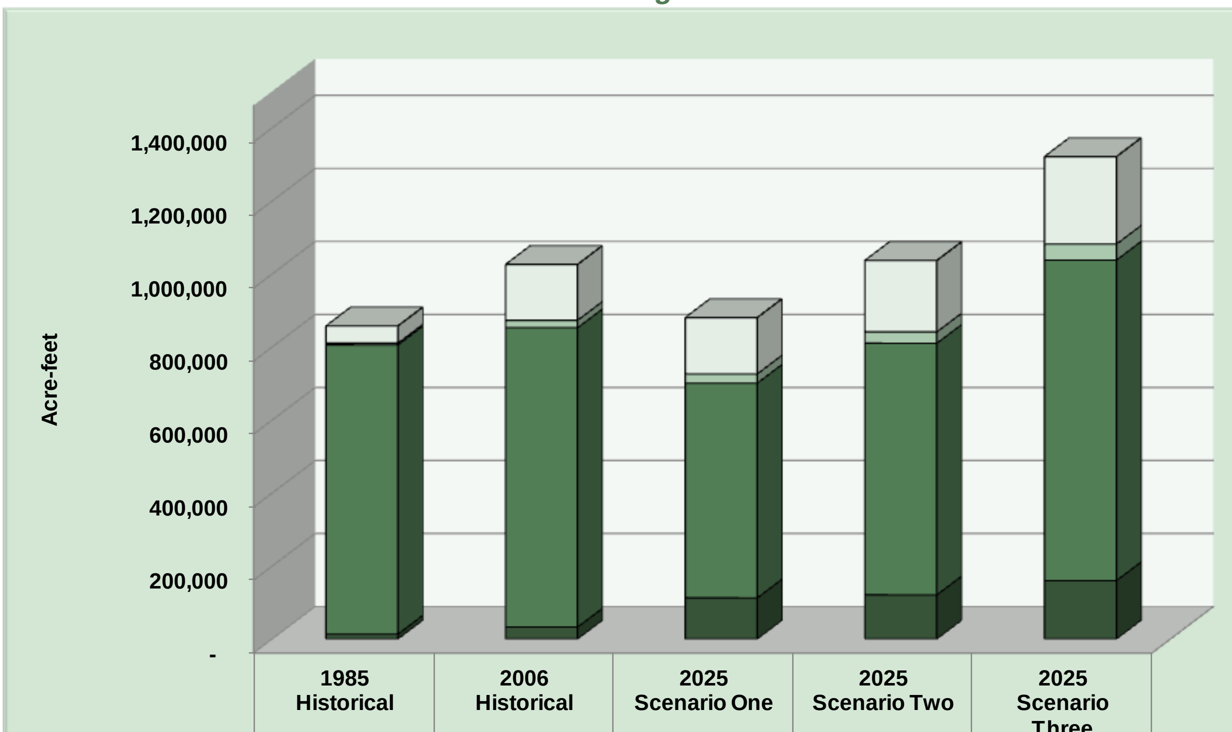
SECTOR	CATEGORY	SCENARIO ONE	SCENARIO TWO	SCENARIO THREE
Municipal				
Demand		112,809	121,175	160,273
Supply	*Groundwater*	55,332	88,105	125,194
	Surface water	43,456	17,706	17,706
	CAP (direct use & credits recovered)	12,482	13,824	14,457
	Reclaimed water	1,539	1,539	2,916
	Incidental Recharge	4,512	4,847	6,411
Industrial				
Demand		25,189	31,042	43,676
Supply	*Groundwater*	21,285	23,230	33,906
	Surface water	-	-	-
	CAP (direct use & credits recovered)	1,763	5,173	6,057
	Reclaimed water	2,141	2,639	3,712
	Incidental Recharge	1,366	1,528	1,705
Agricultural				
Demand		588,157	689,180	877,896
Supply	*Groundwater*	300,332	381,270	578,976
	In-Lieu Groundwater	13,572	10,313	5,475
	Surface water	85,199	110,949	110,949
	CAP (direct use, no In-Lieu Groundwater)	186,554	184,147	179,995
	Reclaimed water	2,500	2,500	2,500
	Incidental Recharge	226,337	226,337	226,337
Indian				
Demand		154,234	195,401	239,479
Supply	*Groundwater*	14,890	53,057	87,135
	Surface Water	20,000	20,000	20,000
	CAP	119,344	122,344	132,344
	Incidental Recharge	36,475	36,475	36,475
Other				
Demand	*Riparian*	10,602	10,602	10,602
Supply	*Cuts to the aquifer*	679	516	274
	CAGRD Replenishment	670	1,096	540
	Net Natural Recharge	86,561	88,804	92,199
	Canal Seepage	28,581	33,490	42,675
Groundwater Use not counted towards overdraft	*GW Allowance*	31,899	52,954	67,475
Overdraft or Surplus	***Subtracting GW Allowance***	**-1,066**	**120,530**	**367,198**
	Without Subtracting GW allowance	**30,833**	**173,485**	**434,673**

Note: All volumes are in acre-feet.

8.1.1 Demand Range

Total projected 2025 demand ranges from 880,389 to 1,321,324 acre-feet (*See Figure 8-1*). Generally, the difference in Municipal demand between the three baseline scenarios is due to a combination of assumptions regarding future population growth and corresponding water use. The difference in Agricultural demand in the three baseline scenarios involves the rate of urbanization, crop prices, and the cost and availability of water supplies. For Indian Agricultural demand, it was assumed that by 2025, the amount of irrigation on-reservation would increase, with different assumptions on the rate of increase in each scenario. The primary difference in Industrial demand figures concerns assumptions regarding potential new Dairy and Large-Scale Power Plants development. The assumptions and methodology used for water demand projections are detailed in Sections 7 through 10.

Figure 8-1 Historical and 2025 Projected Demand by Sector
Pinal Active Management Area



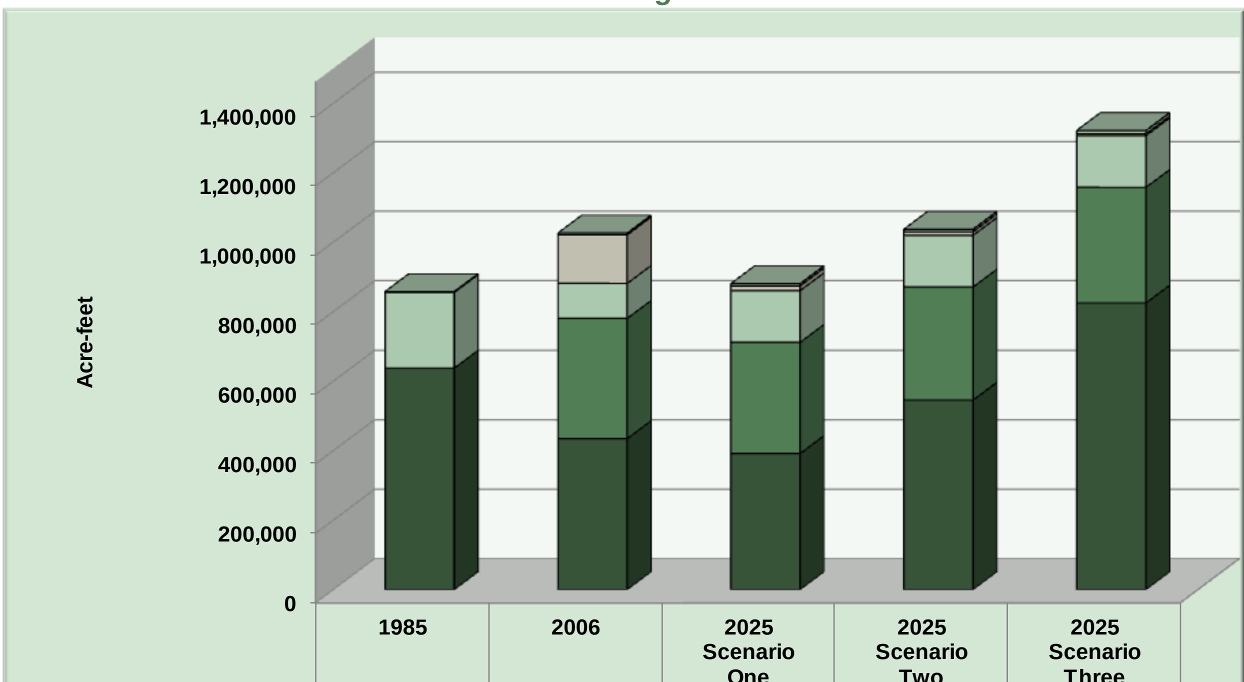
	1985 Historical	2006 Historical	2025 Scenario One	2025 Scenario Two	2025 Scenario Three
TOTAL	857,550	1,026,030	880,389	1,036,797	1,321,324
INDIAN	46,896	152,925	154,234	195,401	239,479
INDUSTRIAL	4,955	20,243	25,189	31,042	43,676
AGRICULTURAL	792,092	819,894	588,157	689,180	877,896
MUNICIPAL	13,607	32,968	112,809	121,175	160,273

8.1.2 Supply Range

The total projected supplies used to meet demand are shown in *Figure 8-2*. Historically, non-CAP surface water has been a significant supply within the Pinal AMA; in Baseline Scenarios One, Two, and Three, the projected availability of this source is assumed to be constant. The amount of reclaimed water, both direct use and stored/recovered, has increased only slightly during the historical period. Projected reclaimed water use varies from 6,180 to 9,129 acre-feet among the three baseline scenarios, as a function of projected Municipal and Industrial demand. In 2025, CAP use is projected to range from 320,143 to 332,853 acre-feet. More than one-third of the future CAP use is assumed to be a result of the increase in on-reservation Indian Agriculture, as well as full utilization of Agricultural CAP and municipal providers' CAP allocations, and Industrial CAP use.

By far the largest difference in projected supply among the three baseline scenarios is in groundwater use. Generally, it was assumed that if Agriculture, Municipal, and Industrial demand increases, groundwater will be a large portion of the supply needed to meet that increased demand. This additional groundwater use directly affects overdraft.

Figure 8-2 Historical and 2025 Projected Supplies
Pinal Active Management Area



	1985	2006	2025 Scenario One	2025 Scenario Two	2025 Scenario Three
TOTAL	857,549	1,026,030	880,389	1,036,797	1,321,324
RECLAIMED WATER	1,848	4,805	6,180	6,678	9,129
IN-LIEU GROUNDWATER	0	139,616	13,572	10,313	5,475
SURFACE	217,764	100,585	148,655	148,655	148,655
CAP	0	346,335	320,143	325,489	332,853
GROUNDWATER	637,938	434,689	391,838	545,662	825,211

8.1.3 Offsets to Overdraft

A number of factors, as shown in Table 8-2, offset groundwater pumping. As mentioned previously, incidental recharge results from sector water use activities, such as water applied to fields in excess of crop consumptive use and evaporation demands within the Agricultural sector, or a similar application of water to Municipal or Industrial turf-related facilities. Incidental recharge rates are assumed to be consistent with historical rates, depending on the water use sector and nature of the water use.

Net natural recharge in the Pinal AMA consisting of inflows from the Tucson and Phoenix areas, major drainage recharge, ungauged tributary inflow, mountain front recharge, and basin and ephemeral stream recharge is estimated to yield a benefit to the AMA of 82,750 acre-feet under all three scenarios.

Pursuant to recharge statutes, in many cases permitted artificial recharge activities require that a certain percentage of the recharged volume be mode non-recoverable to benefit the aquifer. These required non-recoverable volumes are called cuts to the aquifer, and have been discussed in Section 3.4.3. The amount of water accounted for as cuts to the aquifer varies slightly under the three baseline scenarios based on different assumptions regarding amounts of projected recharge, type of water, and type of facility. The assumptions and methodology involved in Recharge projections are detailed in Section 13.

Table 8-2 2025 Projected Offsets to Overdraft
Pinal Active Management Area

TYPE OF OFFSET	Scenario One 2025	Scenario Two 2025	Scenario Three 2025
Incidental Recharge			
Municipal	4,512	4,847	6,411
Industrial	1,366	1,528	1,705
Agriculture	226,337	226,337	226,337
Indian Agriculture	36,475	36,475	36,475
Net Natural Recharge	82,750	82,750	82,750
Reclaimed Water Discharge	3,811	6,054	9,449
CAGRD Replenishment	670	1,096	540
Canal Recharge	28,581	33,490	42,675
Cuts to the Aquifer	679	516	274
TOTAL	**385,181**	**393,093**	**406,616**

Notes: All volumes are in acre-feet.

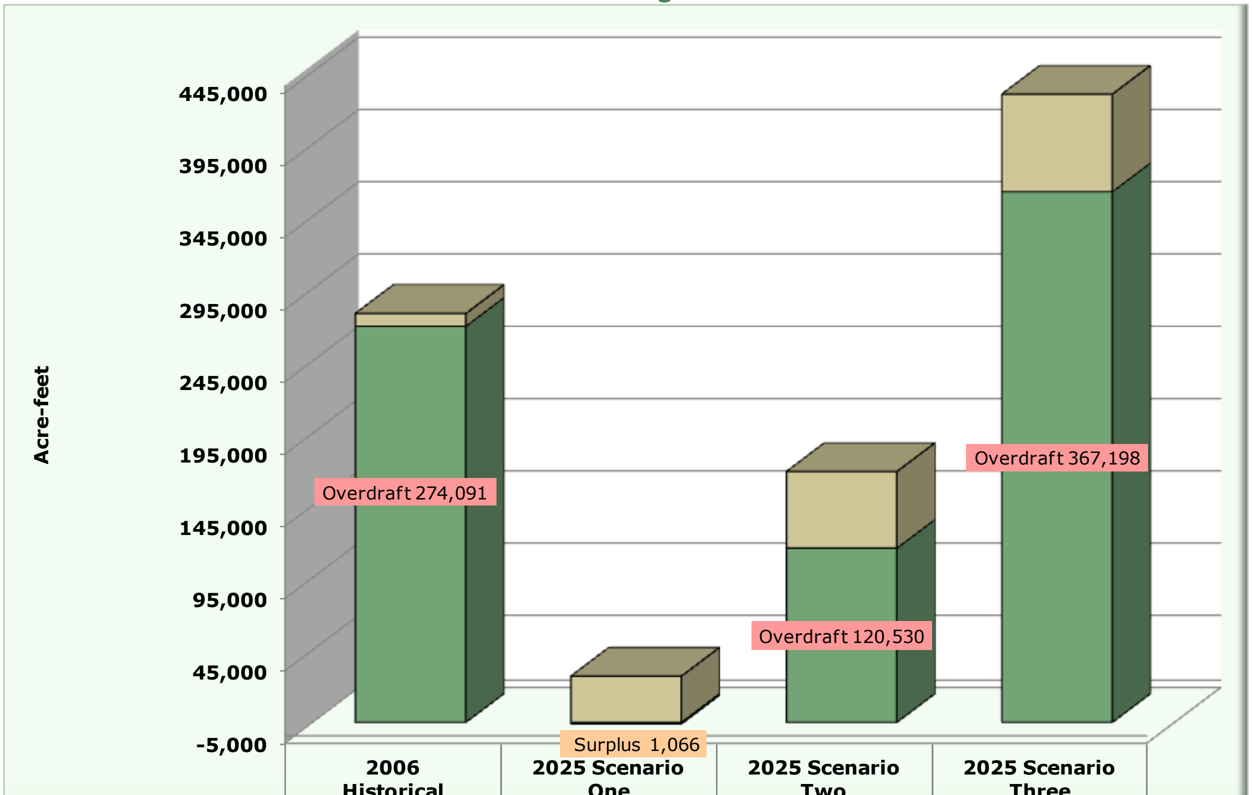
8.2 Overdraft Range

In 2006, the estimated overdraft, including groundwater allowance, for the Pinal AMA was just over 282,000 acre-feet. The projected 2025 overdraft figures, including groundwater allowance, vary from 30,833 in Baseline Scenario One to 434,673 acre-feet in Baseline Scenario Three (*See Figure 8-3)*.

As detailed earlier in this Assessment, a portion of this overdraft is groundwater allowance under the AWS Program, and is deemed to be consistent with the management goal of the Pinal AMA. Without counting for these groundwater allowance volumes, the AMA would be in surplus by about 1,000 acre-feet in Baseline Scenario One or at overdraft in the range of 120,530 to 367,198 acre-feet for 2025 in Baseline Scenarios Two and Three respectively.

It should be noted again that in addition to the AWS Program groundwater allowance, certain users are legally permitted to withdraw groundwater pursuant to groundwater rights and withdrawal authorities that do not have a replenishment requirement. These withdrawal authorities include IGFRs, Type 1 and Type 2 rights, groundwater withdrawal permits, exempt wells, and service area rights operated by undesignated municipal providers who serve customers not covered by a CAWS. Groundwater pumped pursuant to these types of withdrawal authorities is included as overdraft and continues to be an impediment to reaching the water management goal because no replenishment is required.

Figure 8-3 2025 Projected Overdraft or Surplus
Pinal Active Management Area



	2006 Historical	2025 Scenario One	2025 Scenario Two	2025 Scenario Three
TOTAL	282,913	30,833	173,485	434,673
GW Allowance	8,822	31,899	52,954	67,475
Overdraft or Surplus	274,091	-1,066	120,530	367,198

8.3 Factors Affecting Projected Overdraft

Agricultural and Indian Agricultural Demand

As was the case during the historic period, overdraft in the projected baseline scenarios is most affected by the groundwater used by the Agricultural sector. Each of the three baseline scenarios assumes very significant reductions in the use of CAP in-lieu of groundwater, ranging from about 13,500 acre-feet in Baseline Scenario One to less than 5,500 acre-feet in Baseline Scenario Three. In the absence of the CAP in-lieu of groundwater, all three projected scenarios assume a return to increased use of groundwater in amounts ranging from about 300,000 acre-feet in Baseline Scenario One to almost 579,000 acre-feet in Baseline Scenario Three. This latter amount approaches the highest use year during the historic period, 1985, during which almost 595,000 acre-feet of groundwater was used. Indian groundwater demand is also expected to increase; the projected scenarios assume between about 15,000 acre-feet to as much as 87,000 acre-feet of potential groundwater use.

The goal of the Pinal AMA recognizes the need for this continued dominant groundwater use for Agricultural purposes.

Lagged Agricultural Incidental Recharge

As was also the case during the historic period, the estimated incidental recharge that will result due to agricultural activities will be the largest offset to overdraft in the AMA. In 2006, the incidental recharge estimated to occur from agriculture, including Indian agriculture, was 182,919 acre-feet. As noted in Section 3.4.2 and 6.3, this amount of water is from agricultural activity twenty years before, since in this Assessment the Agricultural Incidental Recharge is lagged. In each of the three baseline scenarios, the total amount of incidental recharge projected to occur is based on water applied in 2005 and is therefore 262,812 acre-feet in all three scenarios. As long as Agriculture continues to be the predominant use, and for twenty years afterwards, a significant amount of pumpage will be offset by agricultural incidental recharge.

Streambed Infiltration, Canal Seepage and Groundwater Inflow

Streambed infiltration, canal seepage and groundwater inflow were noteworthy offsets to overdraft during the historic period, in a total amount of 158,258 acre-feet in 2006. In the baseline scenarios, Streambed infiltration and groundwater inflow remain constant at 36,200 and 57,350 acre-feet respectively, but canal seepage varies among the three baseline scenarios. It ranges from 27,488 to 42,675 acre-feet, varying based on the amount of water delivered through the canals.

