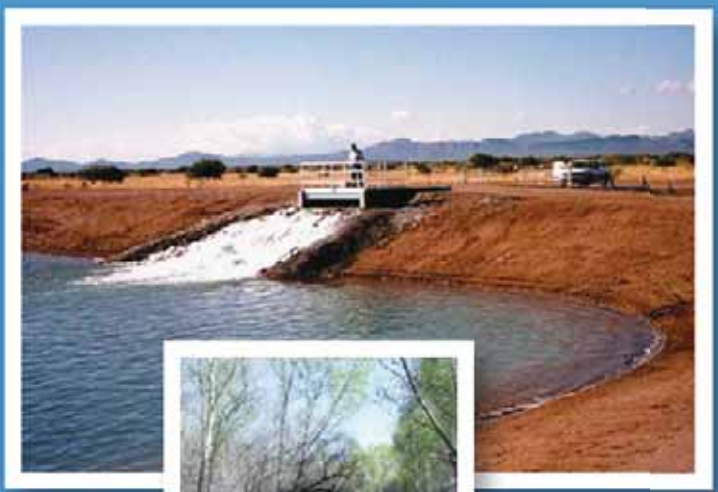
A City of Tucson
and Pima County
Cooperative Project

Water & Wastewater

Infrastructure, Supply & Planning Study



Chapter 1

May 2009

CHAPTER 1: CURRENT STATE OF WATER, WASTEWATER AND RECLAIMED WATER SYSTEMS

This section responds to item A from the Scope of Work approved by Mayor and Council and the Board of Supervisors, as reproduced below:
This initial study phase should consist of inventorying existing infrastructure conditions and developing an assessment of this infrastructure and its capacity. The work of Tucson Water, as well as the Pima County Regional Wastewater Reclamation Department, can be extensively used in this initial analysis. The goal would be to determine the current state of City and County water, wastewater and reclaimed water infrastructure systems. This would include a review of capacity expansions that may be necessary today to accommodate the existing population distribution throughout the service areas of Tucson Water and the Regional Wastewater Reclamation Department. Existing management staff of the City and County, working together, will draft this comprehensive report, building on the City Water Plan 2000-2050, as well as Pima County's Regional Optimization Master Plan.

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Introduction

The focus for this portion of the report includes the current service areas and potential future service areas of Tucson Water and Pima County Regional Wastewater Reclamation Department as depicted in the maps below.

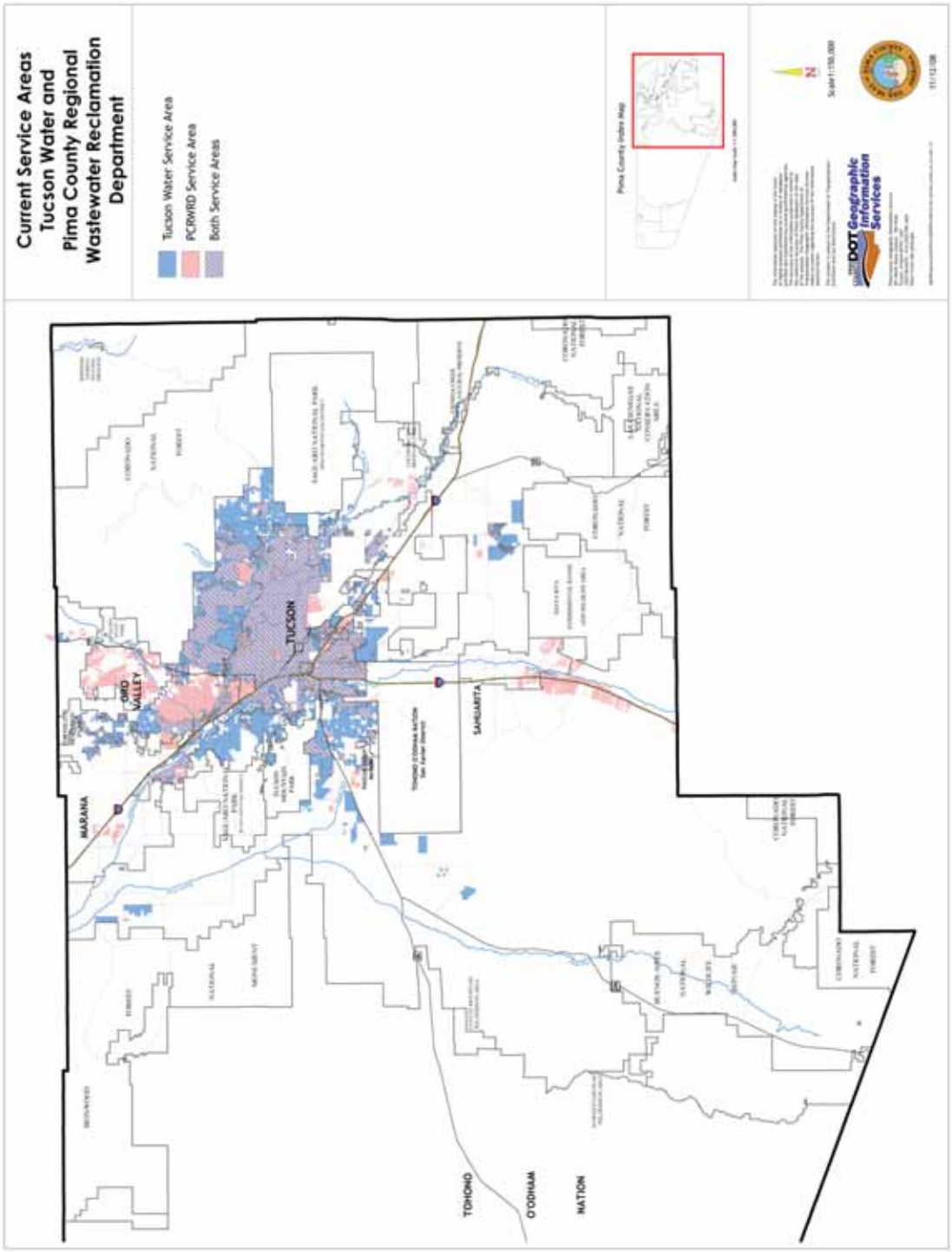


Figure 1-Current Service Areas Tucson Water and Pima County Regional Wastewater Reclamation Department