Unreplenished Groundwater and Allowable Groundwater

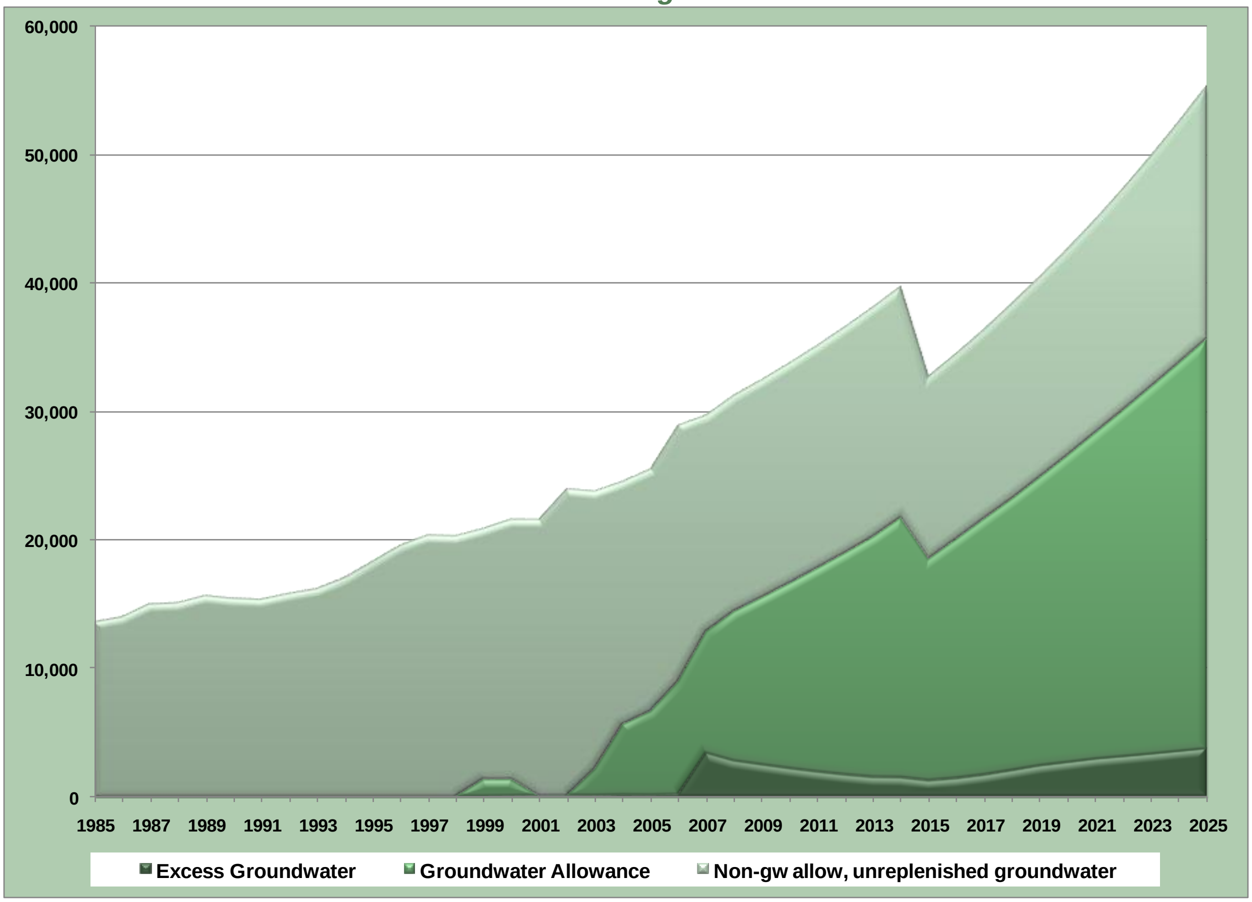
Authorities including IGFRs, Type 1 and Type 2 rights, groundwater withdrawal permits, exempt wells and service area rights operated by undesignated municipal providers who serve customers not covered by a CAWS issued after 1995 do not currently have a replenishment requirement and will not in 2025. As such, groundwater pumped pursuant to these types of withdrawal authorities applies directly to groundwater overdraft because no replenishment is required.

Groundwater use by the Municipal sector that will not be subject to replenishment in 2025 is projected to range from 19,740 acre feet, which is less than the 2006 amount of 19,939 acre-feet, to 36,925 acre-feet. Compared to other factors affecting overdraft, unreplenished groundwater in the Pinal AMA is not major. More significant is the groundwater allowance. In 2006, the total groundwater allowance was 8,822 acre-feet. By 2025, it is projected to range from almost 32,000 acre-feet to 67,000 acre-feet (See Figure 8-4). The groundwater allowance is considered consistent with the AMA goal, but because it is not replenished, it contributes physically to overdraft. This factor grows over time with population.

Artificial Recharge

The Pinal AMA has, via GSFs, played a critical role in enabling the state to maximize its use of Colorado River water, as hundreds of thousands of acre-feet of CAP water has been indirectly stored in the Maricopa-Stanfield and Eloy subbasins. A modest amount of the water stored will be used for municipal purposes, but he vast majority of that water will eventually serve other users, including California and Nevada. However, this use of CAP via GSFs has assisted the AMA in meeting the first part of the management goal by preserving the local agricultural economies. In the Baseline Scenarios, much less water is projected to be available for storage at GSFs, as less excess CAP will be available by 2025 as M&I users grow into their allocations. Water projected to be stored, minus losses, fluctuate over the projected period in all of the Baseline Scenarios, but by 2025, the total amount to be stored at GSFs ranges from about 13,572 acre-feet to 5,475 acre feet, much less than the 143,647 acre-feet stored in 2006. The ability for CAP stored at GSFs, also known as in-lieu of groundwater use, to preserve the local agricultural economy will be, given the assumptions made in the baseline scenarios, greatly diminished by 2025.

Figure 8-4 Excess, Groundwater Allowance and Non Groundwater Allowance, Unreplenished Groundwater in Baseline Scenario One Pinal Active Management Area



Note: Volumes are in acre-feet.

9. MUNICIPAL PROJECTIONS

Generally, the highest population projection was paired with the highest water demand projection method and the lowest population projection was paired with the lowest demand projection method. This established the end points of the range of projected municipal population and demand. A third scenario fell between the highest and the lowest scenarios (*See Figure 9-1*).

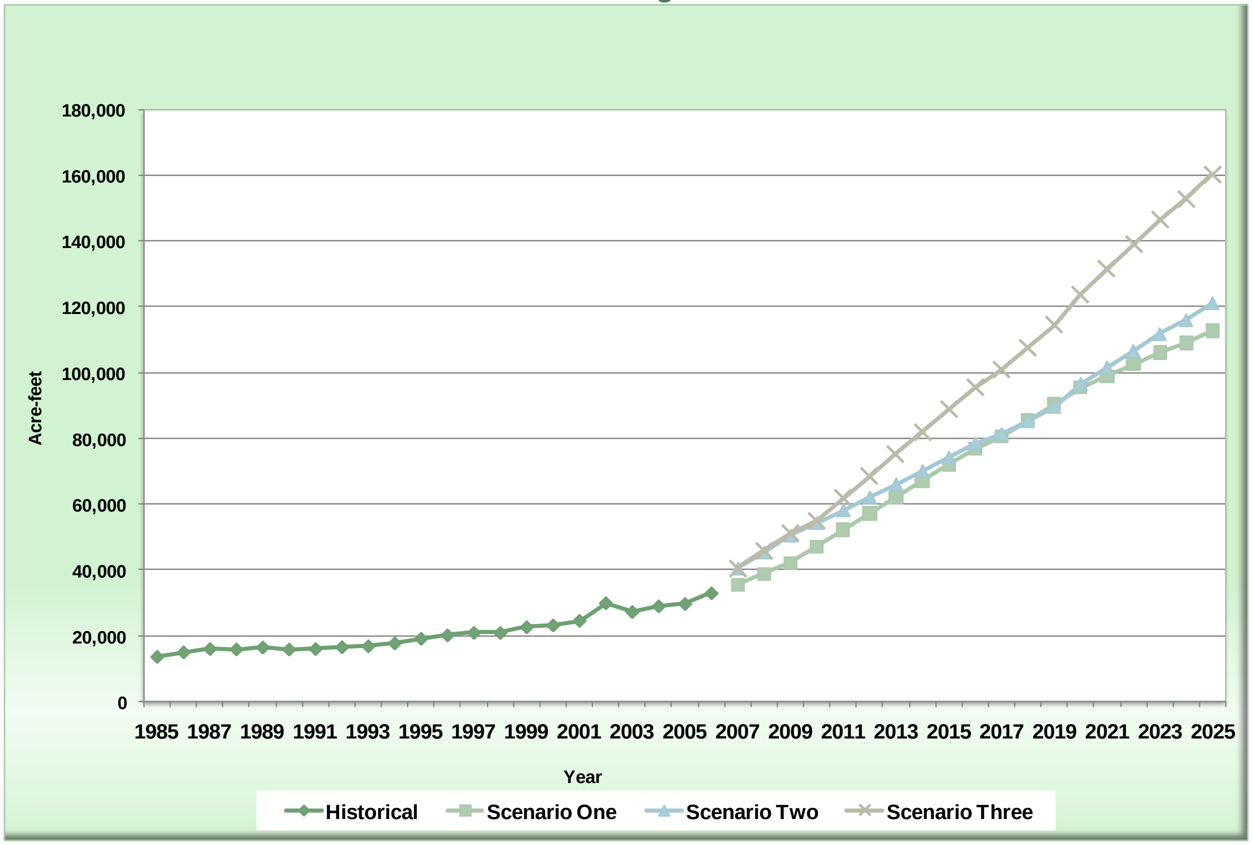
9.1 Description of Demand Methodologies and Assumptions

9.1.1 Population

Projecting Municipal demand begins with population. Some Industrial subsector demand is also directly related to population. This is discussed further in the Industrial projection section. Various methods of projecting population that incorporated multiple steps were used for this Assessment. Some of the scenarios used all the steps, and others did not. Methods used include:

- Population projections prepared by other agencies were used to develop a total Pinal AMA population projection. In Pima and Pinal counties, the regional associations of government projections were used.

Figure 9-1 Historical and Projected Municipal Demand
Pinal Active Management Area



- *A calculated total AMA population* was developed using different methods for large providers, small providers, and exempt wells:
  ◦ *Simple statistics* were used to project population for each individual large municipal provider that does not hold a DAWS. For designated providers, the projected population and demand included in the provider's DAWS was used. Trend lines with the highest statistical correlation were selected for each undesignated provider. The trend lines used data from 1985 through 2006. In some cases, water providers submitted population projections to ADWR that extended for some years beyond 2006 but did not extend out to 2025. ADWR used the providers' projections for as many years as were given, and extended the projections to 2025 with statistical trend lines.
  ◦ *The* small provider and exempt well sub-sector populations were projected using an *average percent growth rate.* The period used to generate the growth rate varied by scenario, but was either from 1985 to 1999 or from 2000 to 2006.
  ◦ *Using* these methods, the projections for large providers, small providers, and exempt wells were summed to develop a *calculated total AMA population.*

The methods were compared and categorized from lowest to highest. Appendices 1 through 4 describe the individual Municipal assumptions for the Pinal AMA in more detail.

9.1.2 Designations of Assured Water Supply

Water providers who hold a DAWS have provided ADWR with projected water demand, and in some cases, projected population in their applications for DAWS and in their annual reports. ADWR used information provided in the applications for DAWS for designated providers because the determinations of AWS for these providers are based on this information, which is tracked using data provided in the annual reports. If there was insufficient information, ADWR examined past water use and population trends for the provider and used that information to create an inferred projection that reasonably fit the provider's past trends and plans as submitted to ADWR.

9.1.3 Central Arizona Groundwater Replenishment District Plan of Operation

Every ten years the CAGRD is required to submit a Plan of Operation to ADWR outlining how it will meet its current and future replenishment obligations. In its 2004 Plan of Operation, the CAGRD projected the population, total demand, groundwater demand, and replenishment obligation of enrolled member lands and member service areas, as well as future member lands not yet enrolled. The CAGRD worked with the Maricopa Association of Governments (MAG), the Pima Association of Governments (PAG), and ADES to develop population projections, using MAG's projection model and geographic boundaries. As explained in Section 9.2.1, ADWR uses several population projection methodologies including those of other agencies in this Assessment. ADWR also used demand and supply assumptions in this Assessment that differed from those used by the CAGRD in its Plan of Operation. Because of these differences, ADWR did not adopt the figures included in CAGRD's Plan of Operation, but instead developed its own estimate of the CAGRD replenishment obligation. These figures are for planning purposes only for this Assessment and are not intended to modify or replace the figures the CAGRD has used in its Plan of Operation.

ADWR did not approach the replenishment obligation from the perspective of growth in individual subdivisions (as the CAGRD used in its Plan of Operation). Instead, ADWR began with the population projection for each municipal provider as a whole, and then separated out the population growth in each provider's service area since 1995 (the year of the adoption of the AWS Rules). For undesignated providers (providers who do not hold a DAWS) the sum of all post-1995 population was compared to the sum of the population and demand associated with the linear build-out of issued CAWS at the end of 2006. The difference between projected population and 1995 population represents future population that is assumed to be associated with new CAWS (comparable to future member lands projected by the CAGRD). Similarly, the difference between projected demand and 1995 demand represents future demand, however, not all future demand will be associated with a subdivision and a CAWS. To estimate the proportion of new demand that might be associated with a future CAWS, the single family to multi-family ratio for undesignated providers was applied to the future demand. This approach was taken since new subdivisions primarily consist of single family homes. Then an assumption was made in order to estimate the groundwater portion of future demand presumed to be associated with subdivisions. The ratio of the sum of all undesignated provider groundwater demand to the sum of all undesignated provider total demand was used to estimate the groundwater portion of the future CAWS demand.

For each issued CAWS, the volume of replenishment obligation was based on the CAGRD's reporting percentage for each year through 2025. The remainder of the projected annual groundwater demand minus the calculated replenishment obligation was presumed to be groundwater allowance use. When the groundwater allowance for a CAWS was exhausted, all groundwater demand was assumed to be met by the CAGRD as replenishment obligation.

For each member service area, the replenishment obligation was calculated as the difference between the projected groundwater demand and the projected groundwater allowance use rate as submitted in the provider's application for a DAWS up to any cap on maximum replenishment in the provider's Member Service Area Agreement with the CAGRD.

9.1.4 Baseline Scenario One Demand Methodology and Assumptions

Baseline Scenario One projected total large provider population by using the overall average rate of growth for large providers during the historical period. The total projected population for individual large providers was determined by multiplying each provider's Baseline Scenario Two population projection by the percent difference between the total large provider projected population in Baseline Scenario Two and the total large provider projected population in Baseline Scenario One. This method reduces the population projection for all providers by the same percentage. The *Third Management Plan for the Pinal Active Management Area 2000 – 2010* conservation requirement calculation methodology was used with the population projection for each large provider to calculate the projected Baseline Scenario One demand for each large provider.

The projected demand by institutional providers is included in the total for large municipal providers in this Assessment. In Baseline Scenario One, the prison population was decreased by the percent difference between the Baseline Scenario One projected population and the Baseline Scenario Two population for large providers. Institutional provider demand was projected in the same way as in Baseline Scenario Two.

For small providers in Baseline Scenario One, the average rate of growth of small provider population from 1985 through 1999 was multiplied by the 2000 through 2006 overall average GPCD rate for small providers to calculate small provider projected demand.

Baseline Scenario One projects exempt well population using the average historical growth rate in exempt well population from 1985 through 1999. Exempt well demand was calculated using the *Third Management Plan for Pinal Active Management Area, 2000 – 2010* interior and exterior water use models for single family housing units, the 2000 US Census average persons per housing unit for Pinal County, and the projected exempt well population for all three scenarios.

The 1985 through 2006 average volume of urban irrigation demand by large untreated water providers was used in all three scenarios. In addition, in Baseline Scenario One there is an assumed increase in urban irrigation associated with agricultural acres in the SCIDD going out of production and converting to flood irrigation residential landscaping.

9.1.5 Baseline Scenario Two Demand Methodology and Assumptions

Baseline Scenario Two projected each large municipal provider's population using the best fit statistical trend line generated from the historical service area population data. For each projection year, the projected population was then multiplied by each large provider's 2000 to 2006 average GPCD rate to calculate projected demand.

The projected demand by institutional providers is included in the total for large municipal providers. Modest increases in prison population were assumed based on discussions with prison officials. Prison demand was projected using the 2000 through 2006 average prison GPCD rate multiplied by the prison population. Francisco Grande resort was not projected to continue as an institutional provider because it is served potable water by another provider.

Population for small providers in Baseline Scenario Two is the same as for Baseline Scenario One. Demand is calculated using the 1985 through 2006 overage average small provider GPCD.

Exempt well population for Baseline Scenario Two was projected using the average Pinal County growth rate from 2000 through 2006. An assumed number of housing units for exempt well population was calculated by dividing the projected population by the average persons per housing unit. The projected demand for exempt wells was calculated by multiplying the housing units by the exterior water use model and adding the population multiplied by the interior water use model.

The 1985 through 2006 average volume of urban irrigation demand by large untreated water providers was used for Baseline Scenario Two.

***Table 9-1* 2025 Projected Municipal Water Demand**
Pinal Active Management Area

Municipal Use Category	Scenario One	Scenario Two	Scenario Three
Large Providers			
Total Use	53,077	87,385	116,825
Groundwater Use	39,074	72,038	99,469
Institutional Provider			
Total Use	1,210	1,721	2,251
Groundwater Use	1,210	1,721	2,251
Small Providers			
Total Use	3,917	4,178	8,815
Groundwater Use	3,917	4,178	8,815
Urban Irrigation			
Total Use	43,717	17,967	17,967
Groundwater Use	244	244	244
Domestic Well Use			
Total Use	10,887	9,924	14,415
Groundwater Use	10,887	9,924	14,415
Municipal Total Demand	**112,809**	**121,175**	**160,273**
Municipal Total Groundwater Demand	**55,332**	**88,105**	**125,194**

Note: All volumes are in acre-feet.

9.1.6 Baseline Scenario Three Demand Methodology and Assumptions

Baseline Scenario Three used the Central Arizona Association of Governments' (CAAG's) projections. A total AMA population projection was developed and large provider population as a percentage of total AMA population was set equal to the 2006 percentage. The total projected population for individual large providers was determined by calculating the percent difference between the Baseline Scenario Three large provider projection and the Baseline Scenario Two large provider population projection. Projected demand was calculated for each projection year by multiplying the projected population by the provider's 2000 through 2006 average GPCD rate.

The projected demand by institutional providers is included in the total for large municipal providers in this Assessment. In Baseline Scenario Three the prison population was increased by the percent difference between the Baseline Scenario Three projected population and the Baseline Scenario Two population for large providers. Demand was projected in the same way as in Baseline Scenario Two.

Baseline Scenario Three used the CAAG projections to project small provider population, holding small providers at the same percent of the total AMA population that they accounted for in 2006. The projected small provider demand in Baseline Scenario Three is equal to the projected population multiplied by the 1985 through 2006 average GPCD rate for small providers.