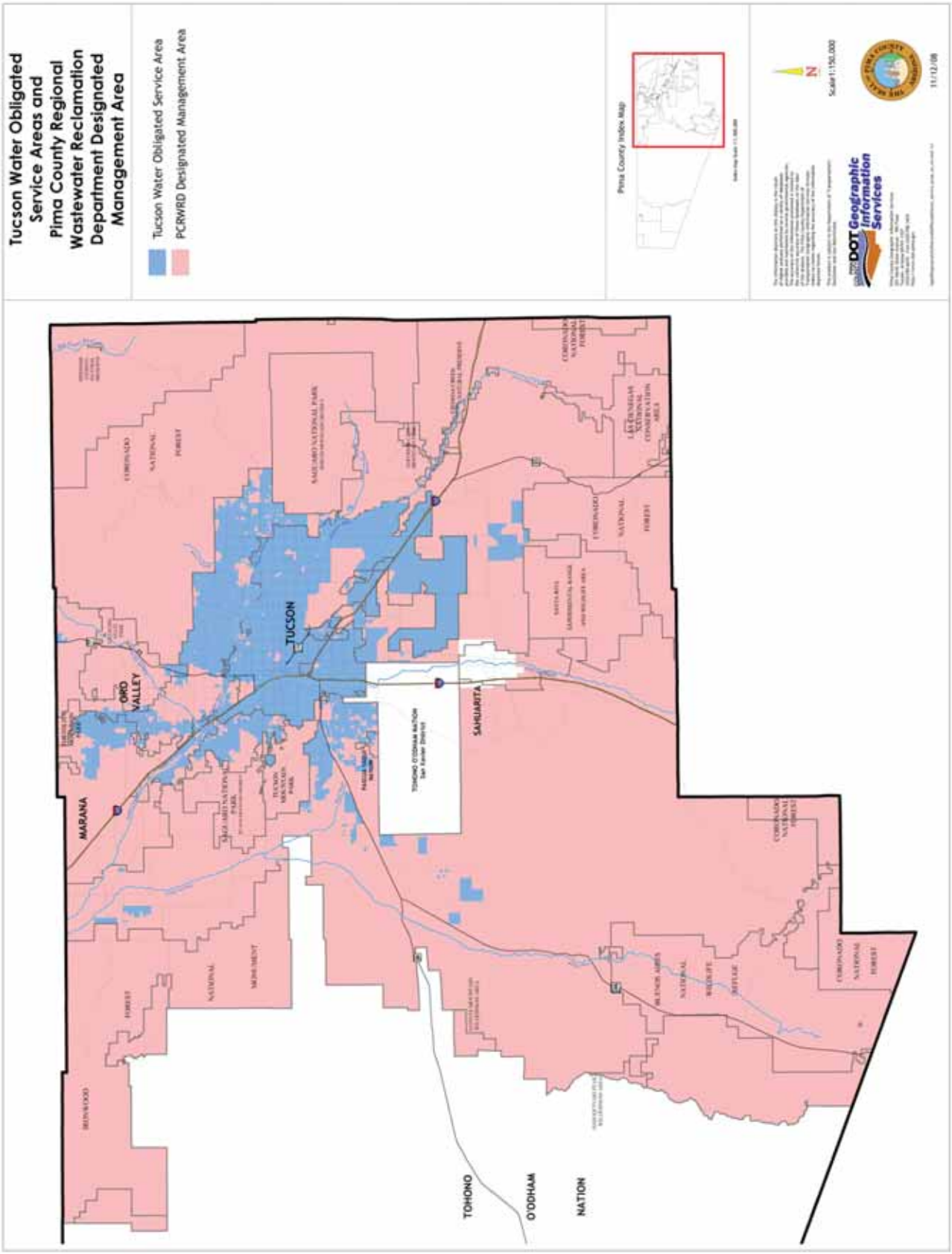


Figure 2-Service Areas

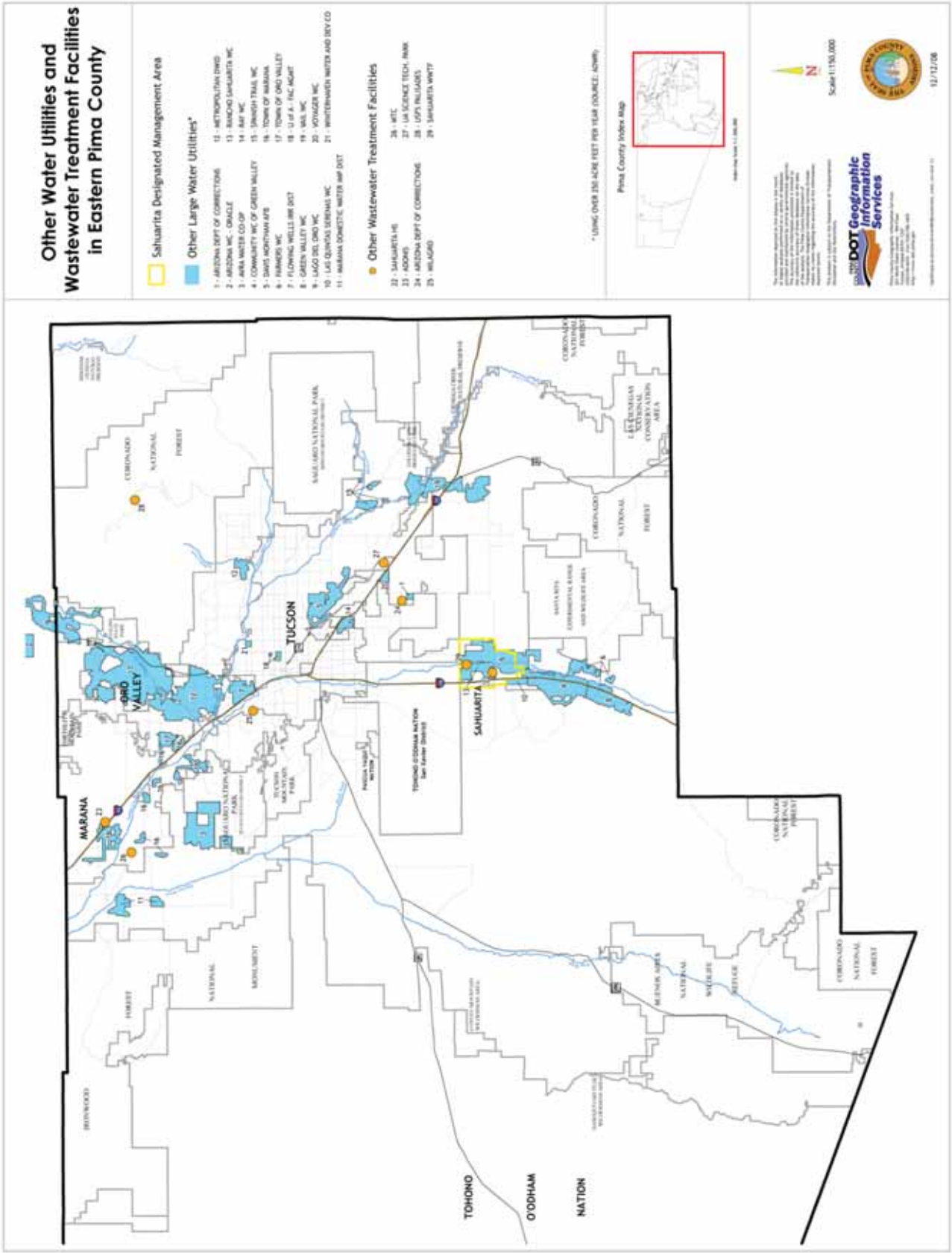


Figure 3-Other Water; Wastewater Providers–Eastern Pima County

A Brief History of Water and Wastewater Systems in Pima County

1870 Tucson Population: 3,224 (PC: 5,716)

- Tucson Water Company formed in cooperation with the Tucson City Government
- Groundwater pumping began with Tucson Water Company constructing 20-foot wells
- Railroad arrived in Tucson (1880)

1900 Tucson Population: 7,531 (PC: 14,689)

- First sewer installed on Main Avenue

1910 Tucson Population: 13,191 (PC: 22,818)

- City of Tucson purchased the Tucson Water Company and formed the Water and Sewerage Department
  - o Sewage conveyed to sewage farm near "A" Mountain

1930 Tucson Population: 32,506 (PC: 55,676)

- High-powered "deep well" turbine pumps allowed groundwater to become major source (1920s)
- City built first Wastewater Treatment Facility west of the Santa Cruz River on Fort Lowell Road

1940 Tucson Population: 35,752 (PC: 72,838)

- Last year that Tucson's water table was balanced
  - o Groundwater was withdrawn in some areas at greater rate than natural replenishment
- End of any perennial surface flow in the Santa Cruz River near Tucson

1950 Tucson Population: 45,454 (PC: 141,216)

- Joint City / County study recommends construction of Roger Road WWTP
- Pima County Sanitary District formed for areas outside city limits
- City of Tucson completed Phase I of Roger Road WWTP with capacity of 12 million gallons per day (mgd)

1960 Tucson Population: 212,892 (PC: 265,660)

- Roger Road WWTP expanded to 24 mgd
- Pima County Sanitary District installed wastewater treatment lagoons at Ina Road site
- Pima County Sanitary District dissolved and Pima County Department of Sanitation formed
- Roger Road WWTP expanded to 36.9 mgd

1970 Tucson Population: 262,933 (PC: 351,661)

- COT purchased and retired over 22,500 acres of farm land in Avra Valley
- COT submitted letter of intent to begin using its CAP allotment
  - o Implementation goal – 1992
- EPA demonstration grant to build pilot plant at Randolph Park. First reclaimed water system in Arizona; effluent used for city golf course irrigation

1970 Tucson Population: 262,933 (PC: 351,661)

- Creation of the Environmental Protection Agency and the Clean Water Act led to availability of funds for treatment improvements and a push for coordinated infrastructure
- Pima Association of Governments (PAG) created for cross-jurisdictional planning issues
  - o Established PAG 208 planning process and Designated Management Agency
- EPA requested consolidation of wastewater infrastructure to obtain federal grants for Ina and Roger Road facilities
- Pima County Ina Road WPCF (25 mgd) completed in 1977
- Through City / County IGA, Pima County Government assumed responsibility for sanitary sewerage service in City and County
  - o County received consolidated City / County wastewater conveyance and treatment system
  - o City received 90% of effluent

1980 Tucson Population: 330,537 (PC: 531,443)

- Groundwater Management Act led to creation of Arizona Department of Water Resources (ADWR)
  - o Established goal of safe yield in the Tucson Active Management Area by 2025

1990 Tucson Population: 405,390 (PC: 666,881)

- First CAP water delivered to customers
  - o Customer complaints led to 1994 City directive to return to groundwater until issues resolved
- Citizen's initiative prevented Tucson Water from directly delivering CAP water
- Tucson Water developed the Central Avra Valley Storage and Recovery Project (CAVSARP) to blend ground and CAP water
- Roger Road WWTP expanded to current capacity of 41 mgd

2000 Tucson Population: 486,699 (PC: 843,746)

- Delivery of blended water started through CAVSARP project
- City of Tucson begins recharge of CAP water to Southern Avra Valley Storage and Recovery Project (SAVSARP)
- Renewal of discharge permits for Ina and Roger Road WRFs: requirement for reduction of nitrogen concentrations in effluent discharged to the Santa Cruz River

Planning for the Future: 2006 County Population: 1,000,000 (COT: 534,685)

- Pima County Metropolitan Facility Plan Update
- Pima County Regional Optimization Master Plan (ROMP)
  - o Deadlines of 2014 / 2015 for regulatory compliance at Ina and Roger Road WRFs
- Tucson Water – Water Plan: 2000-2050 Update

1.1 Tucson Water Potable System

Although each generation believes its struggles are unique, a look at Tucson's water history shows that dealing with supply limitations is not new. From those times when the local economy was dominated by agriculture to today's urban culture, local inhabitants have had to contend with limited water resource availability. In addition, changing federal, state and local policies and regulations have been significant in shaping local history and the evolution of Tucson Water.

This section provides a brief history of water in the Tucson region and then presents a more detailed inventory of Tucson Water in 2008.

1.1.1 Historical Context

Surface water and groundwater are the principal sources of water for human settlements. Surface water, from the Santa Cruz River, supported an agricultural community along its banks for 4,000 years. By the 1890s, human use had dried up the Santa Cruz River and pumping groundwater became the sole source of water, an era that lasted through the mid-1990s, when Tucson Water began receiving delivery of its allotment of Colorado River water. On July 1, 2008 Tucson Water began receiving and storing 100 percent of the Colorado River water it is allotted, marking the start of a new era. However recent budgetary constraints have temporarily impacted the amount of Colorado River water able to be purchased.

4,000 Years of Agriculture and Water Management in Tucson

When studying water issues it is important to consider the ages-long human settlement in the Tucson area and the role that water has played in that. Readily available water, particularly surface water from the Santa Cruz River, is the reason that people originally settled here and have been living in the Santa Cruz River Valley and in the Tucson Basin for thousands of years. For at least the past 6,000 years, the Santa Cruz has been a intermittent stream with perennial stretches. Until the late 1800s there were extensive wetlands along the river course. Even today there remain about 120 miles of year-round surface flow in the watershed.

Recent archeology work near Interstate-10 and the downtown area has helped us better understand early farming and water management practices here. Evidence has been discovered indicating irrigated farming was in use here as much as 3,200 years ago.

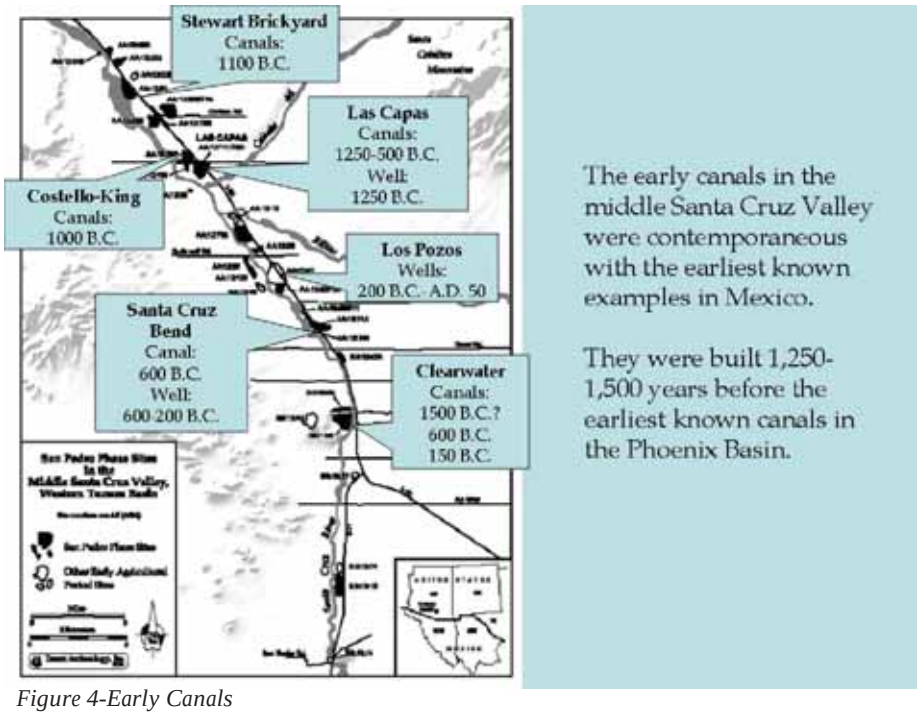


Figure 4-Early Canals

Radiocarbon dating has allowed archaeologists to recreate a history of the Santa Cruz River going back 6,000 years. Alternating periods of channel-down-cutting followed by in-fill are characteristic of the River and the use of it as a water source by early peoples. Excavations show early farming cultures that developed along the Santa Cruz floodplain. These cultures utilized canals and wells. Evidence of the use of these and other early water management techniques has been discovered at multiple sites along the River.

Indications of this early agriculture in the Tucson area extend back 4,100 years with canals appearing 3,500 year ago. Although we don't fully understand the connections between that earlier farming village culture and the later Hohokam culture that flourished in southern Arizona between about AD 350 and 1450, we do know that the Hohokam lived in larger villages and built even larger canals. Over time, these native peoples were becoming better hydraulic engineers with headgates and larger capacity systems appearing. During this time there may have been 4500 – 7000 people living in the entire Tucson basin.