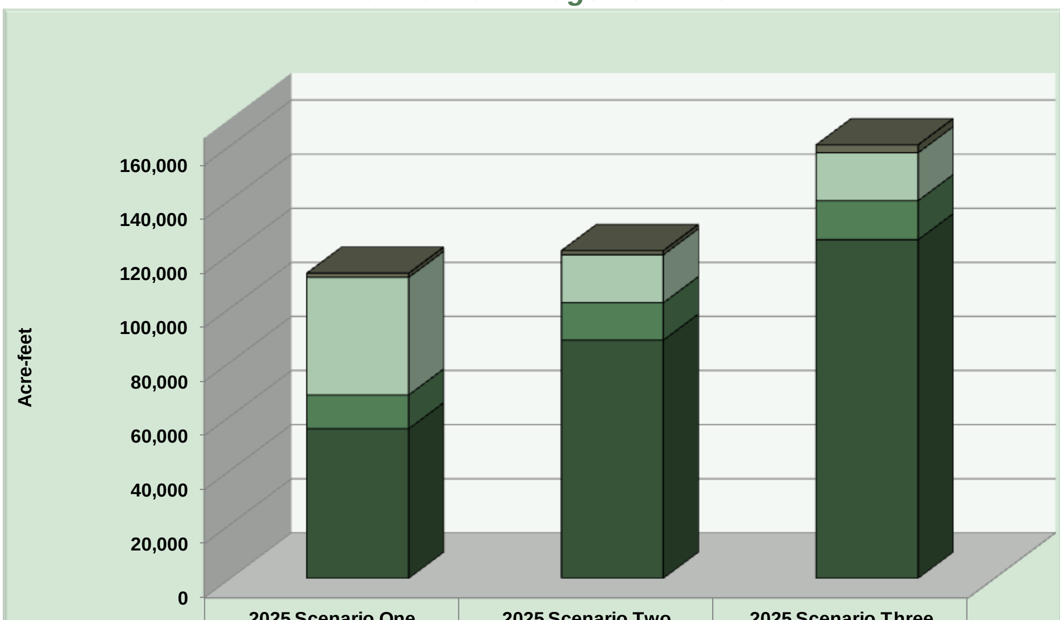
In Baseline Scenario Three, exempt well population is the total projected population for the AMA minus the projection for large providers, institutional providers, and small providers. Demand was calculated using the same approach as in Baseline Scenario Two for exempt well population.

Urban irrigation demand is the same in Baseline Scenario Three as in Baseline Scenario Two.

9.2 Description of Supply Methodology and Assumptions

Individual supply assumptions were made for each large provider based on the DAWS for designated providers or historical use of supplies for undesignated providers, with renewable supplies capped based on treatment capacity limitations or allocations. It is assumed that providers holding a DAWS will use their groundwater allowance first, consequently, the primary source of supply would be groundwater. Renewable supplies would then be used as necessary to maintain their DAWS. CAP water use by undesignated providers begins in 2015 when plans to directly treat and deliver CAP are assumed to be realized *(See Figure 9-2)*.

Figure 9-2 2025 Projected Municipal Supplies
Pinal Active Management Area



	2025 Scenario One	2025 Scenario Two	2025 Scenario Three
TOTAL	112,809	121,175	160,273
Reclaimed Water	1,539	1,539	2,916
Surface Water	43,456	17,706	17,706
CAP	12,482	13,824	14,457
Groundwater	55,332	88,105	125,194

Because all new subdivisions after 1995 must meet the AWS Rule requirements, new groundwater demand associated with CAWS was presumed to meet the AMA goal requirement of the AWS Rules for Pinal AMA, first by use of the groundwater allowance and then through replenishment by the CAGRD. Due to the number of issued CAWS in the Pinal AMA that have not yet started construction or are only beginning to build, it is likely that much of the growth between now and 2025 will be associated with the build-out of issued CAWS. Most of these CAWS were issued prior to the change in the AWS Rules that caps groundwater allowance; therefore, there is a much greater use of groundwater allowance than there is excess groundwater in all of the projected scenarios in Pinal AMA.

Institutional providers, small providers, and exempt well population use only mined groundwater in all three baseline scenarios.

9.3 Overview of Municipal Results

The recent reduction in residential construction due to current economic conditions has not been accounted for in any of the three baseline scenarios. However, the volume of demand associated with CAWS and DAWS issued in the Pinal AMA to date is sufficient to account for all of the increase in municipal demand in all three scenarios. The length of time it will take for the new subdivisions to reach build-out is difficult to project given the current economy, but for purposes of this Assessment, a 25-year build-out was assumed for all CAWS in the Pinal AMA. However, when the economy recovers, the significant number of previously issued CAWS and approved projected DAWS demand can begin to develop immediately and growth could accelerate rapidly. This leads to a high degree of uncertainty in projecting population in the Pinal AMA and the range between the scenarios is extreme. Even under Baseline Scenario Three, which is the scenario with the highest projected demand, the Municipal sector in the Pinal AMA is not as dominant as the Agricultural sector, but it does represent a significant potential for demand in the future.

As agriculture is projected to decline, the SCIDD, which is an existing large untreated water provider, is projected to increase deliveries of surface water for urban irrigation. This is reflected in Figure 9-2.

Groundwater remains the primary source of supply in all three municipal baseline scenarios, although more CAP is used in Baseline Scenario Three, and surface water increases due to the increase in urban irrigation water delivered by the SCIDD. Because of the manner in which groundwater allowance was calculated prior to the September 2007 AWS Rule change, many of the previously issued CAWS in the Pinal AMA may never need to offset their groundwater demand with replenishment. Without an incentive or requirement to switch from groundwater to renewable supplies or to replenish groundwater, it is unlikely that a shift in supplies used will occur until lack of physical availability or poor water quality become motivating factors for change.

9.3.1 Baseline Scenario One Results

In Baseline Scenario One, projected Municipal demand is 242 percent greater in 2025 at 112,808 acre-feet (*See Figure 9-1* and *Table 9-1)* than in 2006 when it was 32,968 acre-feet.

Groundwater demand increases by 92 percent, from 28,895 acre-feet in 2006 to 55,332 acre-feet by 2025 (*See Figure 9-2*).

The proportion of Municipal sector demand comprises a larger proportion of total AMA demand in 2025 than in 2006, increasing from 3 percent of total AMA demand to nearly 13 percent (See *Figure 8-1*).

9.3.2 Baseline Scenario Two Results

Municipal demand in Baseline Scenario Two increases by 268 percent, from 32,968 acre-feet in 2006 to 121,175 acre-feet in 2025 (*See Figure 9-1* and *Table 9-1*).

Groundwater demand in Baseline Scenario Two increases by 205 percent, from 28,895 acre-feet in 2006 to 88,105 acre-feet in 2025 (*See* Figure 9-2*).*

The proportion of Municipal sector demand increases from only 3 percent of the total AMA demand in 2006 to about 12 percent in 2025 (*See Figure 8-1*).

9.3.3 Baseline Scenario Three Results

Municipal demand in Baseline Scenario Three increases by 386 percent, from 32,968 acre-feet in 2006 to 160,273 acre-feet in 2025 (*See Figure 9-1* and *Table 9-1*).

Groundwater demand in Baseline Scenario Three increases 333 percent, from 28,895 acre-feet in 2006 to a projected 125,194 acre-feet in 2025 (*See* Figure 9-2).

Municipal demand in Baseline Scenario Three increases from only 3 percent of the total AMA demand in 2006 to over 12 percent by 2025 (*See Figure 8-1*).

10. INDUSTRIAL PROJECTIONS

As discussed in Section 3.1.2, the Industrial sector is made up a number of different subsectors. When completing the Industrial projections, three projected baseline scenarios were developed for each Industrial subsector in the AMA. This method allowed for individual subsector analysis resulting in a broad range of potential Industrial demand in the AMA. The Pinal AMA Industrial subsectors are dairies, turf-related facilities, sand and gravel, electric power generation, feedlots, metal mining and the generic, catch-all category, “other Industrial”. Subsector demand scenarios were added together to derive the AMA’s range of the total Industrial demand projections.

10.1 Description of Demand Methodologies and Assumptions

The Pinal AMA industrial demand projection scenarios were developed using a combination of methods:

- *Trend line analysis* (where the x-value is a measure of time) or simple regression analysis (where the x value is a measure other than time, such as population) was generally used to predict future water use if an Industrial subsector’s historical water use had a strong relationship ($R^2 > 0.6$) to time or population. Trend line analysis was also used to study the rate of growth or decline in the number of facilities within a subsector over time. This analysis was especially helpful in detecting when established water use trends start to change.
- Generally, if a subsector did not exhibit a strong relationship to time or population, then one of the following methods were used: the scenario was developed by AMA staff or sector professionals based on professional judgment, or the *average historical use* or *current use* was *held constant through time*. Subsectors, such as dairies, that are based on a commodity generally fit into this category. See Appendix 5 for more details on the specific methodology used in projecting each Industrial subsector.

As mentioned earlier, it is important to note that ADWR defines an Industrial user as an entity that uses water for a non-agricultural purpose and does not receive water from a municipal source. Generally, Industrial users have their own wells and associated water rights or withdrawal permits. The Industrial sector predominately uses groundwater to meet its demand; however, non-groundwater supplies are counted in this sector if they are not supplied by a municipal provider. See Appendix 5 for a more detailed description of individual Industrial subsector assumptions.

Factors Driving Future Industrial Use in Pinal

In the Pinal AMA, the industrial subsectors that will most likely be influenced by future population growth are turf facilities, electric power generation, and sand and gravel operations. It is important to note that although changes in population may affect local water use in a subsector, there may be exceptions. Unlike turf development, which tends to be located near the population that benefits from it, electric power is often generated a considerable distance from its users. In other words local population growth does not always mean a similar increase in local power generation and associated water use.

Factors that could affect Dairy water use in the Pinal AMA include land prices in both the Phoenix and Pinal AMAs, the availability and price of feed, and the price of milk. Feedlots and mining are also commodity driven subsectors that are dependent on the local and global economy. It is important to note that historical non-Indian metal mining was so insignificant in the Pinal AMA that it was assumed that no metal mining water use would occur there in the future. The only significant mining in the Pinal AMA is on reservation land. This water use is not reported to ADWR.

10.1.1 Baseline Scenario One Demand Methodology and Assumptions

Baseline Scenario One for the Pinal AMA assumed the following occurs:

- Dairy water use stays relatively constant at 2006 levels, with only a slight increase because of tighter dust control regulations;
- Turf water demand follows a logarithmic (non-linear) relationship with population and assumes population growth in the Pinal AMA follows the population projection for Baseline Scenario One;
- Electrical power generation water demand increases slightly (300 acre-feet) for a new substation;
- Sand and gravel and feed lot water demand remains constant at 2006 use; and
- Other Industrial use remains constant at 2002 to 2006 average use.

Assumptions for all three baseline scenarios (*See Table 10-1*) were based on the following sources: ADWR Data Management's Correlation Study of Sand and Gravel and Population, Dairy Graphs, ADWR Data Management's Industrial Projections by Trend Lines Study, Arizona Public Service Resource Plan 2009 through 2025, Rethinking Dairyland September 2002 - Facing Up to The Western Dairy Boom, AMA Industrial Memo dated September 2008, and AMA staff email correspondence with a dairy professional dated May 2009.

10.1.2 Baseline Scenario Two Demand Methodology and Assumptions

Baseline Scenario Two for the Pinal AMA made the following assumptions:

- Dairy water use shows modest increases related to the projected development of two or three additional dairies;
- Turf water demand follows a logarithmic (non-linear) relationship with population and assumes population growth in the Pinal AMA follows the population projection from Municipal Baseline Scenario Two;
- Electrical power generation water increases more than in Baseline Scenario One with the addition of one small substation plus one 250 to 350 megawatt plant
- Sand and gravel and feed lot water demand same as in Baseline Scenario One; and
- Other Industrial use is the same as in Baseline Scenario One.

10.1.3 Baseline Scenario Three Demand Methodology and Assumptions

Baseline Scenario Three for the Pinal AMA made the following assumptions:

- Dairy water use increases rapidly as the development of new dairies continues;
- Turf water demand follows a logarithmic (non-linear) relationship with population and assumes population projection from Municipal Baseline Scenario Three;
- Electrical power generation water use increases more than in Baseline Scenario Two with the addition of one small substation and several 250 to 350 MW or larger plants;
- Sand and gravel and feedlot water use same as in Baseline Scenario One; and
- Other Industrial use is the same as in Baseline Scenario One.

10.2 Description of Supply Methodology and Assumptions

The assumption was made that Industrial demand would be served by the same supplies in the same proportions as in 2006, with some minor exceptions based upon specific information available to ADWR. This general supply methodology was similar to the one used in the 3MP when supply proportions from 1995 were projected forward.

In 2006, the Pinal Industrial demand was met by approximately 84 percent groundwater, 7 percent CAP water, and 9 percent reclaimed water. However, if AMA staff knew that a specific project was planned in the AMA and a water source had been identified, that specific demand and supply was used in supply projections.

10.3 Overview of Industrial Results

Historically, Industrial demand in the Pinal AMA has shown a significant increase. This is due, in large part, to dairies moving from the Phoenix AMA into the Pinal AMA; however, rapid population growth in the Pinal AMA also contributed to increased Industrial demand, particularly in the turf and sand and gravel subsectors. Baseline Scenarios One through Three illustrate a reasonable range of potential Industrial water use in the AMA. It is unlikely that demand will exactly follow any one of the baseline scenarios from 2007 until 2025, but it is reasonable to assume that demand will fluctuate within this range of demand scenarios (*See Table 10-1*).

Table 10-1 2025 Projected Industrial Demand by Facility Type
Pinal Active Management Area

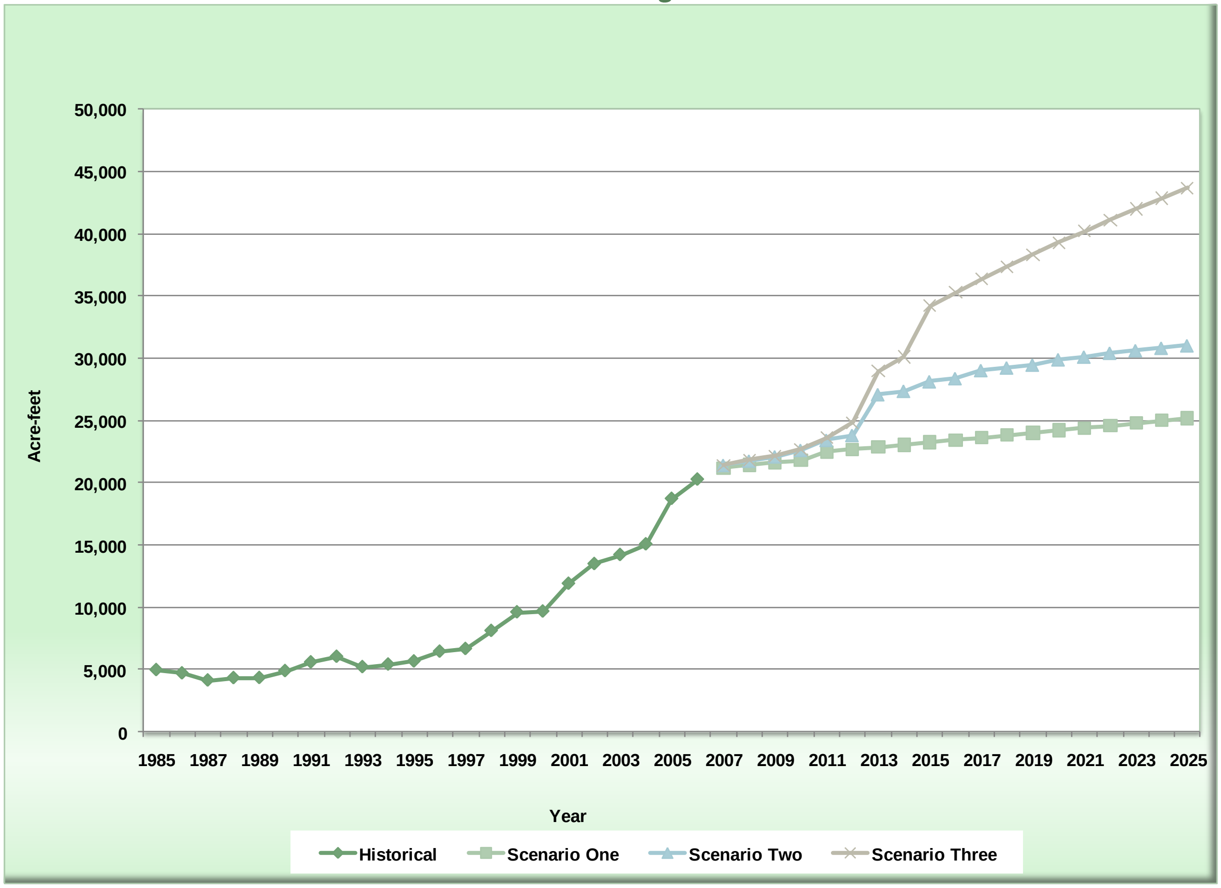
Type of Facility	2025 Scenario One	2025 Scenario Two	2025 Scenario Three
Dairies	10,000	11,500	19,658
Turf-Related Facilities	9,715	11,067	12,543
Feedlots	2,700	2,700	2,700
Sand and Gravel Operations	1,314	1,314	1,314
Mining	0	0	0
Large-Scale Power Plants	400	3,400	6,400
Other	1,061	1,061	1,061
Total	**25,190**	**31,042**	**43,676**

Note: All volumes are in acre-feet.

10.3.1 Baseline Scenario One Results

In Baseline Scenario One, Industrial demand increases slowly through the projection period. In this scenario, total Industrial demand is 25,189 acre-feet in 2025. This is an increase of almost 25 percent over the 2006 demand (See *Table 10-1 and Figure 10-1)*).

Figure 10-1 2025 Historical and Projected Industrial Demand
Pinal Active Management Area



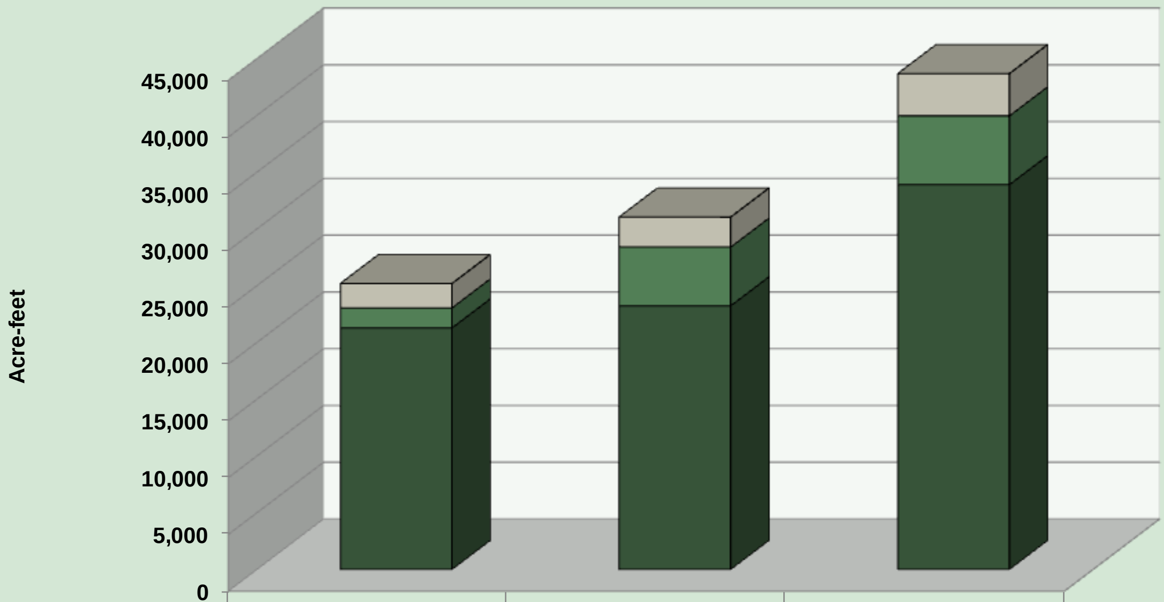
10.3.2 Baseline Scenario Two Results

In 2006, Industrial water use was 20,243 acre-feet; showing a steady increase since 2000. In Baseline Scenario Two, demand shows a fairly steady increase with a larger increase between 2011 and 2013 and a 2025 demand of 31,042 acre-feet (*See Table 10-1)*. This total demand is just over 50 percent higher than 2006 demand levels. Approximately 75 percent of the demand is met with groundwater, 17 percent with CAP, and eight percent with reclaimed water (*See Figure 10-2*).

10.3.3 Baseline Scenario Three Results

In demand projection Baseline Scenario Three, Pinal industrial demand increases the most aggressively peaking at 43,670 acre-feet in 2025 (See *Figure 10-2*). Approximately 78 percent of the demand by 2025 is met with groundwater, 14 percent with CAP, and eight percent with reclaimed water (*See Figure 10-2*).

Figure 10-2 Historical and Projected Industrial Demands
Pinal Active Management Area



	2025 Scenario One	2025 Scenario Two	2025 Scenario Three
TOTAL	25,189	31,042	43,676
Reclaimed Water	2,141	2,639	3,712
CAP	1,763	5,173	6,057
Groundwater	21,285	23,230	33,906

11. AGRICULTURAL PROJECTIONS

11.1 Description of Demand Methodology and Factors Driving Agricultural Demands

Total Agricultural demand is the sum of the IGFR demands. These demands were categorized into Irrigation District (ID), exempt IGFR, and Other IGFR demands. Other IGFR demands include all IGFRs that are not exempt and not served by a major ID; these users tend to pump their own private wells (*See Section 5.3*).

Three baseline demand scenarios were developed for each ID, exempt IGRs, and Other IGFRs. The overall Agricultural demand scenarios were then calculated by adding together the individual demand scenarios. This method allowed for the greatest range of potential demand.

The Pinal AMA individual Agricultural demand projections were developed using a combination of methods:

- *Trend line analysis* of historical water use (where the x-value is a measure of time);
- *Regression analysis* using historical water use and population (where the x-value, usually population, is a factor other than time);
- *Multiple regression analysis* (where there are several independent variables such as time, population, certified irrigation acres, and precipitation);
- *Projections by AMA staff or sector professionals;* and
- *Average historical use*

Over the past 20 years, acreage and groundwater allotments have decreased while Agricultural demand has fluctuated. There is no apparent correlation between changes in Agricultural demand and the decrease in acreage and groundwater allotments (See Section 5.3). For this reason, certified irrigation acres and groundwater allotments were not projected for the Pinal AMA. Compared to maximum groundwater allotments, total Agricultural demand has varied from less than 50 percent to greater than 90 percent of the total AMA use, fluctuating significantly with market conditions. Due to flexibility accounting, the low ratio of demand to allotments has prevented groundwater allotments from limiting demand.

Because Agricultural demand was influenced by factors other than population, certified irrigation acres, or climate factors, one of the following methods was used: 1) projections by sector professionals and AMA staff; 2) evaluating trends with time, or 3) average historical water use or current use was assumed (+/- one standard deviation for alternative scenarios). Much of the variability may be related to economic factors such as crop prices, federal subsidies, or regional demand; however, those factors are extremely difficult to project, and so were not considered.

Water use by exempt IGFRs constitute a relatively small portion of Pinal AMA Agricultural water demand (See Section 5.3.4). Projected water use for these rights was held at the same level as historical use.

Canal losses were projected for each ID by multiplying the average of the 2000 to 2006 loss ratios by each ID's projected demand. SCIDD is an exception. Historically, SCIDD has experienced high losses due to delivery through an unlined canal system. The Gila River Indian Community Water Rights Settlement provided funding for the lining of SCIDD canals (ADWR, 2006). The SCIDD canals will be lined between 2010 and 2020. This may reduce canal losses by up to 48,000 acre-feet (Mason, 2008), increasing SCIDD's supplies by up to 25,000 acre-feet (ADWR, 2006).

11.1.1 Baseline Scenario One Demand Methodology and Assumptions

Baseline Scenario One for the Pinal AMA includes the following assumptions.

- Extinguishments of agricultural lands in some IDs occurs as a result of the extinguishment credit schedule in the AWS Rules;
- Demands in other IDs decline at the rates projected by ID managers;
- Demands outside of IDs held at one standard deviation below historical averages; and
- Additional surface water supplies based on SCIDD canal lining would not be realized before 2025.

11.1.2 Baseline Scenario Two Demand Methodology and Assumptions

Baseline Scenario Two for the Pinal AMA includes the following assumptions.

- Demands in the IDs decline at the rates projected by ID managers or by trend lines; and
- Demands outside of IDs held at the historical average.

11.1.3 Baseline Scenario Three Demand Methodology and Assumptions

Baseline Scenario Three for the Pinal AMA includes the following assumptions.

- Demands in the IDs follow trend lines; and
- Demands outside of IDs held at one standard deviation above the historical average

11.2 Agricultural Supply Methodology and Assumptions

Similar techniques were used to examine the three supply scenarios. Information about the current water portfolios for each ID, large farm, or other entity was also included in the analysis. In certain cases, knowledge regarding supply availability from sector professionals, especially ID managers, was used.

Surface water supply projections were based on trends and input from sector professionals. Use of spill water was not independently projected; spills depend on specific storm events and management of reservoirs and as such are highly variable.

CAP supplies were based on current CAP NIA settlement pool allocations, recent use, projected demand, and planned expansions of delivery systems. The total CAP NIA settlement pool water for all AMAs will be reduced by 25 percent in 2017 and by an additional 25 percent in 2024, reducing to zero after 2030. For the purposes of these projections, reductions were applied proportionately to each allottee's supply.

Reclaimed water supplies were based on current contracts and average historical reclaimed water use.

CAP and reclaimed water may be delivered to GSFs. GSF supply projections were based on current permits, and projected amount of supplies available for storage. This supply is identified as in-lieu groundwater in this Assessment.

Projected demands not met by surface water, CAP, reclaimed water, or in-lieu groundwater were assumed to be met by mined groundwater. See Appendix 6 for more details on the specific methodology used in projecting each demand and supply component.

11.3 Overview of Agricultural Results

Historically, total agricultural water demand in the Pinal AMA has fluctuated, but has not exhibited a steady upward or downward trend (See Section 5.3.2). Although future agricultural demand in the Pinal AMA is highly uncertain, it will most likely depend on the rate at which the AMA urbanizes, crop prices, and the cost and availability of water supplies. Projection scenario results indicate that demand in 2025 could range from approximately 590,000 to 880,000 acre-feet (*See Table 11-1*).

Table 11-1 2025 Projected Agricultural Demand
Pinal Active Management Area

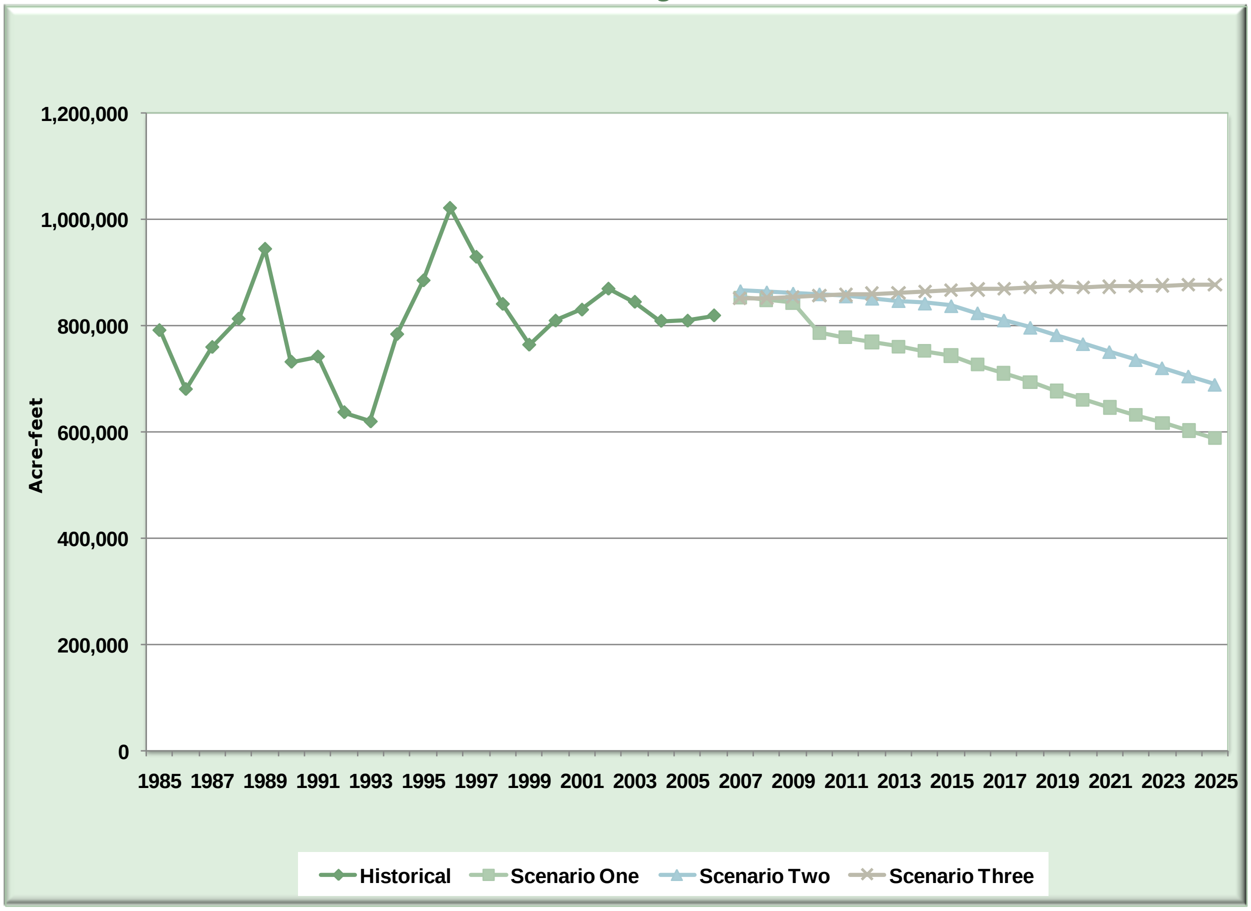
Scenario	Total Water Use	Groundwater Use
One	588,157	313,904
Two	689,180	391,583
Three	877,896	584,452

All volumes are in acre-feet and groundwater use includes CAP In-lieu groundwater.

11.3.1 Baseline Scenario One Results

In Baseline Scenario One, Agricultural demand increases slightly through 2009, then decreases by approximately 28 percent, from 819,894 acre-feet in 2006 to 588,157 acre-feet in 2025 (*See Figure 11-1*). The demands in 2025 are projected to be met with approximately 15 percent surface water, 32 percent CAP, less than one percent reclaimed water, two percent CAP in-lieu groundwater (stored at GSFs), and 51 percent groundwater (*See Figure 11-2).*

Figure 11-1 Historical and Projected Agricultural Demands
Pinal Active Management Area



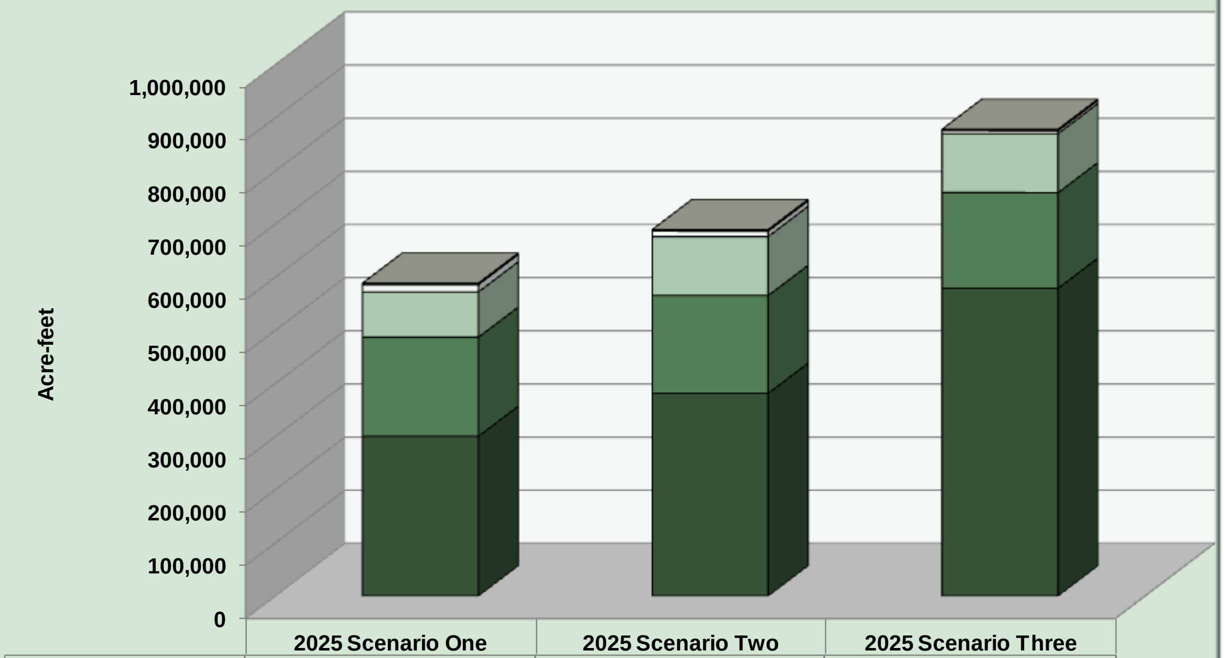
11.3.2 Baseline Scenario Two Results

In Baseline Scenario Two, Agricultural water demand increases from approximately 820,000 acre-feet in 2006 to nearly 870,000 acre-feet in 2007, then gradually decreases to approximately 690,000 acre-feet in 2025 (84 percent of the 2006 level) (*See Figure 11-1*). The demand in 2025 is projected to be met with approximately 16 percent surface water, 27 percent CAP, less than one percent reclaimed water, less than one percent CAP in-lieu groundwater (stored at GSFs), and over 55 percent groundwater (*See Figure 11-2).*

11.3.3 Baseline Scenario Three Results

In Baseline Scenario Three, Agricultural demand increases by approximately seven percent, from approximately 820,000 acre-feet in 2006 to nearly 880,000 acre-feet in 2025 (*See Figure 11-1*). The demands in 2025 are projected to be met with approximately 13 percent surface water, 21 percent CAP, less than one percent reclaimed water, less than one percent CAP in-lieu groundwater (stored at GSFs), and 66 percent groundwater (*See Figure 11-2*).

Figure 11-2 2025 Projected Agricultural Supplies
Pinal Active Management Area



	2025 Scenario One	2025 Scenario Two	2025 Scenario Three
TOTAL	588,157	689,180	877,896
Reclaimed Water	2,500	2,500	2,500
In-Lieu Groundwater	13,572	10,313	5,475
Surface water	85,199	110,949	110,949
CAP (Direct Use)	186,554	184,147	179,995
Groundwater	300,332	381,270	578,976

12. INDIAN PROJECTIONS

Indian demand information is not reported to ADWR, therefore projecting demands and supply utilization can only be assumed based on historical trends and information obtained from Indian Settlements.

12.1 Description of Demand Methodology and Assumptions

Three baseline demand scenarios were developed for Indian demands within the Pinal AMA. The focus of the increased demand was in the Indian Agricultural sector. The overall agricultural demand scenarios were calculated by adding together all of the individual Indian Tribe or Community demand scenarios. This method allowed for the greatest range of potential demand (*See Figure 12-1)*.

The Pinal AMA individual Tribe or Community demand was projected using similar statistical methods as the Agricultural projections (*See Section 11.1* above) and were based on one of the following: 1) technical assessment of Indian water rights settlements and irrigation project plans; 2) evaluation of trends with time; or 3) assumption of average historical water use or current use. Much of the variability could be related to economic factors such as crop price or regional demand; however, those factors are extremely difficult to project, so were not considered.

Figure 12-1 Historical and Projected Indian Agricultural Demand Pinal Active Management Area

12.1.1 Baseline Scenario One Demand Methodology and Assumptions

Baseline Scenario One for Pinal AMA Indian agriculture made the following assumptions:

- New fields coming into production at current efficiency standards;
- Low-intensity crops grown;
- Average surface water volumes available up to settlement amounts; and
- Minimum CAP allocations (based on settlement figures) used for agriculture, after allowances for leases and on-reservation municipal, industrial, and environmental uses.

12.1.2 Baseline Scenario Two Demand Methodology and Assumptions

Baseline Scenario Two for Pinal AMA Indian agriculture made the following assumptions:

- New fields coming into production at current efficiency standards;
- Medium-intensity crops grown;
- Average surface water volumes available up to settlement amounts; and
- Average CAP allocations (based on settlement figures) used for agriculture, after allowances for leases and on-reservation municipal, industrial, and environmental uses.

12.1.3 Baseline Scenario Three Demand Methodology and Assumptions

Baseline Scenario Three for Pinal AMA Indian agriculture made the following assumptions:

- New fields coming into production at current efficiency standards;
- High-intensity crops grown;
- Average surface water volumes available up to settlement amounts; and
- Maximum CAP allocations (based on settlement figures) used for agriculture after allowances for leases and on-reservation municipal, industrial, and environmental uses.

12.2 Description of Supply Methodology and Assumptions

Supply scenarios were examined using techniques similar to those used to generate demand scenarios. The supply scenarios rely heavily on the supply portfolios outlined in settlement documents.

Projected agricultural water demand and supplies for the GRIC were split between the Phoenix and Pinal AMAs based on current ratios of supplies and demand in each AMA.

See Appendix 8 for more details on the specific methodology used in projecting each demand and supply component.

12.3 Overview of Indian Results

Historically, Indian Agricultural demand has increased, while fluctuating somewhat due to water supply, climate, and economic conditions (See Section 5.4.3). Although future Indian Agricultural water demand is somewhat uncertain, it is generally expected to continue to increase in Pinal AMA based on current settlements and projects (ADWR, 2006). Projection scenario results indicate that demand in 2025 could range from approximately 154,000 to over 239,000 acre-feet (*See Table 12-1*).

Table 12-1 2025 Projected Indian Agricultural Demand Pinal Active Management Area

Scenario	Total Water Use	Groundwater Use
One	153,449	14,105
Two	194,616	52,272
Three	238,694	86,350

Note: All values are in acre-feet.