When Father Kino and soldiers of the Spanish Empire arrived in the Santa Cruz Valley in the 1690s they found the people living at the base of what is today "A" Mountain using canals to irrigate their crops. This Tucson settlement was part of a chain of native villages strung along the rivers of what is now Arizona and Sonora - the Pimeria Alta.

Father Kino was an influential figure in the history of the southwest for many reasons. He introduced Christianity and established a chain of missions. But he also introduced cattle and wheat to the native peoples, thereby transforming their culture. Prior to this, all of the native crops had summer growing seasons, making it difficult for the inhabitants to sustain themselves in the lean seasons of late winter and early spring. Wheat is a winter crop and so it was a perfect complement to the native summer crops. The Native Americans were able to double-crop for the first time in their irrigated fields and hunger became, for the most part, a thing of the past. Kino's introduction of cattle also transformed the Papago people (today the Tohono O'odham) and livestock remains an important part of their economy to this day.

However, it wasn't until the Presidio of Tucson was established in 1775 that both sides of the Santa Cruz River were irrigated and cultivated and for the first time water sharing became an issue. This led to an agreement in 1776 - the native village on the west side would get three-fourths of the water and the Presidio on the east side would get one-fourth. But the treaty was broken almost immediately and by the 1790s, the native people's share was reduced to one-half. These villages were traditional Sonoran irrigation communities in which all farmers used the water from a main canal that was common property. There was an elected "zanjero" to oversee the operations and when there were water shortages, they were shared proportionally by everyone.

In 1864 the first legislative assembly of the Territory of Arizona adopted the Howell Code, which provided a temporary government for Arizona and established four counties including Pima County covering a significant area in Arizona. Tucson was designated as the county seat. From the 1870s through 1899, parts of the original territory covered by Pima County were used to create Maricopa, Pinal, Cochise, Graham, and Santa Cruz counties.

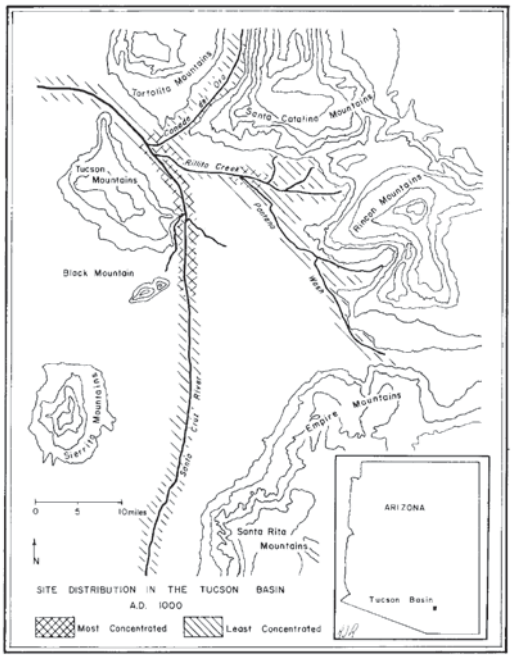
When U.S. troops arrived in Tucson in 1865, their first action was to map all of the fields so they could identify properties owned by Confederate sympathizers and confiscate them. By the 1870s Anglo-Americans who had arrived in Tucson had impounded the river at several locations, creating dams to power flour mills and form lakes for recreation.

In 1880, the railroad arrived in a Tucson that was still an agrarian community. The railroad, however, would totally transform the town. The railroad delivered metals to the region making it possible to build an underground delivery system for water. By the late 1800s surface water flows were no longer adequate to meet the needs of crop irrigation, milling operations, livestock maintenance and mining uses. The railroads also brought American entrepreneurs who wanted to speculate in land and water rights, resulting in a water law judgment by a U.S. judge that commodified water and transformed it from common property to private property. The rails also brought dimensioned lumber and with it the change in construction from adobe to wooden structures which brought about the need for fire protection.

The cumulative impact of these events transformed the Santa Cruz River into the river we know today - a dry riverbed most of the time. The cattle industry's overstocking of the range contributed to this scenario and a series of terrible drought years in the 1880s and 1890s followed by several closely spaced years of huge floods helped cut the 20-foot deep river channel that exists today.

Tucson 1900 to Present

A history of Tucson Water can be divided into time periods defined by milestones in water use: the transition to dependency on groundwater, a prolonged phase of over drafting the aquifer, the passage of the federal clean water legislation, the passage of the Groundwater Management Act, the construction of the Central Arizona Project, and most recently, the era in which the Colorado River is now our principal water source.



By A.D. 1000, the Hohokam were using all parts of the Tucson Basin. They built their villages along streams and rivers and hunted and gathered in the foothills and mountains.

Figure 5-Hohokam Settlement in Tucson Basin

1900 to World War II

The period from 1900 and before World War II, Tucson grew, but a relatively modest rate, especially when compared to the explosive growth we experienced after the war's end. During this time, Tucson Water was established and began to consolidate and expand its infrastructure.

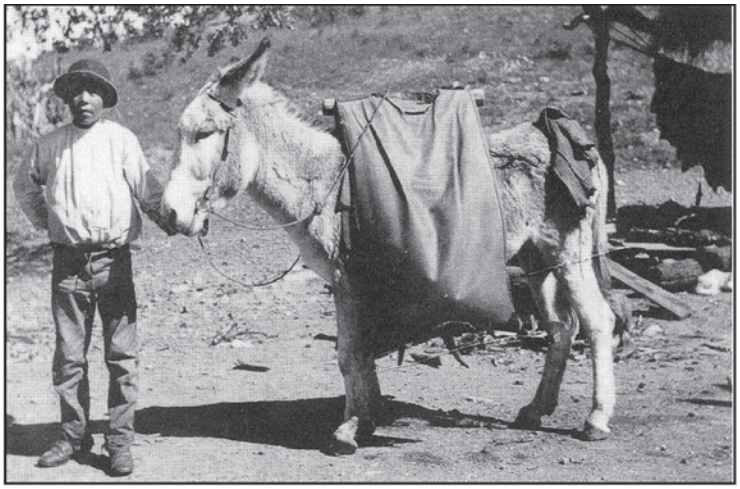


Figure 6-Water used to be delivered by donkey in Tucson

In 1882, Tucson's first municipal water system was constructed. In 1900 Tucson's Mayor and Council purchased the Tucson Water Company and established the Tucson Water and Sewerage Department. The new department served 625 connections, and water use was still largely dependent on surface water and shallow wells. Water shortages were reported in 1903, 1906, 1909 and 1912. In 1912, already threatened with a fifty-dollar fine[1] for leaky faucets, customers were urged to sprinkle only between the hours of 5:00 A.M. and 8:00 A.M. or 5:00 P.M. and 8:00 P.M. By 1922, concerned with the waste of water from leaking faucets, the Tucson Water Director requested a full-time employee to implement a water-saving education program, and in 1924 the traditional flat rate for water use was eliminated with a requirement for water meters on all new services.

Regional events impacting the future of Tucson Water include the 1922 signing of the Colorado River Compact by representatives of the seven basin states with allocations from the Colorado River (Arizona, California, Colorado, Nevada, New Mexico, Utah and Wyoming), and the 1928 signing of the Boulder Canyon Project Act (BCPA). The BCPA authorized construction of Hoover Dam, and approved the Colorado River Compact, which apportioned Colorado River allocations among the lower basin states (Arizona, California and Nevada).[2]

Locally, in 1928 the City built its first wastewater treatment facility. The facility was located west of the Santa Cruz River, south of Prince and was initially sized for a projected 1937 population of 42,600.

The invention of the turbine pump in the 1920s greatly increased the efficiency of well pumping. The turbine pumps, installed inside wells at water level, could pump much higher volumes of water than the older ground-level pumps that drew water by suction. This new technology made it possible for deep wells to be constructed in the Tucson basin, setting the stage for eventual overdrafting of the local aquifer.

1950 to 1970

The post-war era introduced explosive population growth, in Tucson, throughout central Arizona, and throughout the west. It was at the beginning of this time period, that we began overdrafting the aquifer and public concern over the process began to crystallize.

By 1943 the water system in Tucson was serving 8,184 connections, and the early-mid 1940s probably marked the last time the aquifer in the Tucson basin was in balance.[3] Agriculture, mining, and urban growth all placed demands on the region's water resources that could not be matched by natural recharge.

Statewide concern over dramatic increases in groundwater pumping caused the state legislature to pass the Arizona Critical Groundwater Code in 1948. The primary intent of the new code was to freeze agricultural expansion, but it never proved effective due to budget issues and legal challenges. Groundwater pumping continued to grow, and in 1953 the

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[1] *2008 equivalence of $50 fine is approximately $1,000. (http://www.bls.gov/cpi/)*

[2] *The Lower Basin States' total allocation from the Colorado River was allocated by specific quantity to the Lower Basin States while the Upper Basin States' allocation was allocated by percentage to the Upper Basin States.*

[3] *Julio Betancourt, 2003, 2004 reference in* The Lessening Stream *by Mihael Logan.*

Arizona Supreme Court determined that groundwater was not "public property" thereby limiting state intervention and enforcement of the Critical Groundwater Code.[4]

In 1953, growth and increased water usage prompted the City to build a new wastewater treatment plant at Roger Road. Upon completion of the new facility, the City first sold effluent for irrigation use to agricultural customers at Continental Ranch near what is now Cortaro Road and I-10. In 1965, to meet water demand and plan for the future water needs of the growing population, the City began to develop a well field in Avra Valley by purchasing agricultural lands for their groundwater rights. From 1965 until the early 1980s City purchases of agricultural land for groundwater rights would eventually total about 22,500 acres. The farms purchased by the City were all retired from agricultural use and groundwater pumping, thus beginning a slow recovery of the Avra Valley aquifer, to a point that water level declines were almost non-existent by 1980.

1970s

During the 1970s, while concern about overdrafting continued to build, the federal government became a pronounced factor in local water issues with passage of clean water legislation.

In 1970 President Richard Nixon created the Environmental Protection Agency (EPA). The EPA's mission was to protect the nation's public health and its environment; clean up and prevent pollution; ensure compliance with (and enforcement of) environmental laws; assist states with environmental protection; and promote scientific research and education. Two years later Congress passed an amendment to the 1948 Water Pollution Control Act that virtually rewrote the older law. The new law, known as the Clean Water Act (CWA), included §208, "Areawide Waste Treatment Management." This section required area-wide waste treatment plans, or "208 Plans." The Safe Drinking Water Act (SDWA), passed by Congress in 1974, authorized the EPA to establish comprehensive national drinking water regulations to ensure water safety. The states were allowed to seek "primacy," that is, authority to enforce the new Acts on behalf of the federal government. Accordingly, many states, including Arizona, promulgated their own laws and regulations to implement the SDWA. The CWA and SDWA focused considerable attention and regulatory oversight on water quality.