12.3.1 Baseline Scenario One Results

In Baseline Scenario One, demand decreases in 2007, then gradually increases to approximately the same demand as the year 2006 in 2025 (*See Figure 12-1*). The demands in 2025 are projected to be met with approximately 13 percent surface water, 77 percent CAP, and 10 percent groundwater (*See Figure 12-2*).

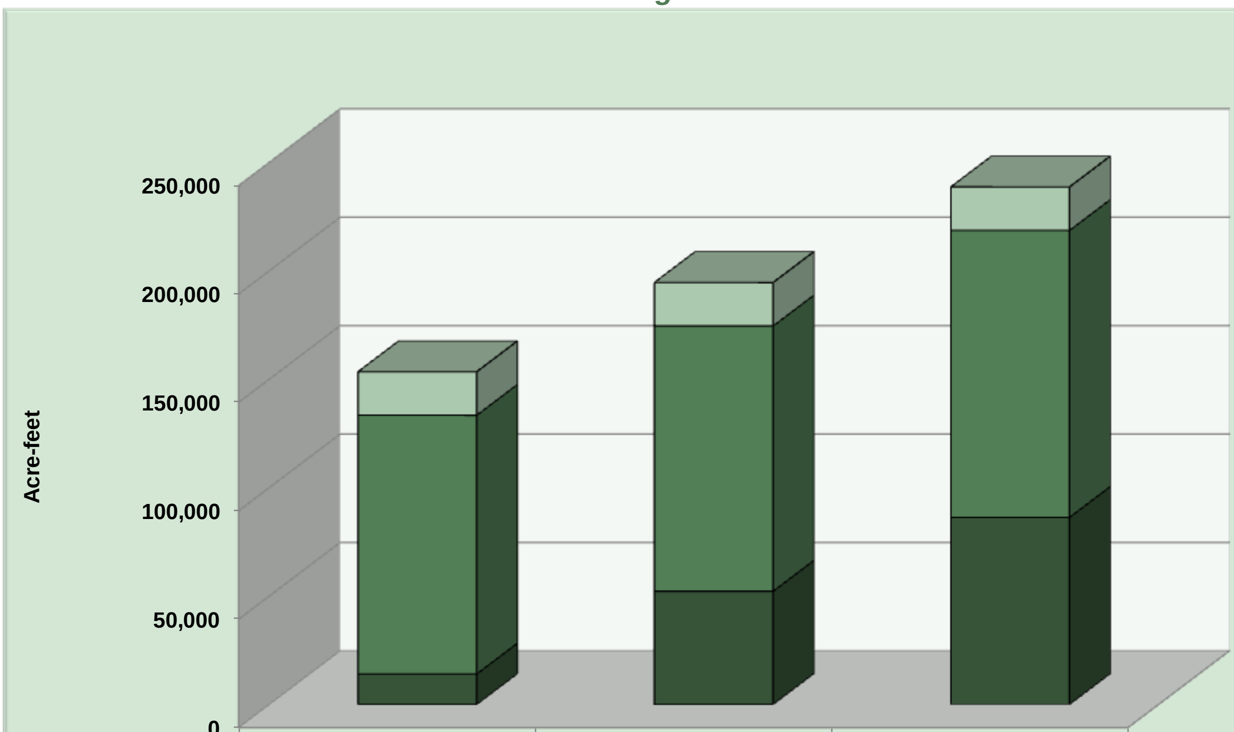
12.3.2 Baseline Scenario Two Results

In Baseline Scenario Two, demand decreases in 2007, but increases by approximately 28 percent between 2006 and 2025, from 152,925 acre-feet to 195,401 acre-feet (*See Figure 12-1*). The demands in 2025 are projected to be met with approximately 10 percent surface water, 63 percent CAP, and 27 percent groundwater (*See Figure 12-2*).

12.3.3 Baseline Scenario Three Results

In Baseline Scenario Three, demand decreases in 2007; however, between 2006 and 2025 there is an overall increase of approximately 56 percent from 152,925 acre-feet to 239,479 acre-feet (*See Figure 12-1*). The demands in 2025 are projected to be met with approximately nine percent surface water, 55 percent CAP, and 36 percent groundwater (*See Figure 12-2*).

Figure 12-2 2025 Projected Indian Agricultural Supplies Pinal Active Management Area



	2025 Scenario One	2025 Scenario Two	2025 Scenario Three
TOTAL	153,449	194,616	238,694
SURFACE	20,000	20,000	20,000
CAP	119,344	122,344	132,344
GROUNDWATER	14,105	52,272	86,350

13. RECHARGE PROJECTIONS

13.1 Projection Methodology of CAP Recharge at Groundwater Savings Facilities

In the Pinal AMA, the majority of recharge activity consists of CAP storage at GSFs. The two factors that most influence this type of recharge are the number of agricultural acres in production and the ability to store water. Limitations on the volume of water available for storage include distribution of excess CAP; financial constraints; ability to recover stored water; projected demand; and the volume of direct use of CAP.

There is a limited volume of recovery in all three baseline scenarios. This results in more than 98 percent of water projected to be stored remaining in storage in all three scenarios in 2025.

The Overall Projection of CAP Available to Store

The amount of CAP water that would be available to store was projected by examining and accounting for all projected uses of CAP, direct as well as stored, for all three CAP AMAs.

Municipal CAP use was projected based on individual assumptions of supply utilization for each large provider. Assumptions were based on information included in applications for DAWS, historical use of CAP water, current and future water treatment capacity, and a review of current ability to store and recover CAP water.

A volume of CAP water stored by municipal providers was projected for each year. At a maximum, this could be equal to the total CAP M&I allocation of each provider minus any direct CAP use. Generally, if a provider was directly using less than their allocation, the remaining volume was assumed to be stored up to the provider's maximum permitted underground storage capacity for CAP water. Recovered water was assumed to be a portion of the volume assumed to be stored that year (annual recovery), except in years in which the provider's recovered volume exceeded the amount the provider stored; any amount over and above the amount stored is assumed to be recovery of long-term storage credits.

Direct CAP use (as opposed to in-lieu or recovered CAP) in both the Industrial and Agricultural sectors was projected based on information obtained from CAP users in those sectors and from past trends.

GSF (in-lieu) CAP in the Agricultural sector was projected independently from direct use of CAP (pool water). A comparison was made between the volume of GSF CAP projected to be used in the Agricultural sector to the volume of CAP available to store at GSFs by municipal providers, the AWBA and the CAGRD, as well as any others. The lesser of the two volumes was selected for each projection year. This is because GSF CAP stored cannot exceed agricultural demand, and the projected GSF CAP use by the Agricultural sector cannot exceed the volume of available CAP to store at GSFs.

Potential Indian CAP use was projected based on review of settlement documents.

Arizona Water Bank

AWBA staff prepared the initial projections of Excess CAP water use by the AWBA; adjustments were made based on ADWR's projected CAP water use by other users. The projections (except for 2007 and 2008 for which historical data was used) are based on the assumptions used to develop the AWBA's Ten-Year Plan of Operation for 2010 through 2019 (AWBA Plan), adopted June 17, 2009. The assumptions in the AWBA Plan were carried forward to 2025 for the purpose of this Assessment.

The assumptions also incorporated CAWCD's Procedure to Distribute Excess Water for 2010 through 2014, adopted by the CAWCD Board of Directors in 2009. In anticipation of increasing demands for excess CAP water, CAWCD staff developed a strategy for distributing excess CAP water among competing demands. Under this strategy, CAWCD created four pools of excess CAP water, in addition to the previously established CAP NIA settlement pool, that guide how excess water will be distributed when demand for this supply exceeds the availability of the supply. One of these pools is for the AWBA, the CAGRD and the BOR, for a fixed volume of 175,000 acre-feet per year. The AWBA's portion of the pool is determined by subtracting the CAGRD's projected storage amount. Although the CAWCD Procedure to Distribute Excess Water is for a five-year period, it was assumed that it, or a similar policy, would continue through 2025. The AWBA's annual storage in each of the three CAP AMAs was also based on the availability of funding and storage capacity in the AMAs. The two main funding sources for the AWBA are withdrawal fees and *ad valorem* taxes levied by CAWCD. Expenditure of these funds is for the benefit of the AMA/county in which they were collected. The last year of *ad valorem* collections is 2016, leaving withdrawal fees as the principal funding source for the AWBA. Although funding is typically the limiting factor in the Pinal and Tucson AMAs, it does not become a limiting factor in the Phoenix AMA until after *ad valorem* tax collections cease.

Finally, the AWBA projections include interstate banking for the Southern Nevada Water Authority (SNWA) after all funding sources and capacity for Arizona storage are utilized. Water stored on behalf of SNWA could include Colorado River supplies acquired by CAWCD with the AWBA's SNWA funds.

Adjusting the Amount of CAP Available to Store

Adjustments to the amount of CAP available to store were approached comprehensively for the CAP AMAs. In some years, the total of the projected uses exceeded the assumed available CAP supply, which varies year to year (*See Table 14-1*). In this situation, the projected storage of CAP water in each AMA was reduced based on the CAWCD Procedure to Distribute Excess Water. In other years, the sum of all projected uses of CAP water across all three AMAs was less than the volume of CAP water assumed to be available. In this situation, the surplus was distributed based on the CAWCD Procedure to Distribute Excess Water. Although the policy extends through the year 2014, the projection scenarios presume that the policy continues, rather than reverting to a pre-policy assumption after the year 2014. If any AMA did not have the capacity to store its portion of the surplus, the surplus was moved to another AMA that had the capacity to store it. This adjustment is based on the assumption that all CAP water available will be fully utilized in each projection year.

13.2 Projection Methodology of Reclaimed Water Recharge at Underground Storage Facilities

In the municipal sector, reclaimed water use was projected based on individual assumptions for each large provider. Assumptions were based on information included in applications for DAWS, historical use of reclaimed water, current and future wastewater treatment capacity, and a review of current ability to store and recover reclaimed water.

The maximum amount of reclaimed water stored by a municipal provider is equal to the total volume of reclaimed water projected to be generated by the provider minus any direct reclaimed water use up to the provider’s maximum permitted underground storage capacity for reclaimed water.

A comparison of historical generation to use revealed that some entities other than municipal providers discharge and store reclaimed water. The difference between the total projected reclaimed water supply and the volume of reclaimed water that municipal providers are projected to use (including storage) represents additional reclaimed water that can potentially be stored. Half of this additional reclaimed water was assumed to be increased discharge, and the other half increased underground storage. The total amount of reclaimed water projected to be stored includes the additional reclaimed water available to be stored and the reclaimed water projected to be stored by municipal providers. These projections show significant increases in reclaimed water storage in Scenarios One, Two, and Three of 383 percent, 572 percent, and 885 percent respectively. This is based on the recent and projected increase of small reclaimed water USFs associated with localized wastewater treatment facilities. This is evidenced by the increase in permitted facilities from four in 2006 to eight in 2009.

13.3 Overview of Artificial Recharge Results

13.3.1 Baseline Scenario One Results

The projected volume of CAP stored at GSFs in the year 2025 is 13,572 acre-feet. This is a reduction of 91 percent from the 143,647 acre-feet stored in 2006. Baseline Scenario One has the greatest amount of GSF storage (*See Table 13-1*).

In Baseline Scenario One, reclaimed water storage at USFs is projected to be 4,372 acre-feet in 2025. This is an increase of 383 percent, or 3,466 acre-feet over the volume stored in 2006.

Table 13-1 2006 Historical and 2025 Projected Artificial Recharge Pinal Active Management Area

Recharge Facilities	2006	Scenario One	Scenario Two	Scenario Three
Groundwater Savings Facility				
CAP Stored	143,647	13,572	10,313	5,475
Underground Storage Facilities (Constructed)				
Reclaimed Water Stored	906	4,372	6,086	8,924
Total Delivered to Storage	**144,553**	**17,944**	**16,399**	**14,399**

Note: Volumes are in acre-feet. Figures reflect water delivered to be stored, minus losses.

In Baseline Scenario One, the cumulative amount of GSF CAP storage projected from 2007 through 2025 is 1,108,103 acre-feet. The total GSF CAP storage by 2025, including the amount of water that had been stored through 2006, is 2,541,645 acre-feet. This volume excludes cuts to the aquifer and annual recovery of the volume of CAP delivered for storage to GSFs (*See Table 13-2*).

13.3.2 Baseline Scenario Two Results

In Baseline Scenario Two, the projected volume of CAP stored at GSFs in 2025 is 10,313 acre-feet. This is about 93 percent less than the volume stored in 2006. The amount of agricultural demand in Baseline Scenario Two is in between that of Baseline Scenarios One and Three (*See Table 13-1*).

In 2025, reclaimed water storage at USFs in Baseline Scenario Two is projected to be 6,086 acre-feet. This is an increase of 572 percent, or 5,180 acre-feet more than the volume stored in 2006.

In Baseline Scenario Two, cumulative GSF CAP storage is projected to be 849,726 acre-feet from 2007 through 2025. By 2025, the total GSF CAP storage in Baseline Scenario Two is 2,283,268 acre-feet, including the amount of water stored through 2006. This volume does not include cuts to the aquifer or annual recovery of the volume of CAP delivered for storage to GSF (*See Table 13-2*).

13.3.3 Baseline Scenario Three Results

In Baseline Scenario Three, 5,475 acre-feet of CAP is stored at GSFs in 2025. This is about a 96 percent reduction from the volume stored in 2006 (*See Table 13-1*).

In Baseline Scenario Three, USF reclaimed water storage is projected to be 8,924 acre-feet in 2025. This is an increase of nearly 900 percent from the amount stored in 2006.

Table 13-2 2006 and Projected Cumulative Artificial Recharge Credits Through 2025 Pinal Active Management Area

Long Term Storage Credits	2006	Scenario One	Scenario Two	Scenario Three
Underground Storage Facilities				
CAP	1,145	1,145	1,145	1,145
Reclaimed Water	3,164	48,995	59,116	81,331
Total	4,309	50,140	60,261	82,476
Groundwater Savings Facilities				
CAP	1,433,542	2,541,645	2,283,268	2,070,419
Total	1,437,851	2,591,785	2,343,529	2,152,895
Total USF/GSF Storage				
Arizona Water Bank				
Intrastate	676,532	894,616	816,578	759,391
Interstate - Nevada	310,828	1,019,358	816,511	656,512
Total Water Bank	**987,360**	**1,913,974**	**1,633,089**	**1,415,904**
CAWCD/CAGRD				
CAWCD	399,061			
CAGRD		15,645	24,555	17,689
Conservation District Account	305			
Replenishment Reserve Account	270			
Total CAWCD/CAGRD	**399,636**			
Recovery	5,082	18,669	36,267	47,466
Credits Remaining in Storage	**1,432,769**	**2,573,116**	**2,307,262**	**2,105,429**

Note: Volumes are in acre-feet. “Credits Remaining in Storage” is calculated by totaling Total USF/GSF storage minus Recovery.

In Baseline Scenario Three, the projected cumulative amount of GSF CAP storage is 636,877 acre-feet from 2007 through 2025. By 2025, the total GSF CAP storage in Baseline Scenario Three, including the amount of water that had been stored through 2006, is 2,070,419 acre-feet. Cuts to the aquifer and annual recovery are not included in this total (*See Table 13-2*).

14. ADDITIONAL SCENARIOS

14.1 CAP Shortage Projected Scenarios

This Assessment includes three additional scenarios incorporating reduced CAP supplies in recognition of potential climate change impacts, resulting in a shortage of CAP supplies. The consensus of an international panel of climate science experts, the International Panel on Climate Change (IPCC), is that the southwestern United States is likely to experience significant impacts from warming, particularly in the water resources sector (Intergovernmental Panel on Climate Change, 2007). IPCC predicts with high confidence that average temperatures will continue to increase. There is now also a strong indication of reductions in winter precipitation in northern Mexico and the southern portions of the southwestern United States. This means that even if total precipitation increases on average across the globe, drought is likely to become an even greater problem in the region than it is today, perhaps becoming the new "normal" (Seagar & Ting, 2007). The IPCC findings also conclude that the intensity of precipitation is likely to increase in future climate scenarios for the southwestern United States. Therefore, both extremes of precipitation – floods and droughts – will increasingly challenge water managers in the region. Increases in temperature, particularly in summer, will affect demand for water in Arizona. Higher temperatures lead to more demand for electricity for air conditioning; more water required to support agriculture, landscaping, and ecosystems; and more evaporative losses from reservoirs, etc.

Across the Colorado River watershed, runoff information generated from the output of a strong majority of the 22 global climate models predicts that flow in the Colorado River will be reduced over the next century. These reductions in flow are primarily a result of drying caused by higher temperatures (reduced soil moisture, increased evapotranspiration and reservoir losses). As the flow in the Colorado River is already fully allocated, any reductions in flow will have consequences for the many water managers who rely on the Colorado River as a source. Additionally, within Arizona, predicted losses of snowpack along the Mogollon Rim and other high elevation areas will likely change the volume and timing of peak runoff and may impact downstream users and habitat (Jacobs, 2009).

Several climate change models exist for the southwestern region of the United States, but at this time, are not localized enough to be useful for the purposes of this Assessment. Instead, ADWR incorporated a period of reduced surface water availability by using actual historical supply records as described below.

14.1.1 CAP Shortage Projection Methodology

In addition to Baseline Scenarios One, Two, and Three, an additional three projection scenarios were prepared that included projecting a shortage of CAP supply. Demand was not altered for any of the shortage projection scenarios; therefore, reclaimed water supply remained unaffected, as did reclaimed water recharge.

ADWR Colorado River Management (CRM) staff, based on the 100-year record of Colorado River flow, generated the projected CAP shortage values. CRM based their calculations on the actual volume of water available on the Colorado River, which varies from year to year. CRM generated 101 different sequences using the Bureau of Reclamation's Colorado River System Simulation RiverWare computer model. Forty-nine of the 101 sequences simulated shortages. The range of shortages is from 320,000 acre-feet to 5,275,400 acre-feet for the period 2009 to 2025. The ADWR Water Management Division selected a representative shortage sequence from 2012 to 2019 because it fell into the period that was being evaluated to use as a shortage scenario for this Assessment. The projected CAP availability and shortage volumes from the sequence selected are shown in *Table 14-1* below.

The shortage volumes for years 2012 through 2019, illustrated in *Table 14-1*, were subtracted from the assumed CAP availability for each year as projected by CRM to generate the shortage projection in those years. Then, the projected volume of CAP use was cut back, using the CAWCD Procedure to Distribute Excess Water Policy, to adjust CAP use to meet the shortage supply. In some years in all three shortage scenarios, the shortage went beyond the excess CAP and cut into the CAP NIA settlement pool water. In this case, the shortage to the CAP NIA settlement pool water was pro-rated among the three CAP AMAs based on the projected Agricultural direct CAP use in non-shortage years.

Table 14-1 CAP Shortages for Shortage Scenarios
All CAP Active Management Areas

Year	Projected CAP Availability	Shortage	Shortage Supply
2009	1,433,223	0	1,433,223
2010	1,414,442	0	1,414,442
2011	1,412,872	0	1,412,872
2012	1,411,303	320,000	1,091,305
2013	1,409,733	400,000	1,009,733
2014	1,408,164	480,000	928,473
2015	1,406,594	400,000	1,006,596
2016	1,405,025	480,000	926,753
2017	1,403,455	400,000	1,003,457
2018	1,401,885	400,000	1,001,887
2019	1,400,550	400,000	1,000,553
2020	1,399,215	0	1,399,215
2021	1,397,902	0	1,397,902
2022	1,382,590	0	1,382,590
2023	1,381,277	0	1,381,277
2024	1,379,964	0	1,379,964
2025	1,378,651	0	1,378,651
Sum of Shortage	**23,826,844**	**3,280,000**	**20,546,844**

Note: All volumes are in acre-feet.