In 1973, the Pima Association of Governments (PAG) was established as a cross-jurisdictional planning organization to coordinate responses to water quality and regional transportation issues. Then in 1974, PAG was designated the regional water quality planning agency for all of Pima County, excluding tribal lands. With this designation PAG became responsible for administering the 208 Plan in Pima County, and Pima County was designated as the Wastewater Management Agency. The 208 planning process and interest in regionalization resulted in the merger of the Tucson Water and Sewerage Department and the Pima County Wastewater Department to form an entity known as Metropolitan Utilities Management (MUM) for better basin-wide management of wastewater facilities in the metropolitan area. Tucson and Pima County continued to operate separate facilities but for the first time adopted basin-wide sewer connection fees and sewer user fees. Jurisdictional management issues led to the dissolution of MUM in 1976.[5]

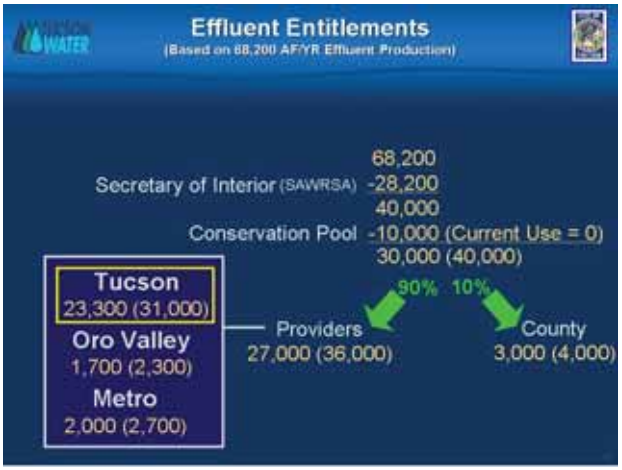

Figure 7-Effluent Entitlements

By the summer of 1977, Tucson Water was serving 110,887 connections, and was in need of significant infrastructure improvements to meet the demands of an ever-increasing population. Facing possible shortages that summer (especially caused by customers watering outside plants every day at peak-use periods), Tucson Water started a demand management program to reduce demand to levels the system could supply. The Beat the Peak program was initiated with the message, "Never water between 4 and 8 p.m. and never more than every other day." The program was very successful, and demand remained at manageable levels until infrastructure could be improved to meet the growing demands.

4 *http://ag.arizona.edu/AZWATER/arroyo/104.html*

5 *http://www.pima.gov/wwm/reports/pdf/FacPlan06_chap/Chap_2.pdf*

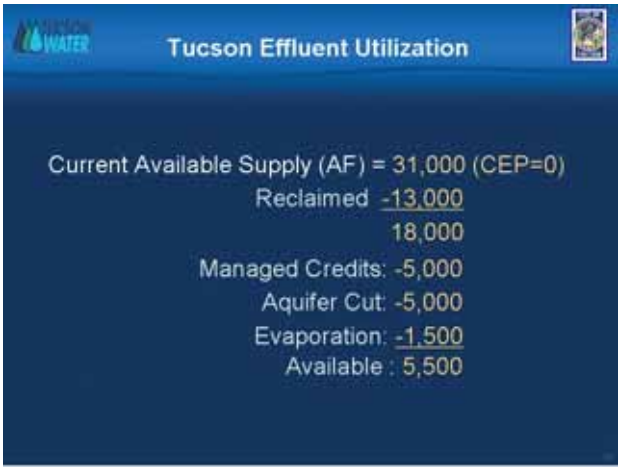

Figure 8-Effluent Utilization

Although not originally intended as a water conservation program, Beat the Peak was not only successful at managing demand, customers actually reduced their water usage. Beat the Peak has evolved over the years with the needs of the water system, and continues even today from June through August as a peak demand management water-savings program.[6]

That same year Congress passed a major revision to the Water Pollution Control Act. With the revision, the new legislation was officially called the Clean Water Act of 1977. Areawide waste management continued as a focus in §208 of the Act, which had continuing implications for Pima County.

The dissolution of MUM in 1976 did not eliminate the need for a regional approach to waste management in eastern Pima County. In an effort to comply with this need the City and County signed an intergovernmental agreement (1979 IGA) that transferred the infrastructure, operation and revenues of the sewer system at no cost to Pima County while the City retained rights to a majority of the effluent generated by the system. The 1979 IGA included language stating the City and County agreed that effluent was a major water resource that must be controlled by the City of Tucson in order to maintain management of the "total water resources of the Santa Cruz and adjacent water basins" and the City would use the effluent to offset groundwater pumping and minimize costs to ratepayers. The 1979 IGA also established the County as the "single management entity, committed to the concept of equal justice for all users of the metropolitan system without regard to jurisdictional location." The 2000 Supplemental IGA subsequently revised certain elements of the 1979 IGA recognizing changes in regional water management. In addition it makes available 10,000 acre-feet annually for future environmental restoration projects and thereby recognizes environmental needs for water supply.[7, 8]

1980s

The 1980s was the decade in which the Central Arizona Project was completed and Arizona began receiving an allotment of the river water.

By the 1970s the Arizona Congressional delegation had been working for decades to secure funding for an aqueduct to bring Colorado River water to central Arizona, including negotiations with the California delegation to accept junior priority for CAP, should shortages occur on the river. Once the California delegation agreed to stop its congressional block on funds to build the Central Arizona Project, the last sticking point was Secretary of Interior Cecil Andrus' insistence that Arizona should do a better job of managing its groundwater. In response, the Arizona Legislature passed the Groundwater Management Act (GMA) of 1980. The GMA made deep structural changes in groundwater management designed to substantially reduce groundwater overdraft. Construction of the infrastructure needed to move Colorado River water into central Arizona moved forward, and the Phoenix area began receiving CAP water in 1985.

The Southern Arizona Water Rights Settlement Act (SAWRSA) was passed by Congress in 1982 as a settlement of claims alleged in U.S. v. Tucson, a lawsuit filed in 1975 against the City of Tucson and other water users in the Upper Santa Cruz Basin. An internal dispute between the Tohono O'odham Nation and the San Xavier allottees prevented final dismissal of the original lawsuit for some time. For more than a decade, the principal parties negotiated a new settlement based on enactment of federal and state legislation and the execution of contractual agreements. The Arizona Water Settlements Act (the Act), enacted on December 10, 2004 is the Congressional component of the settlement. All conditions were met for the Act to be finalized in 2007.

Meanwhile, Tucson Water inaugurated its reclaimed water system in 1984. The system provided treated effluent for turf irrigation needs as a substitute for potable water. The reclaimed system, which has been expanded over the years to serve additional parks, golf courses, schools, and other large turf operations, currently provides about 8 percent of Tucson Water's total water deliveries.

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6 *http://www.ag.arizona.edu/AZWATER/arroyo/104.html*

7 *For more information on the 1979 IGA please visit: http://www.tucsonpimawaterstudy.com/Resources/IGAs_county/3_1_PC_COT_IGA_1979_10860.pdf*

8 *For more information about Intergovernmental Agreements between the City of Tucson and Pima County please visit: http://www.tucsonpimawaterstudy.com/Resources/CityCo_IGA.html*

In 1986 the Arizona Legislature created the Arizona Department of Environmental Quality (ADEQ). The department was responsible for enforcing federally delegated environmental functions concerning air and water quality. The agency also wrote rules for regulation and administration of state laws, including those governing use of reclaimed water.

1990 to 2000

The 1990s saw delivery of CAP water to Tucson Water and on July 1, 2008, Tucson Water began receiving delivery of and storing its full CAP allotment. Delivery to CAP customers presented unforeseen problems that prompted a re-evaluation of the system before delivery was accepted by the community.

With increasing regulation, a viable CAP allocation, and talk of the upcoming "100-year assured water supply requirement," Tucson Water contracted to have its first Long-Range Water Plan – Tucson Water Resources Plan: 1990-2100 – developed in 1989, (1989 Planning Background Report). That same year construction began on the Utility's Hayden-Udall Water Treatment Plant, which would allow the City to treat and serve Colorado River water directly to its customers. With a goal of utilizing CAP water as early as possible, the Utility's capital improvement budget focused on projects needed for treatment, transmission and storage of CAP water, often at the expense of ongoing maintenance projects such as main replacements.

In 1992 the City began delivering CAP water from the Hayden-Udall Water Treatment Plant to a portion of its service area. The delivery method is called "direct delivery," as the CAP water received disinfection at the Treatment Plant and then was delivered directly to customers as their new water supply, replacing the groundwater they had previously received. While the water produced at the Plant was high quality, by the time it reached customers' homes through aging infrastructure it was not high quality. As a result, the Utility received thousands of water quality complaints as well as claims for damage to water-using appliances such as water heaters. Although many strategies to correct the problems were investigated and tried, Utility staff was unsuccessful in fully alleviating the issues. When the CAP canal was shut down for maintenance in 1994, the Mayor and Council voted to discontinue use of CAP water until the water quality complaints could be resolved. A citizens' initiative resulted in passage of Proposition 200 called "The Water Consumer Protection Act" in 1995. Among various constraints included in the Act, it prevented delivery of CAP water unless it matched the characteristics of Avra Valley groundwater.

The Utility worked with outside experts to determine why the water quality problems were experienced with the CAP deliveries from 1992 - 1994. After extensive analyses, the primary culprit was found to be the pH balance of the CAP water, which, when coupled with other factors (such as reversing the flow direction in many mains, and the deteriorated state of older galvanized mains), acted to mechanically and chemically scour the inside of the old mains. The scouring produced residue in the water, causing a red color, foul odors, bad taste, and problems with appliances.

As a direct result of this CAP delivery program failure, the Utility established a new focus on the customer and the quality of water the customer receives. The many efforts to regain customer confidence, including the "At the Tap" program, proved successful and paved the way for the subsequent reintroduction of CAP water.

As an administrative offshoot of the Groundwater Management Act, the Assured Water Supply (AWS) program was implemented by the Arizona Department of Water Resources in 1995. The AWS program included a set of "rules" to determine water availability based on physical, legal and continuous access to water in an effort to provide some assurance that water supplies for a specific service area or development would be adequate for an extended period of time. For the Municipal Sector the AWS program dramatically changed water resource management and planning with its increased restrictions on the amount of groundwater that could be pumped and water credit / debit accounting methods. Assured Water Supply Certificates are based on the fact that sufficient water has been proven available to serve the proposed development for at least 100 years, that groundwater in excess of legally allowable volumes will be replenished, and that the applicant has the financial capabilities to safely access the proposed water supply. However, it should be noted that an AWS certificate has never been denied in the Tucson AMA and that the requirements of the groundwater management code are mechanisms for managing human water supplies, not for managing water for the environment.

Unable to directly deliver CAP water due to the constraints of the 1995 Water Consumer Protection Act, Tucson Water began exploring methods to utilize its Colorado River allocation. After much investigation of alternatives, the Utility developed a plan to recharge Colorado River water in Avra Valley, recover the recharged water blended with native groundwater through a series of recovery wells, and then pipe the blended water to the Tucson community. The plan was approved by the Mayor and Council, and the Central Avra Valley Storage and Recovery Project (CAVSARP) was designed

and constructed in the late 1990s. This project, part of the "Clearwater Program," would provide water from the CAP that would meet the standards of the Water Consumer Protection Act and allow the utility to cut back on the pumping of groundwater in the Tucson Basin.

But before Colorado River water could be reintroduced to the community, the public had to regain confidence in the Utility and in the quality of water to be received in the "blend". Tucson Water embarked on a multi-pronged effort to identify customer preferences for taste and water quality, and to demonstrate the acceptability of the water blend to the community. Acceptability of the blend was proven by delivering the blend to pilot neighborhoods and carefully monitoring the results, and by distributing many bottles of the blend to the public at community events. At the same time an aggressive main replacement program was conducted to replace 172 miles of deteriorated mains in the central system to maintain the quality of water in the system. Attempts by citizens to both repeal, and later, pass an extension of the Water Consumer Protection Act failed in the late 1990s.