14.1.2 CAP Shortage Projection Results

Because the shortages mostly affect excess CAP water, cumulative projected overdraft between 2007 and 2025 is between 52 and 4,386 percent larger due to the projected CAP shortage. This is due to the reduction in the volume of excess CAP to zero in many of the shortage years, resulting in elimination of AWBA GSF storage in Pinal AMA in many of the shortage years, as well as significant reduction of direct CAP supplies to Agriculture, and the corresponding increase in groundwater use to meet Agricultural demand. Figure 14-1, Figure 14-2, and Figure 14-3 show the relative difference in projected annual overdraft between non-shortage and shortage scenarios for each year from 2007 through 2025.

Figure 14-1 Shortage Scenario One Projected Annual Overdraft or Surplus With and Without CAP Shortage Pinal Active Management Area

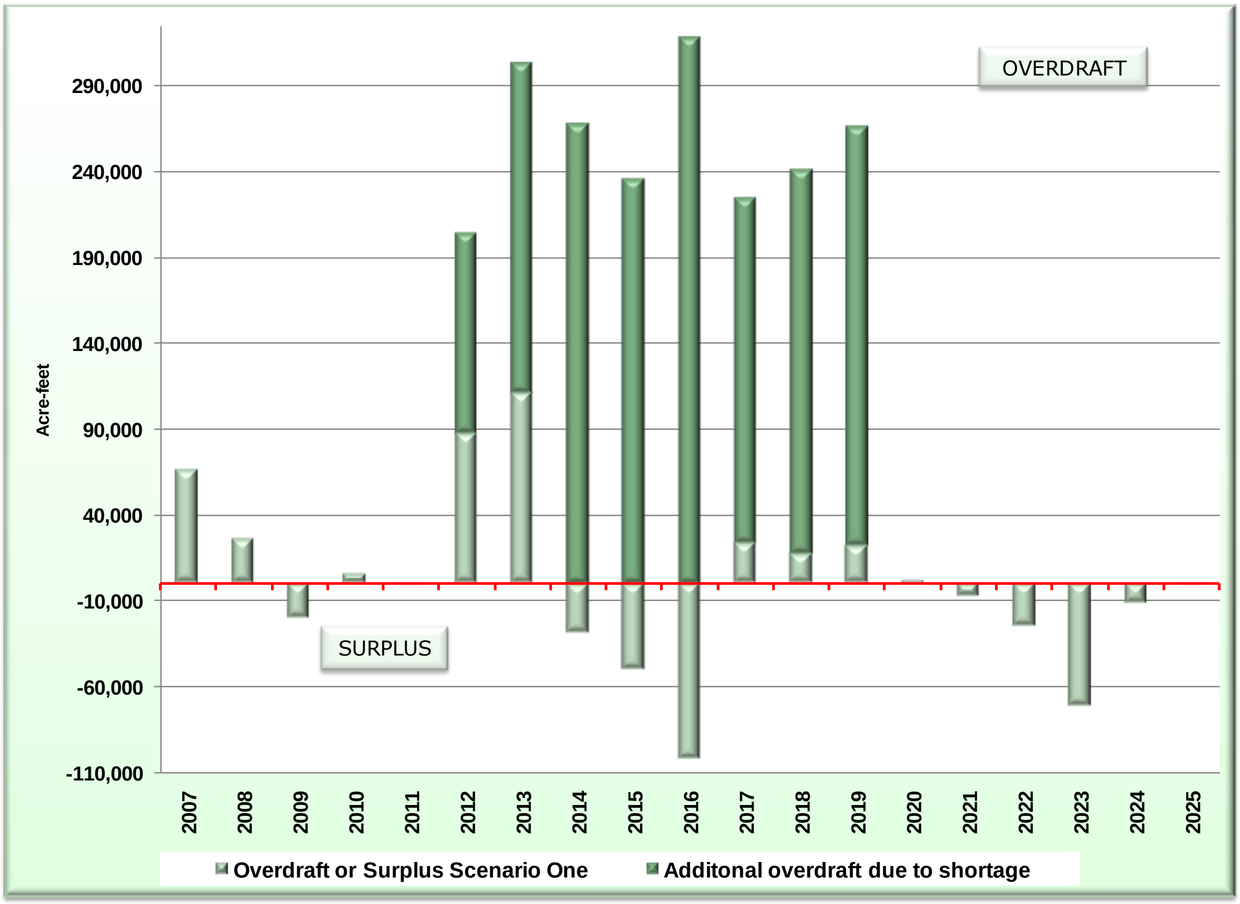


Figure 14-2 Shortage Scenario Two Projected Annual Overdraft or Surplus With and Without CAP Shortage Pinal Active Management Area

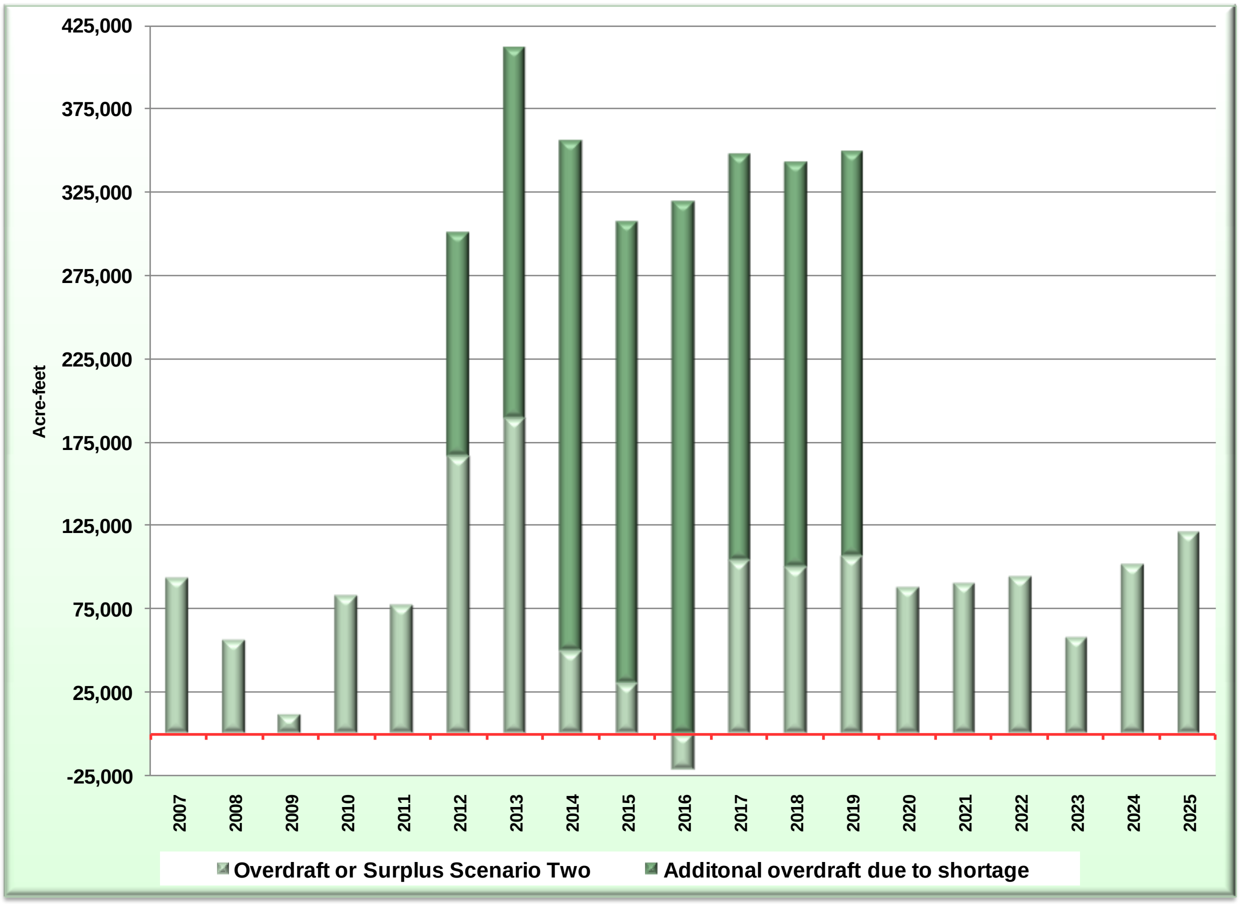
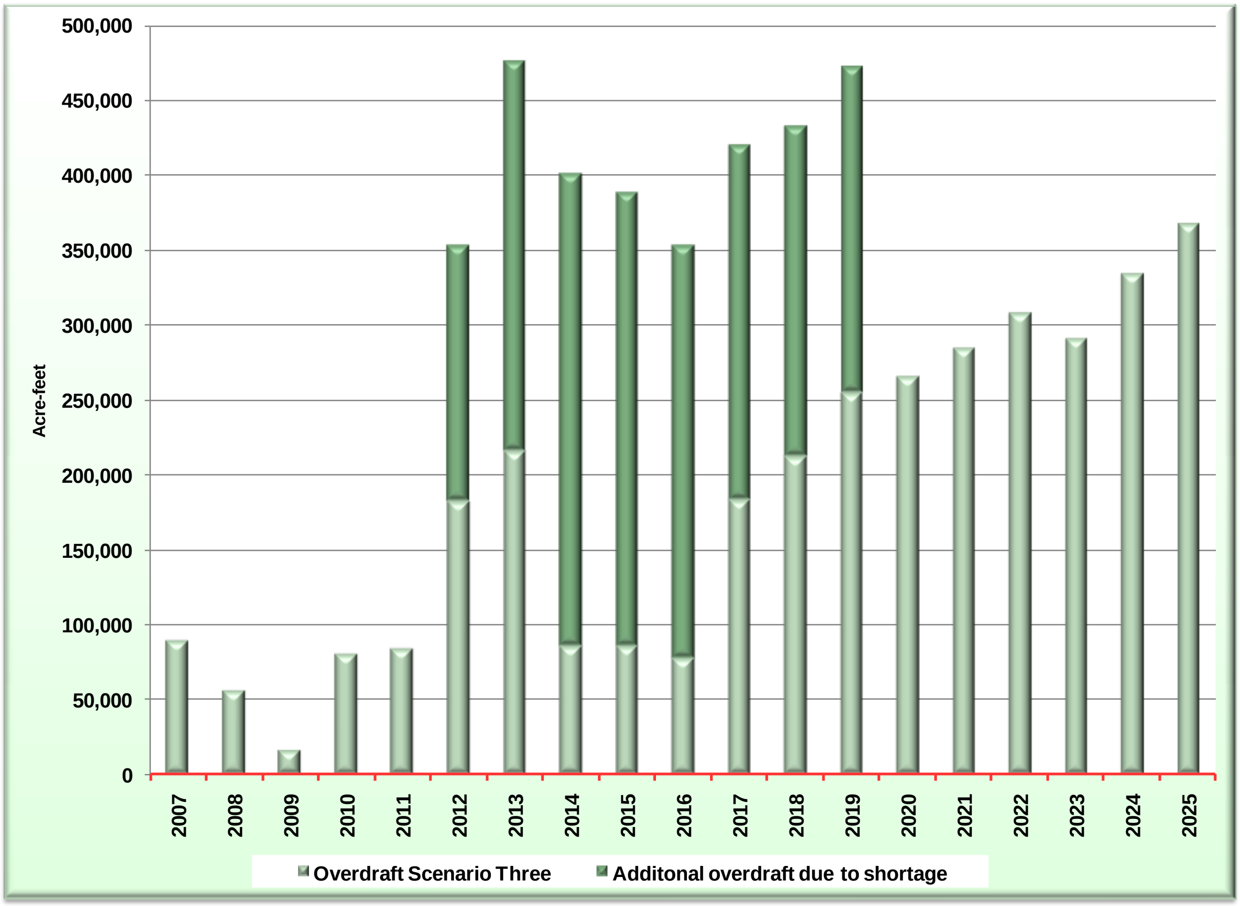


Figure 14-3 Shortage Scenario Three Projected Annual Overdraft With and Without CAP Shortage Pinal Active Management Area



Up to this point, the shortage has been viewed on an annual basis. However, the overall effect of a shortage of this type on the entire projection period from 2007 through 2025 is shown in *Table 14-2* below. Cumulative projected overdraft, where the overdraft of each year is added for a cumulative effect, increases between about 1,798,922 and 1,996,974 acre-feet due to the shortage, which ranges from 52 to 4,386 percent.

The most substantial impacts of the shortage are on the AWBA and on the CAGRD, which store excess CAP water, the lowest priority CAP supply.

14.1.3 Shortage Scenario One Results

Shortage Scenario One (using Baseline Scenario One demands) predicts no change in CAP or reclaimed water storage at USFs between 2007 and 2025. The largest impact is the reduction in storage by the AWBA; Shortage Scenario One results in 443,513 acre-feet less AWBA storage. The second largest impact caused by shortage is that 426,263 acre-feet less CAP is stored at GSFs (*See Table 14-3*).

Table 14-2 Shortage Scenarios Cumulative Projected Overdraft
Pinal Active Management Area

YEAR	2010	2015	2020	2025
Baseline Scenario One				
Cumulative Overdraft	77,452	196,075	158,369	41,017
Cumulative Additional Overdraft due to Shortage	0	812,026	1,798,922	1,798,922
Total Overdraft Shortage Scenario One	**77,452**	**1,008,102**	**1,957,291**	**1,839,939**
Baseline Scenario Two				
Cumulative Overdraft	244,063	756,165	1,131,999	1,595,839
Cumulative Additional Overdraft due to Shortage	0	938,915	1,986,706	1,986,706
Total Overdraft Shortage Scenario Two	**244,063**	**1,695,080**	**3,118,705**	**3,582,545**
Baseline Scenario Three				
Cumulative Overdraft	243,426	896,996	1,890,025	3,474,015
Cumulative Additional Overdraft due to Shortage	0	1,047,867	1,996,974	1,996,974
Total Overdraft Shortage Scenario Three	**243,426**	**1,944,863**	**3,886,999**	**5,470,989**

Note: Volumes are in acre-feet.

Table 14-3 Shortage Scenario One Projected Artificial Recharge
Pinal Active Management Area

Long Term Storage Credits	2006	2025 Baseline Scenario One	2025 Shortage Scenario One
Underground Storage Facilities			
CAP	1,145	1,145	1,145
Reclaimed Water	3,182	48,995	48,995
Total	4,327	50,140	50,140
Groundwater Savings Facilities			
CAP	1,439,282	2,541,645	2,115,382
TOTAL	1,443,609	2,591,785	2,165,522
Arizona Water Bank			
Intrastate	676,490	894,616	840,413
Interstate - Nevada	310,437	1,019,358	630,048
Total	986,927	1,913,974	1,470,461
CAWCD/CAGRD			
CAWCD			
CAGRD		15,645	14,386
Conservation District Account	305		
Replenishment Reserve Account			
Total			
Recovery	4,503	18,669	36,267
Credits Remaining in Storage	**1,439,107**	**2,573,116**	**2,129,255**

Note: All volumes are in acre-feet. “Credits Remaining in Storage” is calculated by subtracting Recovery from the “Total USF/GSF Storage”.

14.1.4 Shortage Scenario Two Results

Shortage Scenario Two (using Baseline Scenario Two demands) shows a less severe impact of the shortage because Baseline Scenario Two already had less excess CAP water available to store than Baseline Scenario One. Shortage Scenario Two predicts 253,824 fewer acre-feet of CAP stored at GSFs by the year 2025 (*See Table 14-4)*. In Shortage Scenario Two, the AWBA has 257,014 fewer acre-feet to store, and the CAGRD has 10,169 fewer acre-feet to store.

Table 14-4 Shortage Scenario Two Projected Artificial Recharge Pinal Active Management Area

Long Term Storage Credits	**2006**	**2025 Baseline Scenario Two**	**2025 Shortage Scenario Two**
Underground Storage Facilities			
CAP	1,145	1,145	1,145
Reclaimed Water	3,182	59,116	59,116
Total	4,327	60,261	60,261
Groundwater Savings Facilities			
CAP	1,439,282	2,283,268	2,029,444
TOTAL	1,443,609	2,343,529	2,089,705
Arizona Water Bank			
Intrastate	676,490	816,578	799,210
Interstate - Nevada	310,437	816,511	576,864
Total	986,927	1,633,089	1,376,075
CAWCD/CAGRD			
CAWCD			
CAGRD		24,555	14,386
Conservation District Account	305		
Replenishment Reserve Account			
Total			
Recovery	4,503	36,267	36,267
Credits Remaining in Storage	**1,439,107**	**2,307,262**	**2,053,438**

Note: All volumes are in acre-feet. “Credits Remaining in Storage” is calculated by subtracting Recovery from the “Total USF/GSF Storage”.

14.1.5 Shortage Scenario Three Results

The least impact of the projected shortages is in Shortage Scenario Three (using Baseline Scenario Three demands). Shortage Scenario Three shows 94,022 fewer acre-feet of CAP stored at GSF facilities by the year 2025. The majority of the impacts of the shortages affect the availability of excess CAP instead of the direct users. As a result, the AWBA has 93,553 fewer acre-feet to store, and the CAGRD has 5,419 fewer acre-feet to store (*See Table 14-5)*.

Table 14-5 Shortage Scenario Three Projected Artificial Recharge Pinal Active Management Area

Long Term Storage Credits	2006	2025 Baseline Scenario Three	2025 Shortage Scenario Three
Underground Storage Facilities			
CAP	1,145	1,145	1,145
Reclaimed Water	3,182	81,331	81,331
Total	4,327	82,476	82,476
Groundwater Savings Facilities			
CAP	1,439,282	2,070,419	1,976,397
TOTAL	1,443,609	2,152,895	2,058,873
Arizona Water Bank			
Intrastate	676,490	759,391	759,391
Interstate - Nevada	310,437	656,512	562,960
Total	986,927	1,415,904	1,322,351
CAWCD/CAGRD			
CAWCD			
CAGRD		17,689	12,270
Conservation District Account			
Replenishment Reserve Account			
Total			
Recovery	4,503	47,466	47,466
Credits Remaining in Storage	**1,439,107**	**2,105,429**	**2,011,407**

Note: All volumes are in acre-feet. “Credits Remaining in Storage” is calculated by subtracting Recovery from the “Total USF/GSF Storage”.

14.1.6 Shortage Implications

Assuming the various projected CAP shortages do materialize, there are significant implications for both the AWBA being able to meet its obligations and the CAGRD’s ability to meet its replenishment obligations.

If the CAGRD is not able to meet its obligation, future development could slow for a period of time. In addition, the number and volume of extinguishments of grandfathered groundwater rights could increase as an alternative method to meeting the consistency with goal requirement of the AWS Rules. In some cases, if the shortages reduce allocations of CAP significantly, designated providers may rely more heavily on pumping pursuant to their groundwater allowance balance in order to meet the consistency with goal requirement, and some designated providers may need to seek additional extinguishment credits to meet the goal requirement of the AWS Rules. Although the amount of credits that may be accrued pursuant to extinguishment of GFRs is finite, extinguishment credits could be used to bridge a shortage gap and allow development to continue. Storage of reclaimed water may increase to the maximum extent feasible, but this supply is limited based on the volume of reclaimed water generated and is linked to overall demand.