2000 to the Present

When the blended water from the Clearwater program began flowing into the Tucson community in May 2001, the results were anti-climatic. Due to extensive planning, two-way communication with the public, and staff training, the introduction of this water supply into the Tucson area was operationally seamless.

In 2004, Tucson Water developed a new long range water resources plan, Water Plan: 2000—2050.[9] The plan includes a detailed discussion of water resources, system infrastructure, and future needs for meeting water demand. The plan also called for an expansion of the Clearwater Program by constructing the Southern Avra Valley Storage and Recovery Project (SAVSARP). Nearly a decade of drought in the West and related projections of shortages on the Colorado River caused Tucson Water to accelerate the schedule for SAVSARP so that the Utility could take advantage of its full allocation of CAP water. On May 12, 2008, basins at SAVSARP began receiving CAP water, and the Utility expected to take its full CAP allocation in fiscal year 2009 until budgetary constraints caused the City of Tucson to elect to remarket up to 50,000 acre-feet of its calendar year 2009 CAP water order. Under the terms of the CAP subcontract, remarketing a portion of the City of Tucson's annual CAP water order does not pose any threat to the City's CAP allocation or to the City's future ability to store CAP water in its recharge facilities. Earlier in 2008, Tucson Water completed its first update to Water Plan: 2000—2050.[10] Currently Tucson Water serves over 220,000 connections with about 40 percent of those connections located outside the City's jurisdictional boundaries. (From Tucson Water DB2 table: UT145AP, 5/20/2008) Additional background on these subjects is available in Tucson Water's long-range plan Water Plan 2000-2050.[11]

1.1.2 Overview of Tucson Water Potable Water System

Geographic Setting

The City of Tucson is located in the northern semi-arid reaches of the Sonoran Desert in Pima County, Arizona. The City is in the center of the Tucson Basin, which is a broad desert valley surrounded by the Santa Catalina, Rincon, Santa Rita, Sierrita, Tortolita, and Tucson Mountains. Average annual precipitation is 12 inches in the valley and about 25 inches in the higher elevations.

Arizona is one of seven states that are part of the Colorado River basin, a huge drainage that covers 244,000 square miles and is 1,440 miles long.[12] **Figure 9** shows the Colorado River basin and the "seven basin states" that have allocations from the river including Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming.

By being connected to the Colorado River, Tucson Water is a part of that very large basin, which includes parts of the seven states. Energy used to transport water through the Colorado River basin, and in Arizona, comes from another large system, the western electrical grid. The western grid consists of most of the states west of Kansas and Nebraska. Tucson Water depends on electric energy from TRICO Electric Cooperative, Tucson Electric Power (TEP), and federally subsidized energy used by the Central Arizona Conservation District, all of which comes from the western grid. The power costs associated with moving water through this large system are reflected in the costs to purchase the water and ultimately in water rates.

[9] *http://www.ci.tucson.az.us/water/waterplan.htm.*

[10] *http://www.ci.tucson.az.us/water/waterplan-2008.htm*

[11] *http://www.ci.tucson.az.us/water/waterplan.htm*

[12] *Utah Division of Water Resources, 2002*

About twenty-five million people in these seven states receive part or all of their water supplies from the Colorado River. The City of Tucson's Colorado River subcontract is the largest municipal subcontract in Arizona and as such, broadens Tucson Water's supply and management planning processes to include national policies and regulations on management of the Colorado River.

Figure 9-Basin States and Mexico

The Colorado River system and the western electric grid that provides much of the power for moving water about the Colorado River basin are an integral part of Tucson's urban water cycle. Although the river has its beginnings in the Rocky Mountains above Denver and gathers water from snowmelt and run-off as it meanders through the seven basin states, the water is eventually delivered to the Tucson area through the Central Arizona Project canal. The canal begins at Lake Havasu on the river, and the river water it delivers represents the majority of the renewable water resource available to the community.

Regionally, Tucson is in the Santa Cruz Watershed, whose boundary geographically corresponds with the Tucson Active Management Area (TAMA) boundary. The TAMA is one of five active management areas (AMAs) delineated by the Arizona Department of Water Resources (ADWR) as a result of the 1980 Groundwater Management Act (GMA). Arizona's Groundwater Management Act is one of the most stringent water management laws in the western U.S. The GMA includes strict water use regulation in the AMAs as they account for about 75 percent of the state's groundwater pumping and about 80 percent of the population. In 2000, the City of Tucson's population was 486,699, making it the second largest city in Arizona.

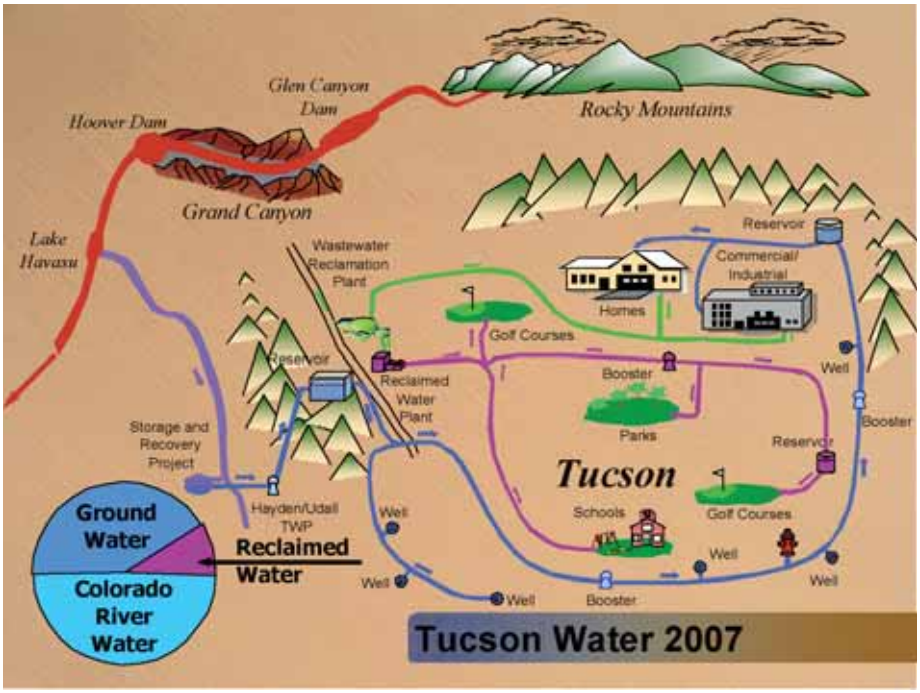

Figure 10-Colorado River System's Relationship to the Urban Water Cycle in Tucson

While the TAMA includes a large portion of Pima County, it also extends a short distance into Pinal County and excludes a large part of Pima County. Similarly, Tucson Water's service area extends beyond the city limits with service to parts of unincorporated Pima County (See **Figure 11**) as well as within the jurisdictional boundaries of the towns of Marana and Oro Valley. Likewise, Pima County's Regional Wastewater Reclamation Department provides service in areas of eastern Pima County that are not served by Tucson Water.

The obligated service area for Tucson Water includes all the present-day services, dark blue, plus the future obligations, shown in light blue on the map. The Utility's service obligations are unusual in that some of them, currently about 40%, are outside the City's jurisdictional boundaries.

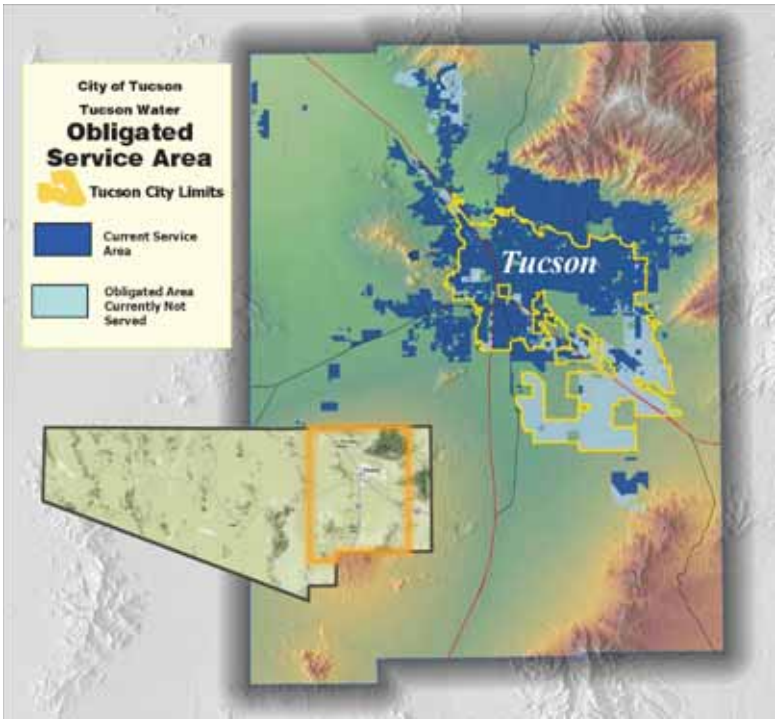

Figure 11-Geographic Setting and Tucson Water's Service Area

The service area is in a basin surrounded by mountains with bedrock consisting in large part of granite and some volcanic material. The sediments derived from this rock are often coarse and result in an aquifer that recharges well and is, in general, productive for groundwater pumping. The average depth to water in the basin today is approximately 350 feet below land surface.

The Tucson Water's service area's mountain topography means that water must be delivered to different elevations. Each one hundred feet of elevation in the system constitutes a "pressure zone," and each of these pressure zones operates, in many ways as an independent water system. Tucson Water's potable system consists of 212 production wells, 65 water storage facilities, and 100 booster pumps to move water around the system and from one pressure zone to another. Fire protection demands are a chief driver of system design (capacity) and planning.
Wastewater in the Tucson area is collected and treated by Pima County. A portion of the resulting effluent is further filtered and treated by Tucson Water and served through a separate system to reclaimed water customers. Customers of this reclaimed water system are mostly large-scale customers such as golf courses, parks, and schools.

Prior to 2001, most energy used by the Utility was expended lifting local groundwater from below ground to the land surface and then further moving it to points of demand in the system. With the change to dependence on Colorado River water, more energy is spent lifting the City's allocation from Lake Havasu, at less than 500 feet of elevation, to the City of Tucson at more than 2,000 feet. (See **Figure 13**) Water is then recharged at the Central Avra Valley Storage and Recovery Project in Avra Valley, where it must later be lifted from below ground level and then delivered to higher elevation customers throughout the service area. The energy costs to lift water from the river to Tucson are ultimately paid by ratepayers through their water rates. Actual figures for energy in FY 2007 were for electricity 119,246,290 kWh costing $9,218,439 and for natural gas 5,347,697 therms costing $5,606,682. The pumping of water accounts for about 97% of the total energy costs for Tucson Water. It is also important to note that the longer the transmission lines, the more electricity is lost.

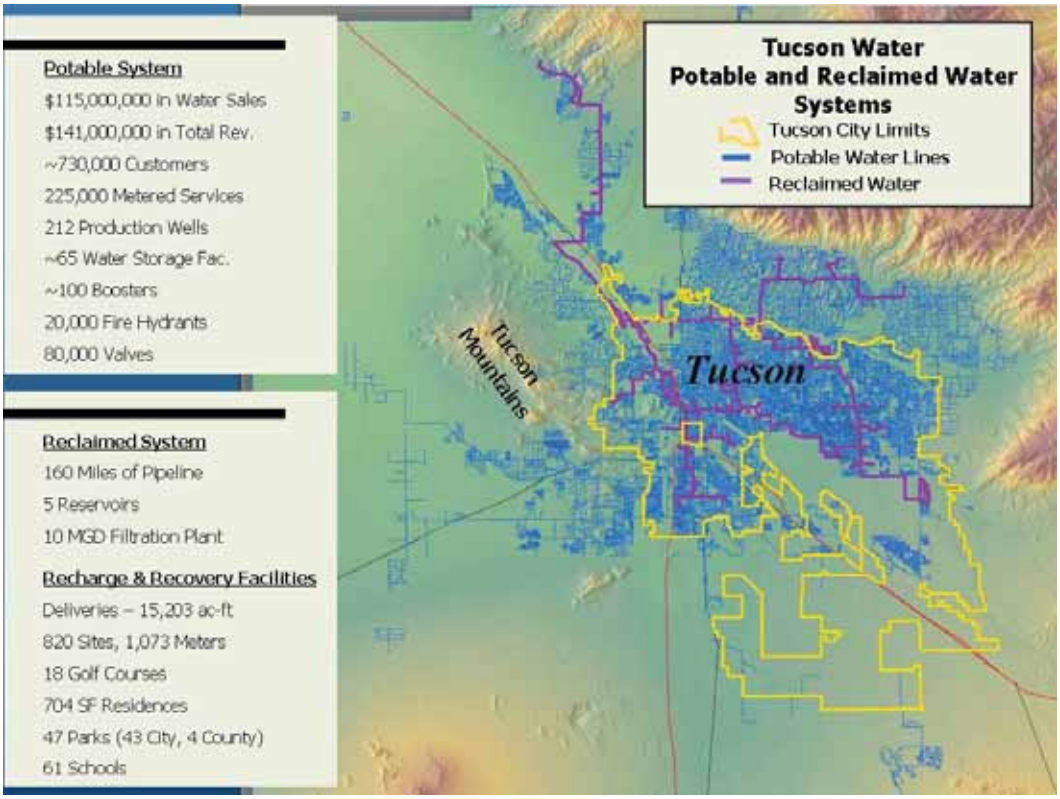

Figure 12-Tucson Water's Potable and Reclaimed Water Systems

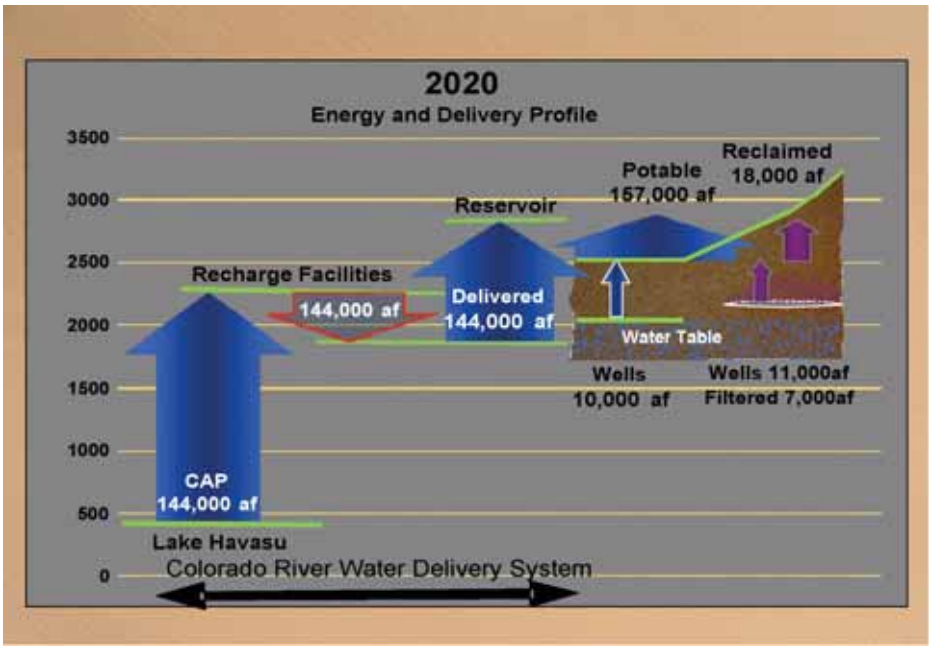

Figure 13-Energy and Delivery Profile

Inventory of Tucson Water Potable Water System

Tucson Water currently has about 4,800 miles of pipelines that convey potable water to more than 200,000 businesses and residences over a 330 square-mile service area both within and outside the City limits. The potable system includes more than 200 production wells, about 65 reservoirs (including storage tanks at isolated systems), and more than 100 boosters to lift water between pressure zones. There are more than 80,000 valves on the potable system along with about 20,000 fire hydrants.

Well Fields

Tucson Water has developed four major well fields that pump native groundwater: Central, Southside, Santa Cruz and Avra Valley. A fifth well field at the Central Avra Valley Storage and Recovery Project (CAVSARP) produces a blend of recharged Colorado River water and native groundwater. CAVSARP and the infrastructure used to transport the "blended water" to the central distribution system is part of the Utility's Clearwater Program which began operations in 2001. Another component of the Clearwater Program is the Southern Avra Valley Storage and Recovery Project (SAVSARP). Although SAVSARP construction is still underway, the facility was dedicated in May 2008 with CAP water delivered to the first recharge basins.

CAP Recharge Projects

The well fields at CAVSARP and SAVSARP were constructed for the purpose of recovering recharged CAP water for the potable distribution system. Water from the Central Arizona Project aqueduct is recharged at these facilities, recovered, and then pumped to the Hayden-Udall treatment plant where it is treated prior to distribution in the central potable system. A third recharge project located at Pima Mine Road was actually the first CAP recharge facility Tucson Water helped construct. Tucson Water and the Central Arizona Water Conservation District are joint owners of the Pima Mine Road Recharge Facility located at the southern terminus of the CAP canal.

Recharge is accomplished by filling large, shallow basins with untreated Colorado River water. The water percolates into the ground (**Figure 15**) and through the unsaturated soil layers until it reaches the saturated soils known as the aquifer. From here the water is pumped up, or recovered for subsequent treatment and delivery for potable or non-potable uses.

Water Pressure Zones

The mountain topography in the Tucson area means that water must be delivered to different elevations. Roughly each one hundred feet of elevation in the system constitutes a "pressure zone" and each of these pressure zones operates, in many ways, as an independent water system. In the central system, elevation changes by as much as 1,700 feet from the lowest to the highest delivery points. To keep the system pressure within tolerances for customer delivery, the system is partitioned into pressure zones; Tucson Water's pressure zones are shown on **Figure 14**. Pressure control valves are used at the boundaries of pressure zones to prevent pressure buildup in zones of lower elevation.

Central Distribution System and Isolated System

As noted above, the potable supply currently comes from more than 200 CAP recovery and groundwater production wells. About 99 percent of the water produced by these wells enters the large, integrated central distribution system. Generally, the water produced from these wells can be moved anywhere in the central distribution system via pipelines, boosters, and reservoirs and may travel 40 to 50 miles to reach customers. In addition to the central distribution system, there are nine small, isolated potable systems supplied by dedicated production wells and associated supply infrastructure. These isolated systems rely entirely on native groundwater and supply infrastructure located in the immediate area.

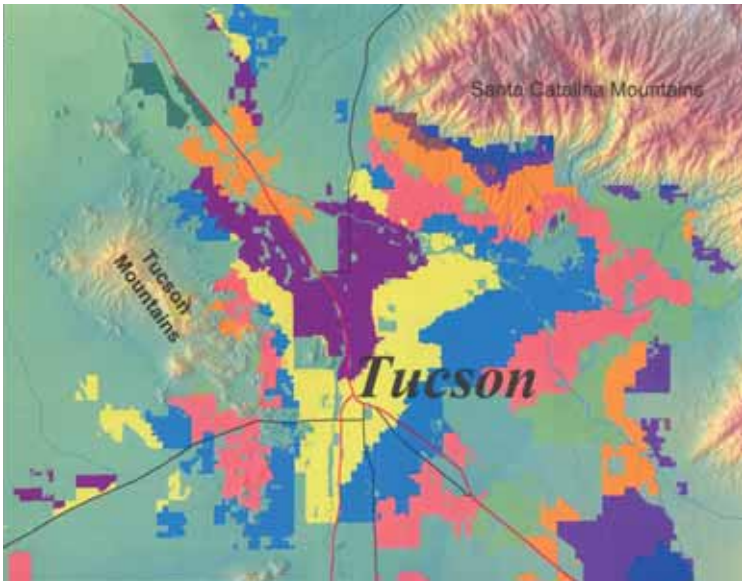

Figure 14-Water Pressure Zones

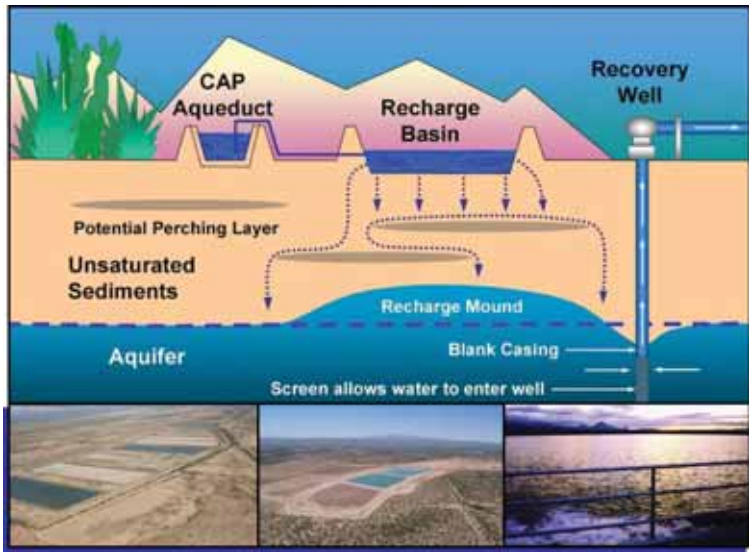

Figure 15-Schematic of recharge process above; CAVSARP left photo, SAVSARP middle photo, and a recharge basin filling with CAP water in right photo

1.1.3 Potable Water System Conditions

Utility staff is continually focused on the condition and functionality of the water distribution systems. Because the reclaimed system is, as a whole, considerably younger than the potable system, more attention is focused on routinely assessing the condition of the potable system. Maintenance personnel communicate with engineering staff about changes in condition and new, or newly discovered, system needs. Engineering staff also systematically review reservoirs and communicate specific maintenance needs to operations and maintenance staff. System conditions are regularly discussed in bi-weekly staff meetings, and reports of problems from water customers are communicated through customer service to maintenance staff.

Tucson Water is using and improving an electronic asset management system for tracking the condition, age, specifications, maintenance requirements, installation date, and other critical data for system components and equipment. (Asset management is a term that includes all physical assets owned by the Utility as well as the system components discussed here.)

Much of the water infrastructure built in the United States after World War II, including some of Tucson Water's facilities, is nearing the end of its life expectancy. The Nessie Curve (**Figure 16**) is a diagram that looks at the expected life span of water system assets and the costs to replace them. The curve is a function of the date the assets were installed in the Tucson water system, the asset's typical life span, and their replacement costs scheduled at the end of their life.