If financing were available, the AWBA may be able to explore other methods of meeting its contract obligations. The AWBA is currently working on strategies to deal with a potential shortage.

If the shortages impact the CAP NIA settlement pool, farmers may begin fallowing their fields, rather than demand remaining constant as has been projected here, or they may pump increasing amounts of groundwater. For Agricultural demand to remain constant, however, crop prices would need to be high enough to offset the increased cost associated with using groundwater for maintained agricultural demand. This may have implications on the portion of the Pinal AMA goal related to maintaining the agricultural economy for as long as feasible.

In summary, it appears that shortages of the magnitude projected in the three Shortage Scenarios has more of an impact on the availability of excess CAP water and affects the AWBA and CAGRD more than those with CAP contracts or sub-contracts. There is still a negative impact on overdraft in 2025, due to reductions in artificial recharge and the benefits from the cut to the aquifer, as well as possible impacts from reduced replenishment by the CAGRD. In the event of the shortages above, Municipal and Agricultural water users have some flexibility to shift to groundwater supplies before demand reduction activities are required, although this is a management decision of the water user.

14.2 Maximized Reclaimed Water Use Scenario

In addition to Baseline Scenarios One, Two, Three and the three Shortage Scenarios, a Maximized Reclaimed Water Use Scenario was developed for the Pinal AMA. Given the fact that use of reclaimed water in all three water using sectors has historically been minimal as a percentage of total sector demand, it seemed reasonable to develop an alternative scenario that increased the projected annual reclaimed water use in the AMA. Specifically, this scenario was developed to analyze the impact of increased use of reclaimed water on preserving the agricultural economy for as long as feasible and preserving water supplies for future non-irrigation uses.

In the Maximized Reclaimed Water Scenario, new reclaimed water usage and storage assumptions were applied to Baseline Scenario One, which was chosen since it was the scenario with the least amount of groundwater demand. Similar to the shortage scenarios, demand was not altered from Baseline Scenario One. The only changes in the template assumptions were an increase in the total amount of reclaimed water used annually, both directly and indirectly through recharge and recovery, as well as the cumulative amount of reclaimed water stored and the type of recharge facility used. The type of facility where reclaimed water is stored is important because 50 percent of the reclaimed water stored at a Managed USF is cut to the aquifer, whereas there are no cuts to the aquifer at Constructed USFs. Past reclaimed water use trends were used to determine how this supply should be divided between the sectors.

14.2.1 Background

Historical use of reclaimed water in the Pinal AMA has been minimal. Direct use of reclaimed water initiated in the Municipal sector in the year 2000 and was 509 acre-feet in 2006. The Industrial sector has always used a small amount of reclaimed water. Direct use of reclaimed water was 1,715 acre-feet in 2006. Agricultural use of reclaimed water has fluctuated, but averaged about 2,500 acre-feet for the historical period.

Underground storage facilities have been permitted to store a total of 36,400 acre-feet per year of reclaimed water in the Pinal AMA, however in 2006 only approximately 900 acre-feet of reclaimed water was stored. A review of wastewater plans for the primary municipalities in the Pinal AMA indicates the intent to store additional reclaimed water in the future and to increase direct use of reclaimed water.

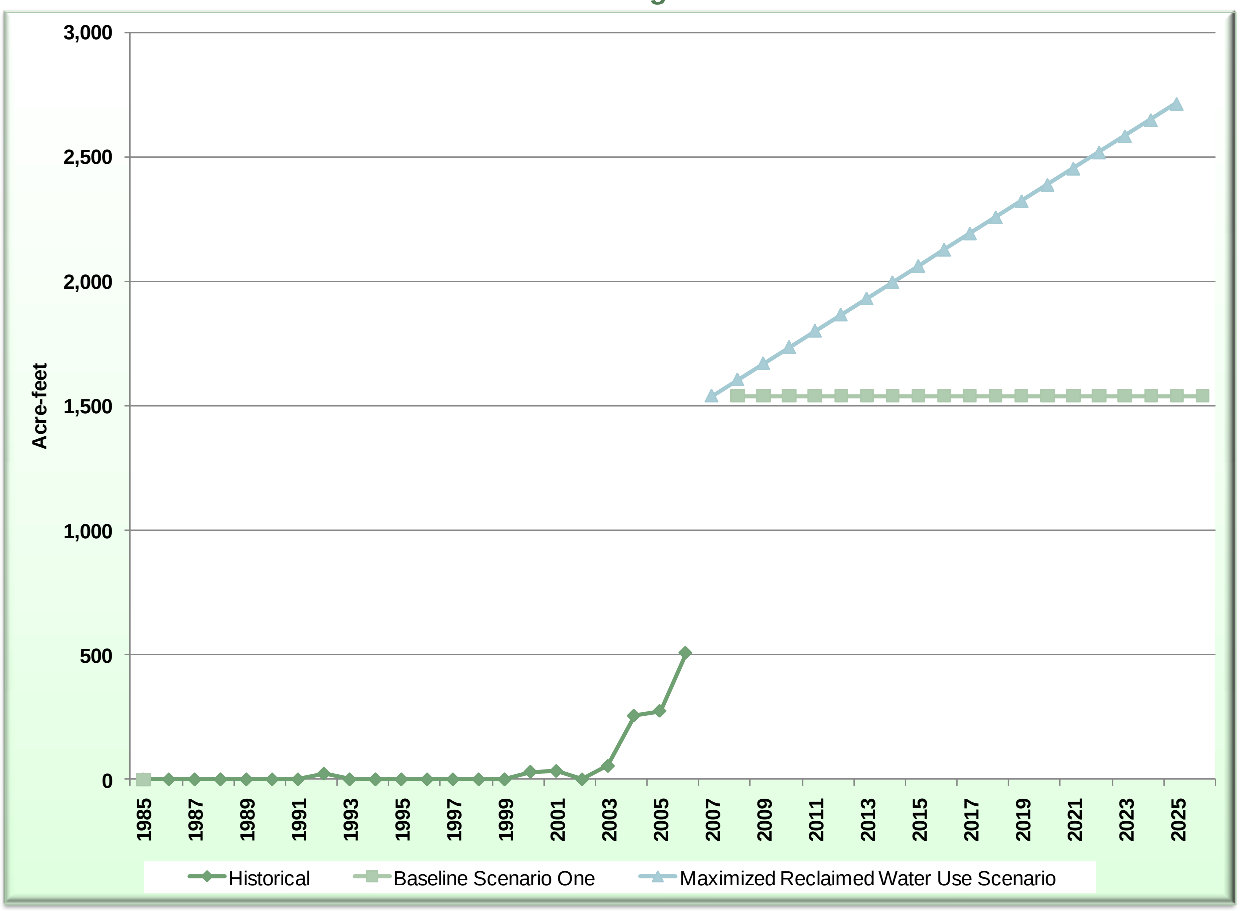
14.2.2 Methodology and Assumptions

Municipal Reclaimed water Use

In the Maximize Reclaimed Water Use Scenario, it was assumed that reclaimed water supplies used to meet Municipal demand would increase from 1,539 acre-feet or approximately one percent of Municipal demand in 2025 (under Baseline Scenario One), to approximately 2,714 acre-feet or approximately two percent of the total Municipal demand by 2025 (*See Figure 14-4*). As noted earlier, Baseline Scenario One reclaimed water assumptions were based on DAWS water supply projections, historical use of supplies and current treatment and delivery capacity.

The increased reclaimed water use in the new scenario assumes that expanded treatment capacity and infrastructure would need to be built in order to meet the increased use of Municipal reclaimed water. No specific assumptions were made as to which customers would use the additional reclaimed water. Currently, the main recipients of reclaimed water in the Pinal AMA are turf facilities, primarily golf courses. New users, however, should not necessarily be confined to the current reclaimed system or necessarily be turf facilities.

Figure 14-4 Maximized Municipal Reclaimed Water Use
Pinal Active Management Area

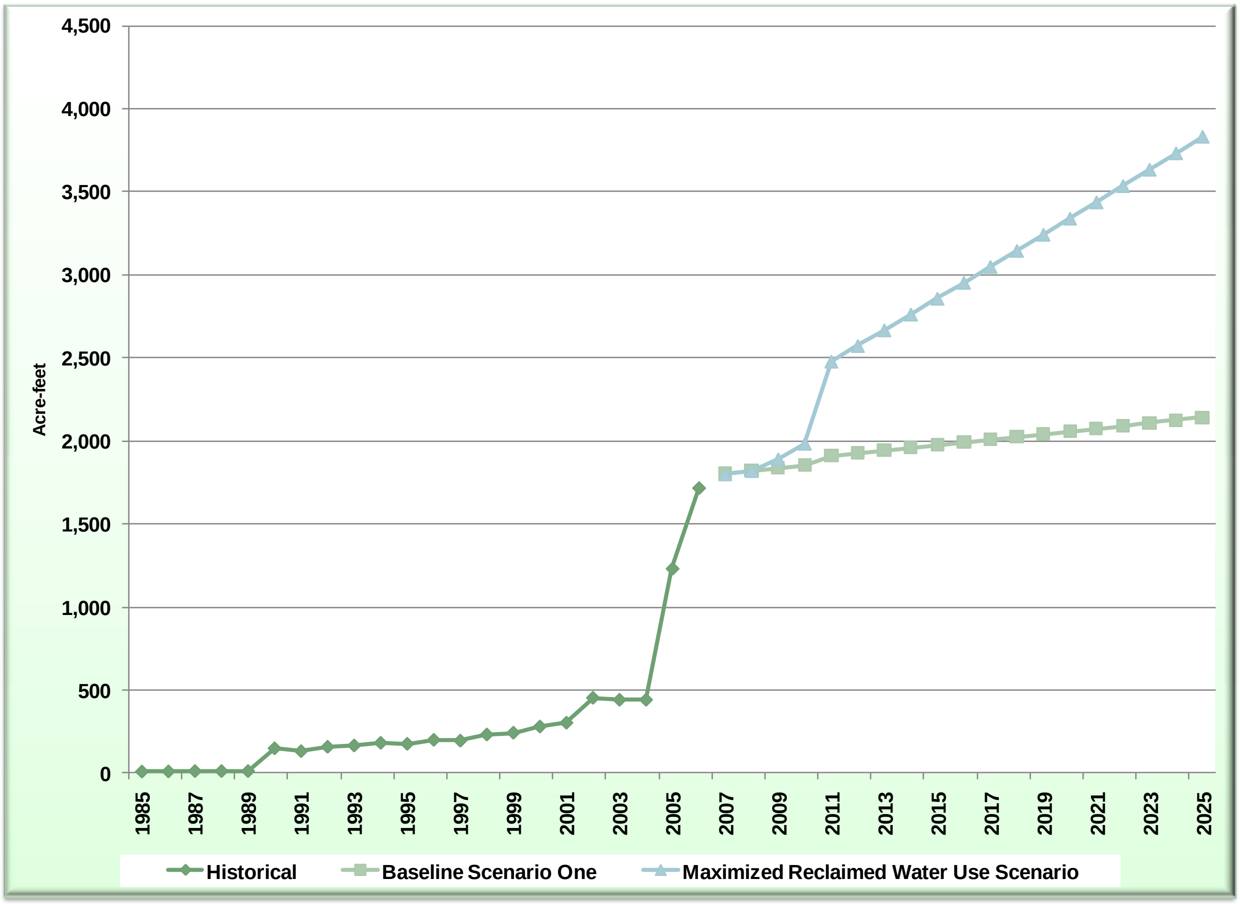


Industrial Reclaimed Water Use

In the Industrial sector, it was assumed that reclaimed water usage would increase from 2,141 acre-feet or approximately eight percent of the total demand in Baseline Scenario One by 2025 to 3,712 acre-feet or approximately 15 percent of the total demand in the Maximized Reclaimed Water Use Scenario (*See Figure 14-5*). This assumption implies that some Industrial grandfathered right holders would stop using groundwater and would switch to reclaimed water.

Sectors such as electric power generation, sand and gravel, and turf facilities may be reasonable recipients of this new supply.

Figure 14-5 Maximized Industrial Reclaimed Water Use Pinal Active Management Area



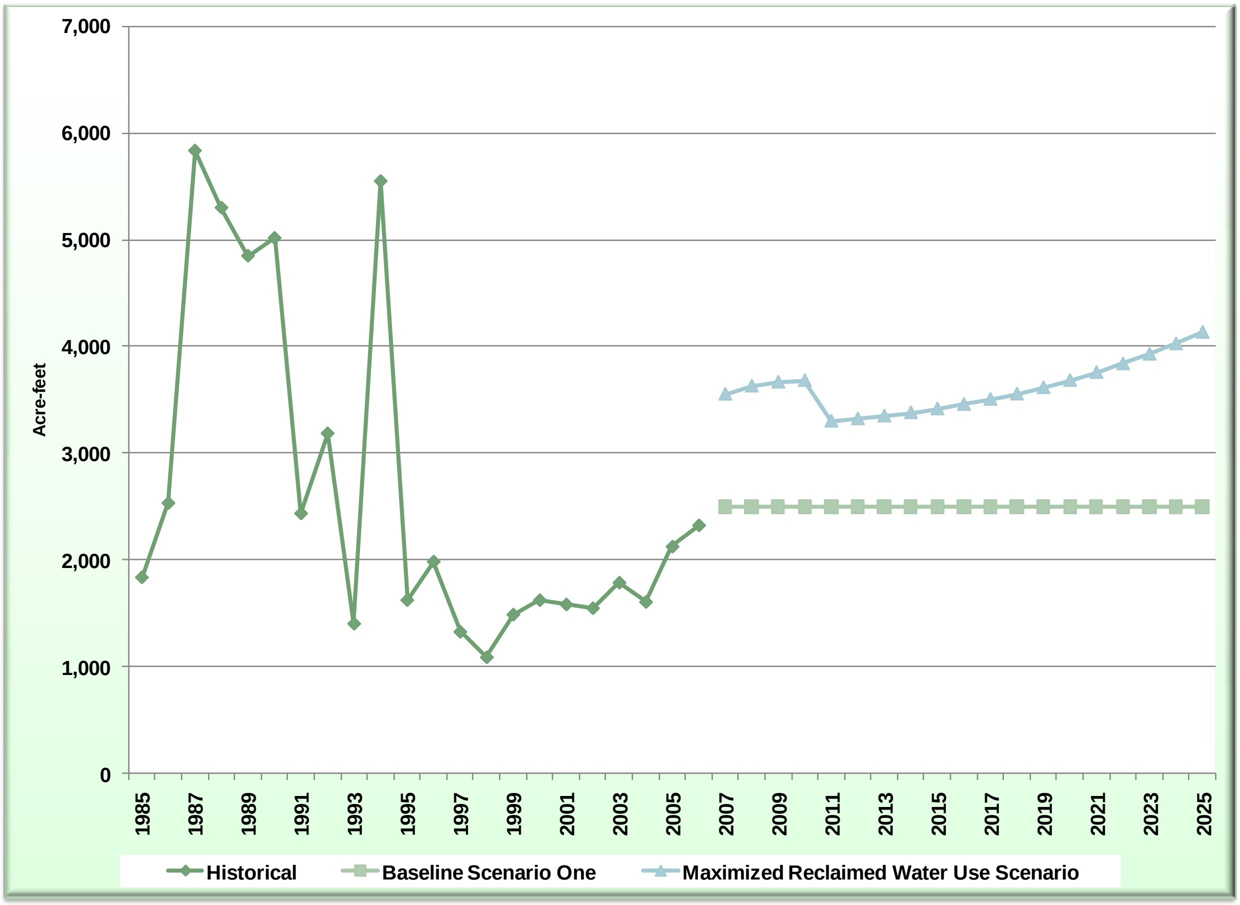
Agricultural Reclaimed Water Use

Reclaimed water was projected to maintain at about 2,500 acre-feet per year in the Agricultural sector in Baseline Scenario One. In the Maximized Reclaimed Water Use Scenario, it was assumed that any additional reclaimed water above the increased volumes assumed to be used by Municipal and Industrial users would be used in the Agricultural sector, up to the total volume of reclaimed water produced. This results in an increase from 2,500 acre-feet or less than one percent of the total demand in Baseline Scenario One by 2025 to 4,133 acre-feet or about one percent of the total demand in the Maximized Reclaimed Water Use Scenario (*See Figure 14-6*). Based on documented historical use of reclaimed water by the Pinal AMA Agricultural sector, it was assumed that this amount of reclaimed water use was reasonable to consider in the future. It does not exceed the highest volume of reclaimed water historically used in the Agricultural sector, which was 5,831 acre-feet in 1987.

Reclaimed Water Recharge Assumptions

The Maximized Reclaimed Water Use Scenario assumes no reclaimed water is stored, because there is no cut to the aquifer associated with reclaimed water stored at constructed facilities and there are no managed storage facilities for reclaimed water in Pinal AMA. In the Baseline Scenario One, a small amount of reclaimed water was assumed to be stored, gradually increasing to 4,461 acre-feet by 2025.

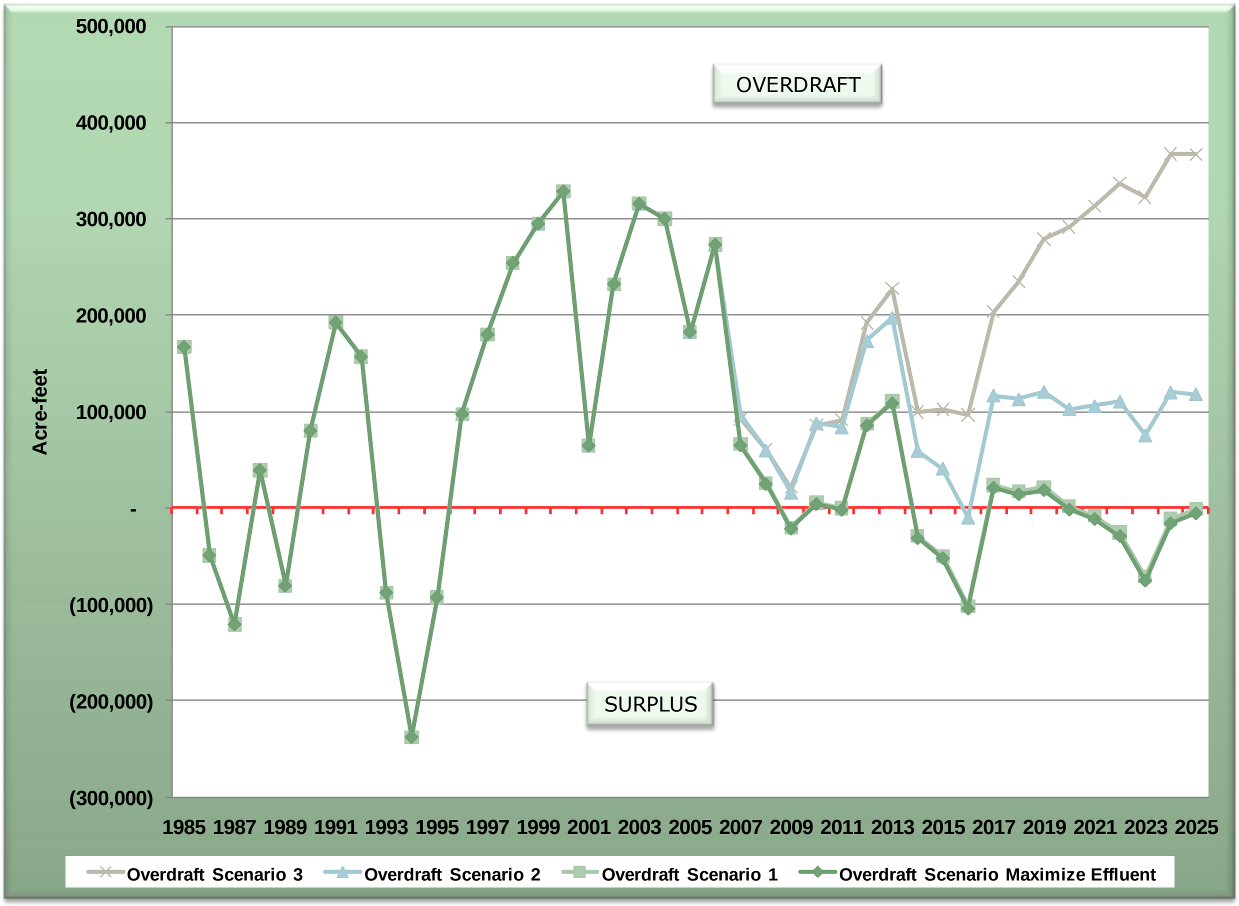
Figure 14-6 Maximized Agricultural Reclaimed Water Use
Pinal Active Management Area



14.2.3 Maximized Reclaimed Water Use Scenario Results

Population in Baseline Scenario One more than doubles from 2007 to 2025. Reclaimed water is projected to increase from about 8,000 acre-feet in 2007 to more than 15,000 acre-feet in 2025. However, the results of the Maximized Reclaimed Water Scenario indicate that there is little impact on the overdraft condition (it is not even discernable on Figure 14-7) of the AMA related to increasing direct use of reclaimed water. This is due to the dominance of agricultural demand in the Pinal AMA and the relatively small volume of reclaimed water projected to be available (*See Figure 14-7)*.