In 2001, the American Water Works Association (AWWA) published "Dawn of the Replacement Era," a study of 20 different utilities located throughout the United States, including Tucson Water. Over the next 30 years, the report states, water utilities will need to make a substantial investment in infrastructure. Replacement needs will be large, as well as needs to expand infrastructure to serve growing communities. The report also states that current and future rate-payers will bear much of these replacement costs and this assumption is no different at Tucson Water, although some of the Utility's infrastructure is funded by development impact fees primarily related to expansion of the system to meet the needs of new development. The Utility assumes ownership as well as responsibility for repair or replacement once the infrastructure is built. In Fiscal Year 2007, Tucson Water reviewed about 150 master plans for new infrastructure in its service area and installed about 3,300 new meters.

The City of Tucson creates biennial budgets to plan for expenditures to address future needs. A portion of each budget addresses future operating expenses. Operations expenses include recurring needs like maintenance, small equipment, vehicles, debt service, salaries, project operations, etc., all of which comprise the utility's annual operations and maintenance

budget. From this operations budget, the future needs of the Utility must be addressed, including infrastructure needs. A sampling of Tucson Water's current infrastructure maintenance issues include:

- Aging wells in the central well field are in need of refitting or reconstruction.
- Reservoirs are aging, and some are in need of complete refurbishing. Storage capacity in reservoirs will need to be increased over time as the Utility's customer base increases.
- Isolated systems require new wells, equipment, or piping to meet demand or to provide redundancy for system reliability.
- The current valve exercise program is not robust enough to keep up with system needs.
- The Utility's corrosion control program is not able to meet all system needs.
- A need for a more formal and fully-funded program is needed for the evaluation of transmission mains (the larger diameter pipes in the system).
- A need for a fully-functional and comprehensive method for evaluating any critical system component over 20 years of age.

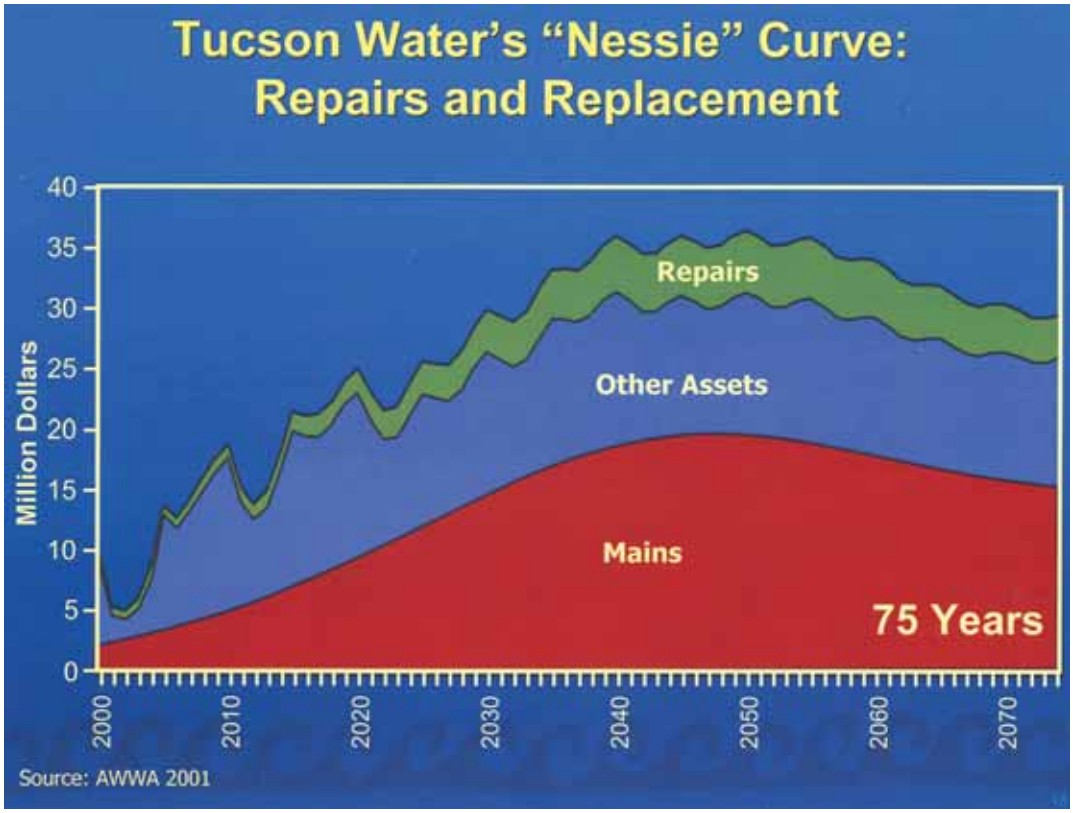

Figure 16-Nessie Curve

Potable System Maintenance

By virtue of its age, size and diversity, the potable system is in constant need of updating, repair, routine maintenance, and sometimes emergency response for pipe breaks or water supply outages. For this purpose the Utility has a staff of trained technicians, engineers, mechanics, equipment operators, and other maintenance specialists. Contractors are also called on for maintenance, when projects are large enough to warrant it, or for pipe breaks and other emergencies that would pull too many maintenance staff away from every day duties that cannot be left unattended.

More than 170 miles of aging potable system galvanized steel and cement/asbestos mains have been replaced with PVC pipe and 48 miles of cast iron mains have been relined. A proactive approach is needed to stay on top of ongoing repair and replacement projects. To save costs, main repair and replacement projects are being planned to coincide with Regional Transportation Authority Projects that require opening up streets for improvement or expansion (see bullet 5 below).

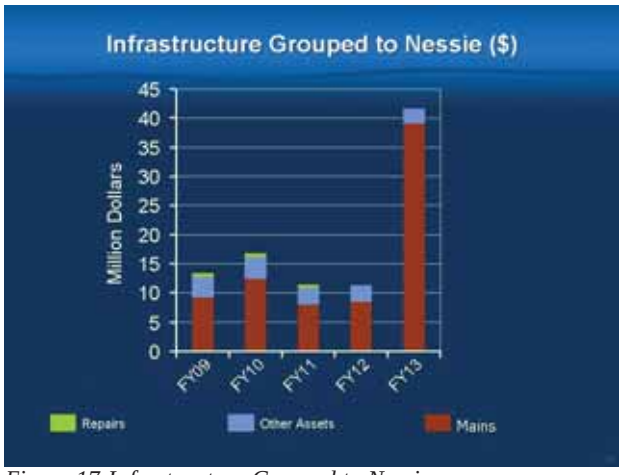

Figure 17-Infrastructure Grouped to Nessie

Employee labor, ratepayer revenues, and years of experience are factors that help keep the Utility abreast of system maintenance. However, in the fluid process of maintenance and assessment, there is always more to evaluate and more to do. At present, Tucson Water is facing recurring issues that have important implications for the future:

- A very high rate of retirement has left the Utility with fewer experienced employees for both routine work and supervision.
- Funding and employees are sometimes mismatched, leaving fewer employees for funded jobs or too little funding for projects with an adequate work force.
- A different mix of equipment is needed for the present-day system (for example: more 10-yard capacity dump trucks and fewer 6-yard trucks).
- Essential experience and knowledge is lost when projects that could be performed by Utility staff are given to contractors.
- City and County have 5-year moratoriums on demolition of new pavement, sometimes limiting the Utility's ability to replace aging pipes.
- Some critical valves on large diameter transmission mains cannot be closed by remote control, leaving the system vulnerable to a slow emergency response.

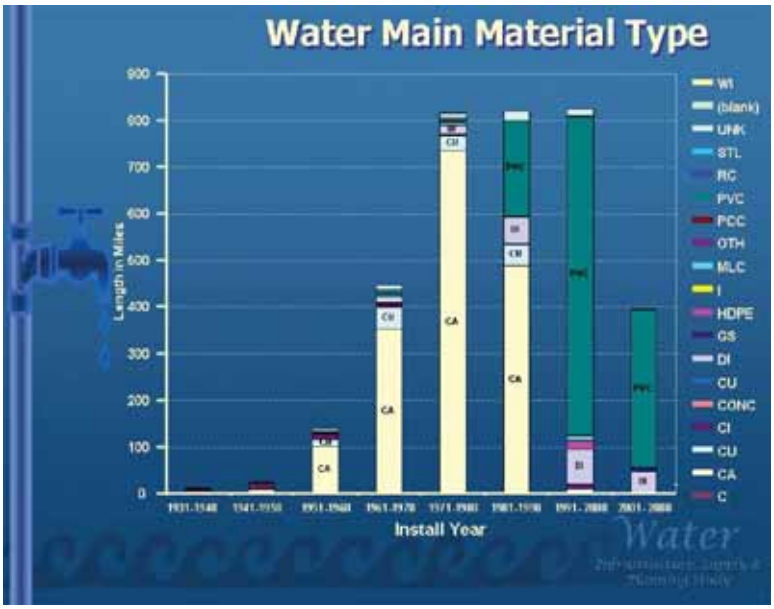

Figure 18-Water Main Material

Identifying Potable Water System Needs

Future potable water system needs are determined by applying an average per person water-use factor to population projections within Tucson Water's projected service area. Population projections are distributed spatially to locate future delivery system needs, and computer models are used to help determine the size of future pipelines or facilities and to ensure there is adequate water supply, storage, and system pressure to meet projected demands in future years. Operations, maintenance and associated power costs related to new facilities must be included in estimating budget requirements for infrastructure.

Utility staff must factor in changing energy needs of the potable and reclaimed distribution systems to ensure adequate funding is included to operate these systems once they are constructed. Meeting the operational and regulatory requirements of the water distribution systems will require increasing amounts of energy in the future and as a result will cost more. In fiscal year 2006, Tucson Water spent approximately $14 million on electric power (over 100 Gigawatt-hours, or enough to power about 11,000 homes for a year) and natural gas (nearly 6 million therms, enough to power 250,000 household water heaters for a year). Eighty-five percent of the electricity and 100 percent of the natural gas was used to power potable system facilities. A total of $16 million is included in the Utility's Fiscal Year 2009 operating budget for energy costs, or 12 percent of that total budget. As the demand for energy has increased over time, alternative energy sources have become more viable because of technological advances, changes in regulations, voluntary programs, and incentives. At the same time, opportunities to develop localized energy-production facilities are being considered to increase security and reliability.

Tucson Water recognizes the need to use sustainable energy for its facilities. Opportunities are being explored to partner with the City of Tucson's General Services Department and local electric providers to expand the use of solar power, evaluate the usefulness of hydroelectric projects, and assess the potential of other sustainable energy technologies at potable facilities.

1.1.4 Financial Planning

Every year Tucson Water develops a financial plan that matches revenues to expenditures over the next five years. The following section describes the financial plan, from the revenue perspective and then from the expenditure perspective.