Figure 14-7 2025 Projected Overdraft Maximized Reclaimed Water Scenario vs. Baseline Projections Pinal Active Management Area



PART IV THE FOURTH MANAGEMENT PLAN PROCESS

The Code requires ADWR to develop Management Plans for each AMA to assist the AMA in achieving its management goal. The Management Plans contain conservation requirements for the Municipal, Industrial and Agricultural sectors; however, they do not apply to the Indian water use sector. While the Management Plans provide requirements for reductions in water use – it is not the only tool available to ADWR for achieving the management goals and should not be viewed as such.

ADWR has developed Management Plans for each of the previous management periods using similar, yet increasingly more complicated approaches. The 1MP (1984 – 1990) was the first comprehensive attempt to manage groundwater within the AMAs. Development of the mandatory conservation requirements used a very straightforward approach, based on water supply and demand quantification.

The 2MP (1990 – 2000) employed a more advanced supply and demand analysis incorporating current and future conditions. In the development of conservation requirements ADWR put more emphasis on aggressive and cutting-edge conservation practices for the three main water use sectors. Water supply augmentation was also integrated into the water management strategies in addition to a newly created Conservation and Augmentation Assistance grants program.

The 3MP (2000-2010) was the mid-point of the 45-year timeframe from the inception of the Code in 1980 to the year 2025 by which safe-yield was to be attained. The 3MP recognized the impacts of the other water management programs not addressed through the Management Plans, including the AWS Rules, the Underground Storage and Recovery Program, the CAGRD, and the AWBA. Because of the recognition of these additional management programs, supply and demand analysis vastly improved. However, the conservation requirements included in the 3MP were strikingly similar to the 2MP.

The 3MP for the AMAs, as well as the findings of the subsequently formed local AMA “Safe-Yield Task Force” (or other similarly named stakeholder groups) and the Governor’s Water Management Commission in 2001, made a series of observations that should frame the development of future water management strategies. Although these observations recognized certain differences among the AMAs, there were fundamental similarities. The principal observations were:

1) While significant progress has been made since the enactment of the Code, it is unlikely that the statutory goals of the AMAs will be met, given the current authorities granted to ADWR;
2) While it is projected that most AMAs will continue to make progress toward achievement of their goals as currently unused renewable water supplies become utilized, we may begin to move in the opposite direction if increased demands outstrip the availability of renewable supplies; and
3) Localized areas within AMAs are experiencing, and will continue to experience, water management problems disproportionate to those of the AMA as a whole due to infrastructure and renewable water supply access, continued allowable groundwater pumping by grandfathered uses, and recovery of LTSCs outside the areas of impact of the recharge facilities.

These observations are a mixture of “good news/bad news”. It is good news from the standpoint that the existing programs and authorities have served this State, most specifically the AMAs, well. We should all be proud of the work accomplished and the progress made to date. The bad news is that with the current authorities, it will be almost impossible to meet the management goals, and may over time move us farther away. These goals are the fundamental underpinnings to ensuring a long-term sustainable water supply for the State of Arizona. The 4MP must emphasize ensuring sustainable water supplies and the effective and efficient management of the State’s most precious resource for Arizona to thrive.

So what should the 4MP look like? The Management Plans to date have served us well; however, they are not really planning tools that provide succinct options for future water management decisions. They are excellent tools in identifying current and projected water use, mandatory conservation requirements, and potential directions and initiatives that could be pursued to move toward goal achievement and wise, long-term water management. The Management Plans should provide more concise direction regarding what is needed to get to the ultimate goal.

ADWR will approach the 4MP more as a Plan for success than a document that simply identifies the statutory requirements for the main water using sectors. In this Plan ADWR, in cooperation with the public, will build on past successes but recognize that additional observations should be considered, including:

1) Conservation will only get us so far. We will continue to address meaningful conservation requirements, but also will review the “incentives” for utilization of renewable water supplies, reduce the complexity and the administrative workload necessary to implement these programs, and be diligent in their enforcement.

2) Have serious discussions regarding the AMA goals and the implications to the State of not reaching them.
3) Consider different approaches to water management among the AMAs, recognizing local conditions and community values.
4) Address the limitations of the Management Plans and underlying authorities as we determine what course of action to follow.
5) Recognize sub-area issues and consider alternative management strategies to address areas where conditions are positive and conditions are negative.
6) Develop, in cooperation with local water users and other water resource entities (CAWCD, AWBA, CAGRD, etc), a long-term water management strategy to get the AMAs where we need them to be by identifying what specific actions/steps we need to take and what resources will be required to accomplish this strategy.

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APPENDICES

Appendix 1 Assumptions Used for Large Municipal Providers

Category	Scenario
Demand	**SCENARIO ONE**: 1985-1999 growth rate population projection was broken down to each large provider by adjusting each provider's population down by the percent that the AMA total Baseline Scenario One population projection is less than the AMA total Baseline Scenario Two population projection for each year, 2007-2025. The Baseline Scenario One population for each large provider multiplied by the TMP conservation requirement for each provider equals large provider demand.
	SCENARIO TWO: Statistical trend lines or the provider's designation of assured water supply population projection multiplied by the 2000-2006 average GPCD for each provider equals large provider demand.
	SCENARIO THREE: Association of Governments population projections were broken down to each large provider by adjusting each provider's population up by the percent that the AMA total Baseline Scenario Three population projection is greater than the AMA total Baseline Scenario Two population projection for each year, 2007-2025. The Baseline Scenario Three population for each large provider multiplied by the 2000-2006 average GPCD for each provider equals large provider demand.
Supply	Individual assumptions were made for each provider based on the designation of assured water supply for designated providers, and historic use of supplies for undesignated, capped based on treatment capacity. Assumed primarily groundwater supplies, then, as needed renewable supplies either as recovered water or direct delivery.

Appendix 2 Assumptions Used for Institutional Municipal Providers

Category	Scenario
Demand	**SCENARIO ONE**: Same as Baseline Scenario One, but population was adjusted down based on the percent the AMA Baseline Scenario One population projection is lower than the AMA Baseline Scenario Two population projection for each year, 2007-2025.
	SCENARIO TWO: Florence and Eyeman prison demand was held constant at the 2000-2006 average GPCD for each. The 2007 estimated prison population for each facility was held constant. Francisco Grande was discontinued after 2005 as it is served by AWC-CG.
	SCENARIO THREE: Same as Baseline Scenario Two, but population was adjusted up based on the percent the AMA Baseline Scenario Three population projection is higher than the AMA Baseline Scenario Two population projection for each year, 2007-2025.
Supply	100% groundwater

Appendix 3 Assumptions Used for Small Municipal Providers

Category	Scenario
Demand	**SCENARIO ONE**: Small provider population was projected using the 1985-1999 small provider growth rate. Small provider population multiplied by the 2000-2006 average GPCD for small providers equals small provider demand.
	SCENARIO TWO: 1985-1999 growth rate population projection x 1985-2006 average GPCD for small providers equals small provider demand.
	SCENARIO THREE: the Association of Governments population projections were used. Small providers were maintained at the same percent of the total AMA population that they were in 2006. Small provider population multiplied by the 1985-2006 average GPCD for small providers equals small provider demand.
Supply	100% groundwater

Appendix 4 Assumptions Used for Urban Irrigation

Category	Scenario
Demand	**SCENARIO ONE**: The 1985-2006 average urban irrigation demand was held constant. In addition, SCIDD urban irrigation deliveries increase corresponding to conversion of agricultural acres to municipal subdivisions.
	SCENARIO TWO: The 1985-2006 average urban irrigation demand was held constant.
	SCENARIO THREE: The 1985-2006 average urban irrigation demand was held constant.
Supply	The 1985-2006 average was used for each source, CAP, surface water, and effluent. Groundwater is remainder of the demand.

Appendix 5 Assumptions Used for Exempt Well Users

Category	Scenario
Demand	**SCENARIO ONE**: Exempt well population is projected using the 1985-1999 exempt well population growth rate. The projected exempt well population, the TMP single family models for new development, and the 2000 Census average persons per household for Pinal County were used to calculate projected exempt well demand for each year, 2007-2025.
	SCENARIO TWO: The exempt well population projection in Baseline Scenario Two scenario uses the Pinal County average growth rate from 2000-2006. The projected exempt well population, the TMP single family models for new development, and the 2000 Census average persons per household for Pinal County were used to calculate projected exempt well demand for each year, 2007-2025.
	SCENARIO THREE: The exempt well population is the remainder of the Baseline Scenario Three population projection (from the Association of Governments) after the large provider, small provider, and Indian populations are subtracted from it. The exempt well population, the TMP single family models for new development, and the 2000 Census average persons per household for Pinal County were used to calculate projected exempt well demand for each year, 2007-2025.
Supply	100% groundwater

Appendix 6 Assumptions Used for Industrial Demand and Supply Projections

User Category		Scenario
Turf	DEMAND	**SCENARIO ONE:** Calculated the line of regression of historic turf water use against the log of population, then projected future demand using population used in municipal demand Scenario One.
		SCENARIO TWO: Calculated the line of regression of historic turf water use against the log of population, then projected future demand using population used in municipal demand Scenario Two.
		SCENARIO THREE: Calculated the line of regression of historic turf water use against the log of population, then projected future demand using population used in municipal demand Scenario Three.
	SUPPLY	All future industrial demand is projected to be served by the same supplies in the same proportion used in 2006, with a few exceptions.
Sand & Gravel	DEMAND	**SCENARIO ONE:** 2001-2006 Historic average held constant through time.
		SCENARIO TWO: 2001-2006 Historic average held constant through time.
		SCENARIO THREE: 2001-2006 Historic average held constant through time.
	SUPPLY	All future industrial demand is projected to be served by the same supplies in the same proportion used in 2006, with a few exceptions.
Dairy	DEMAND	**SCENARIO ONE:** Assumed water use would stay relatively constant at current (2006) use. A slight increase was assumed due to tighter future dust control restrictions.
		SCENARIO TWO: Assumed modest future increase in water use (i.e., more water for future dust control requirements and the addition of 2 to 3 new dairies by 2025).
		SCENARIO THREE: Assumed water use would continue to grow at a rapid pace. Assumed ratio of Phx to Pinal dairies would continue current trend.
	SUPPLY	All future industrial demand is projected to be served by the same supplies in the same proportion used in 2006, with a few exceptions.
Electric Power	DEMAND	**SCENARIO ONE:** Assumed future water use will equal average use (2002-2006) plus the addition of a 300 AF peaking plant.
		SCENARIO TWO: Assumed future water use will equal average use (2002-2006) plus the addition of a 300 AF peaking plant and a 3,000 AF power plant.
		SCENARIO THREE: Assumed future water use will equal average use (2002-2006) plus the addition of a 300 AF peaking plant and a 3,000 AF power plant.
	SUPPLY	All future industrial demand is projected to be served by the same supplies in the same proportion used in 2006, with a few exceptions.

User Category		Scenario
Other	DEMAND	**SCENARIO ONE:** Held constant at average use (2002-2006).
		SCENARIO TWO: Held constant at average use (2002-2006).
		SCENARIO THREE: Held constant at average use (2002-2006).
	SUPPLY	All future industrial demand is projected to be served by the same supplies in the same proportion used in 2006, with a few exceptions.
Feedlot	DEMAND	**Scenario One:** Historic average held constant through time.
		Scenario Two: Historic average held constant through time.
		Scenario Three: Historic average held constant through time.
	SUPPLY	All future industrial demand is projected to be served by the same supplies in the same proportion used in 2006, with a few exceptions.

Appendix 7 Assumptions Used for Agricultural Projections

Category	ITEM	SCENARIO	METHODOLOGY
Demand Factors	Irrigation Acres (> 10 acres)	ALL	In PAMA, there is no strong correlation between certified irrigation acres and demand. Not projected.
	Maximum GW Allotment (>10 acres)	ALL	In PAMA, there is no strong correlation between allotments and demand. Not projected.
Demand	IGFRs < 10 AC	ALL	Estimated using historic average prior to 1993. Held constant for projections.
	IGFRs > 10 AC	One	Sum of Scenario One projections by Irrigation District and "other".
		Two	Sum of Scenario Two projections by Irrigation District and "other".
		Three	Sum of Scenario Three projections by Irrigation District and "other".
	Canal & other losses	ALL	Total of district-by district percentage losses multiplied by projected demands (based on historic average percentages, except SCIDD projected to decrease to 3% by 2020 due to canal lining).
Supply	Groundwater	ALL	Demand not met by other sources.
	IN-LIEU GROUNDWATER (CAP)	ALL	GSF District projections, based on the following formula: [Lesser of: (District GSF Permit), (District Demand not including losses), or (Max historical GSF, plus any District pool water reductions returned to excess: assume that someone will store it in the District)] Minus [Greater of: (0), (District Demand - District Renewables - District "Bucket")]. Then capped at the sum of Muni, GRD, AWBA, and Excess user projected storage volumes.
	GSF (Reclaimed Water)	ALL	N/A
	Surface Water	ONE	SCIDD demand projection minus 5000 af of SCIDD NIA Pool, taking into account NIA Pool reductions in 2017 and 2024. For Scenario 1, it was projected that additional surface water supplies based on SCIDD canal lining were not to be realized before 2025.
		ALL	SCIDD demand projection minus 5000 af of SCIDD NIA Pool, taking into account NIA Pool reductions in 2017 and 2024.
	CAP	ALL	2009 rounded allocation per district (except SCIDD held at 5000 acre-feet), then 25% reductions in 2017 and again in 2024. However, in no case is the District's CAP greater than the District's Demand.
	Reclaimed Water	ALL	Rounded 2007 projected use based on linear trend with time from 2000-2006, then held constant due to no planned expansions.
	Spill	ALL	Due to the complexity of projecting spills, this was included with surface water.
Incidental Recharge	Total	ALL	22% of total demand not including GSF or canal losses

Appendix 8 Assumptions Used for Indian Agricultural Projections

Category	Item	Scenario	Methodology
Demand	Total	One	Sum of scenario one projections for each Community/Reservation, based on settlements, historic use, and current projects underway.
		Two	Sum of scenario two projections for each Community/Reservation, based on settlements, historic use, and current projects underway.
		Three	Sum of scenario three projections for each Community/Reservation, based on settlements, historic use, and current projects underway.
Supply	Groundwater	ALL	All demand not met by other sources, individually capped based on settlements.
	Surface Water	ALL	Amounts available per settlements and based on historic average supplies and use, along with current projects.
	CAP	ALL	Amounts based on demand, with increased use due to current projects, individually capped based on settlements.
	Reclaimed Water	ALL	N/A

Appendix 9 Assumptions Used for Recharge Projections

Storer	Permit Type	Facility Type	Source	Assumption
Municipal	USF	Constructed	Reclaimed	A "reclaimed GPCD" was calculated by dividing historic reclaimed generated by historic population. The reclaimed GPCD was multiplied by the projected large provider population to project future reclaimed generated. The amount of projected uses of reclaimed, including storage, was subtracted from the amount projected to be generated. Any remaining amount was divided in half, with half assumed to be additional reclaimed stored and half assumed to be discharged. In Pinal AMA, no reclaimed GSF was projected nor was any managed reclaimed storage. The volume of reclaimed available for storage varied each year based on the differences between the projected population among the three scenarios.
	GSF		CAP	Individual projections of CAP water stored by large municipal providers were prepared, based on the provider's designation, historic use patterns, M&I allocation, and ability to store CAP water. The sum of the projected CAP storage by municipal providers, the water bank, the GRD and others was compared to the agricultural planner's projection of GSF CAP. The lower of the two figures was used.
Water Bank	GSF		CAP	Projections of GSF CAP in Pinal AMA were prepared by the AWBA based on financing and available storage capacity. Water stored on behalf of Nevada is also included under AWBA GSF in Pinal AMA. If CAP was not fully utilized in any year, the remaining amount was divided among the 3 AMAs based on the CAWCD Distribution of Excess Water policy. If the projected uses of CAP water exceeded the 1.595 maf assumed to be available, cuts were made based on the CAWCD Distribution of Excess Water policy as well. The AWBA and AWBA Nevada water was cut in some scenarios, as was storage of excess water by some industrial users, as well as the GRD for some years in one scenario. The sum of the projected CAP storage by municipal providers, the Water Bank, the GRD and others was compared to the agricultural planner's projection of GSF CAP. The lower of the two figures was used as agricultural GSF CAP. A 2% loss was added to the volume used by the farm to indicate losses in transmission of the CAP water to the GSF farm. This is why the volume stored under GSF is 2% higher than the volume of CAP GSF used under agricultural supply.
GRD	USF	Constructed	Reclaimed	No GRD reclaimed storage is assumed except for some years under the maximum scenario where CAP use in sum for the three AMAs exceeded the total CAP presumed to be available (1.595 maf). For those years the volume the projected CAP use exceeded 1.595 maf was divided between the AMAs based on the CAWCD Distribution of Excess Water policy, and the remaining amount of obligation was assumed to be met with the additional reclaimed available to store.
	GSF		CAP	The projected volume of GRD replenishment obligation was assumed to be stored except for some years under the maximum scenario where the 1.595 total CAP use was exceeded, in those years, the amount over the 1.595 was divided between the 3 AMAs based on the CAWCD Distribution of Excess Water policy, and the difference was assumed to be met with reclaimed storage (see box above). The sum of the projected CAP storage by municipal providers, the water bank, the GRD and others was compared to the agricultural planner's projection of GSF CAP. The lower of the two figures was used.