Financial planning is a three-part process consisting of determining current revenues and revenue requirements, doing a cost of service analysis, and rate design. The determination of current revenues and revenue requirements identifies the department's expected income and expenses. Cost of service consists of the revenue requirements from the previous step less the non-water sales revenues, such as fees and service charges. This cost of service must be allocated to potable and

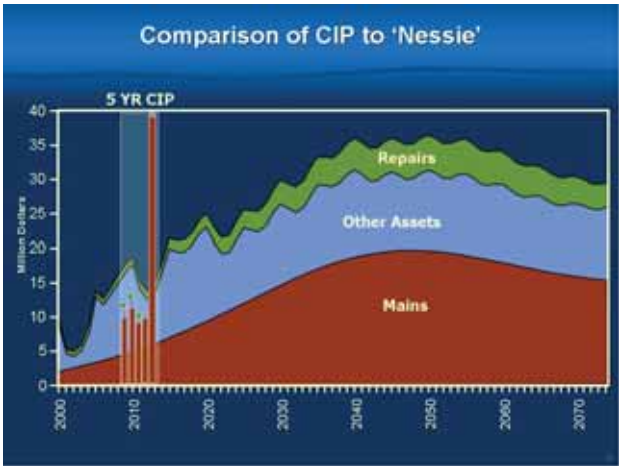

Figure 19-CIP vs Nessie

Figure 20-Revenue Types

reclaimed customers and eventually to the customer classes within those two categories. Rate design is the process of structuring rates to ensure that revenues are stable, conservation is encouraged through pricing, and customers find the rates affordable.

Unlike most city capital improvement programs (CIPs), Tucson Water's CIP is funded with a combination of revenues (from water service and other fees) and bond proceeds. The financial plan details how the capital program will be funded, how much with bond proceeds and how much with revenues, the timing of future bond sales, and the timing and amount of future water revenue bond authorization elections. The various water-revenue types are shown in **Figure 20** below.

The Utility's financial planning efforts culminate in presentation of the plan to Mayor and Council in winter or early spring. Presenting the plan at this time enables Mayor and Council to review the plan before operating and capital budgets are presented as part of the City budget process, and also provides adequate time for cost of service and rate design work so that water rate adjustments can occur at the beginning of the following fiscal year to meet the revenue needs of that year.

Setting Rates and Fees

When conducting any rate or fee study, Tucson Water follows standards and rate-making methodologies approved by the American Water Works Association (AWWA) to support any necessary adjustments. In addition, implementation of new rates or fees, or adjustments to existing rates or fees must follow the public processes required by state law, which establishes time frames for notice to the public hearings on the proposed new rates or fees, and implementation of the new rates or fees.

Water Service Fee Policies

Mayor and Council have adopted several significant policies relating to development of Tucson Water fees, including the following:

- In so far as it is possible, charges for services shall be made on a cost of service basis.
- Commodity charges shall reflect the costs of service across customer classes and seasons.
- Rates structures shall be designed to encourage water conservation.
- Water rates and charges shall be reviewed annually and changes to rates shall be implemented to avoid sudden and large changes in water rates.

All proposed water rate increases are supported by a rate study analysis that includes (1) a cost of service analysis, (2) considerations of modifications to the cost of service results, and (3) a recommended water-rate schedule reflecting rate design decisions.

Mayor and Council have also adopted the policy that costs of water system facilities necessary to serve applications for new water services are paid by the applicant. Financial vehicles to accomplish this policy of growth paying for itself used by Tucson Water include developer financed water system improvements, plan review fees, new water system construction inspection fees, a water system 'buy in' fee called the System Equity fee, a CAP Water Resource fee, as well as new water meter connection fees.

Tucson Water Revenue Bonds

On average, Tucson Water funds approximately 60-65 percent of its capital program via bond — a combination of Tucson Water revenue bonds and Arizona Water Infrastructure Finance Authority (WIFA) loans. WIFA loans are authorized similar to the City's revenue bonds.

Water Revenue Bonds
Tucson Water revenue bonds are currently rated as "Very High Grade" bond quality by all three of the major rating agencies: Aa3 by Moody's, A+ by S&P, and AA by Fitch. These high bond ratings mean the Utility can borrow funds for capital spending with good rates and favorable terms.

WIFA Loans
Federal government funding enables WIFA to provide loans at reduced interest rates. As a result, WIFA loans provide Tucson Water with capital financing at interest rates approximately 20-25 percent below rates on Tucson Water revenue bond issues. Since 1998, Tucson Water has received loans totaling $73 million with interest savings over the life of the debt of approximately $8.3 million.

Capital Improvement Plan
Every year Tucson Water develops a financial plan. The plan includes a Capital Improvement Program (CIP) that covers capital projects for the current and five future years. The need to replace and repair existing infrastructure is one of the major components of the Utility's CIP. The Citizens' Water Advisory Committee (CWAC) reviews the CIP prior to its submittal to Mayor and Council for approval.

A capital project is defined as new, replacement of, or improvements to infrastructure. Budget projections are made for 10 years, with the first five reviewed most closely and actually adopted by Mayor and Council. The CIP, a component of the budget, focuses on the cash requirements for funding operations and for the capital program for each fiscal year within the plan. The City of Tucson's fiscal year begins July 1st and ends June 30th. The program determines the overall revenue increases needed to meet the underlying operational and capital improvements in each year of the plan. Unlike most city capital-improvement programs, Tucson Water's CIP is funded with a combination of revenues (from water service and other fees) and bond proceeds.

Tucson Water's previously adopted CIP for Fiscal Years 2009-2013 totaled $353 million. The major focus of this adopted CIP was to ensure Tucson Water had the facilities to store the City's full CAP allocation in its Clearwater facilities. More than a third of the multi-year CIP ($124.3 million—see **Figure 21**) was allocated to construction and expansion of Clearwater to enable the Utility to take its full CAP allocation by the end of Fiscal Year 2009. As the potential for shortages on the Colorado River has become a matter of concern in recent years, Mayor and Council determined it was in the best interests of the utility and its customers to accelerate delivery and acceptance of the City's full CAP allocation in FY 2009. Under terms in the Secretary of the Interior's Record of Decision for Central Arizona Project Allocations, 1983, if a shortage were declared on the Colorado River, Tucson's subsequent annual deliveries of its allocation could be limited to the amount of CAP water delivered to the City in the last normal year prior to the shortage declaration. Language under the Record of Decision was modified with the passage of 2006 Arizona Water Settlement Acts such that Municipal and Industrial allocations during a shortage would be distributed by a process to be determined by the Secretary and CAP to fulfill all delivery requests to the greatest extent possible. Given that this process is not yet in place, a policy ensuring that Tucson Water takes full delivery of its CAP allocation prior to a potential shortage declaration significantly reduces the risks of diminished supplies as a result of the City of Tucson not taking its full allocation prior to the declaration of a shortage. To implement this policy, the City had to expend significant funds to purchase additional CAP water for delivery as well as make major infrastructure investments, the costs of which were reflected in Tucson Water's previously adopted CIP. Due to recent budgetary constraints however, the City of Tucson elected to remarket up to 50,000 acre-feet of its calendar year 2009 CAP water order. Under the terms of the CAP subcontract, remarketing a portion of the City of Tucson's annual CAP water order does not pose any threat to the City's CAP allocation or to the City's future ability to store CAP water in its recharge facilities.

This CIP also includes $15.6 million for the first phase of a regional reclaimed water facility that will be completed by 2014 (total reclaimed allocation is $38.2 million). The steeper rise in spending that will occur in years 2011 and 2012 reflects two needs:

- Completing renewable water projects as quickly as possible.
- Building infrastructure to move effluent from Ina Road to the reclaimed plant at Roger Road. The need to move effluent from Ina Road is a result of changes Pima County (the sewer system operator) will be making in effluent flows.

Project	Project Total Cost $	Adopted Budget 5 Year Total $	Year of Project Completion
SAVSARP Raw Delivery Pipeline	15.4	7.1	2009
SAVSARP Basins	15.1	5.9	2009
SAVSARP Collector Lines	13.7	13.6	2013
Well Equipping	Annual	10.5	Annual
SAVSARP Reservoir / Booster Station	14.3	14.3	2010
SAVSARP Recovered Water Transmission Main	61.5	61.4	2011
Avra Valley Transmission Main Augmentation	49.2	25.6	2013
Avra Valley Augmentation – Irvington Reservoir	24.5	24.5	2013
Road Improvement Main Replacement	Annual	39.9	Annual
Regional Reclaimed Facilities	20	10	2013
SCADA Upgrades OSHA Requirements	Annual	7.1	Annual
Meter Replacement / Upgrade Program	Annual	6.4	Annual

Table 1-Tucson Water - Major Capital Improvement Projects in Adopted Budget Fiscal Years 2009 to 2013

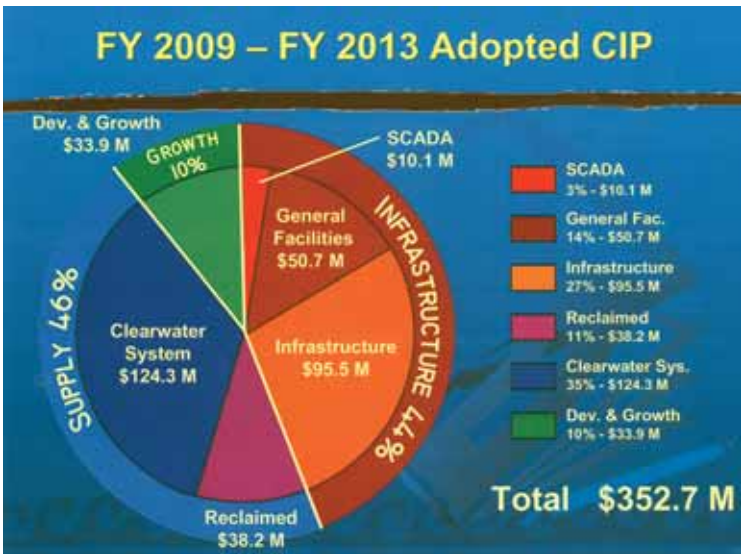

Figure 21-CIP

Operations and Maintenance Expenses

The capital budget process is tied to the operating budget for operations and maintenance needs. The Utility's Fiscal Year 2009 operating budget for potable system operations and maintenance needs is $ 131.4 million. The City's operating budget document (water section) for Fiscal Years (FY) 2009 and 2010 includes $6.2 million and $10.9 million respectively for operational costs of the SAVSARP capital project in anticipation of its completion during FY 2009. Tucson Water develops its operating (O&M) budget in two-year cycles. The majority of the Utility's operating costs are fixed, at least in the twelve months of its fiscal year. CAP water has been included as a fixed expense here, because the Utility will take all its allocation regardless of demand, and store any excess that is not needed to meet current customer demand. On average, approximately 65-70 percent of annual operating expenses will not vary as a result of the quantity of water sold. Staff related expenses, payments to the City of Tucson for administrative support, CAP capital payments, CAP water purchases, and debt service are the most significant fixed items.

The remaining 30-35 percent of operating costs are made up of expenses that vary with the quantity of water produced (power costs, chemicals, maintenance costs, etc.) or are of a discretionary nature; for example, community relations, training, and consultant costs. These elements, together with the relatively fixed costs of water make up the major elements of the Operations and Maintenance Budget. **Figure 22** shows a further breakdown of the O&M budget.

Financial Tracking/Reporting

Because Tucson Water is operated as an enterprise – or business – its funds are kept in separate enterprise funds (accounts) from other City funds. Individual funds are established for the Utility's operating, bond proceeds, and development fee funds. These funds provide the accounting information for reporting on the Utility's revenues, expenses, assets and liabilities, including fixed assets and related debt.

Tucson Water's financial reporting is done on the accrual-basis of accounting, which means revenues and expenses are recorded when they are incurred regardless of when the actual cash transactions take place. Accounting is done in conformance with all applicable Governmental Accounting Standards Board (GASB) Statements (referred to collectively as

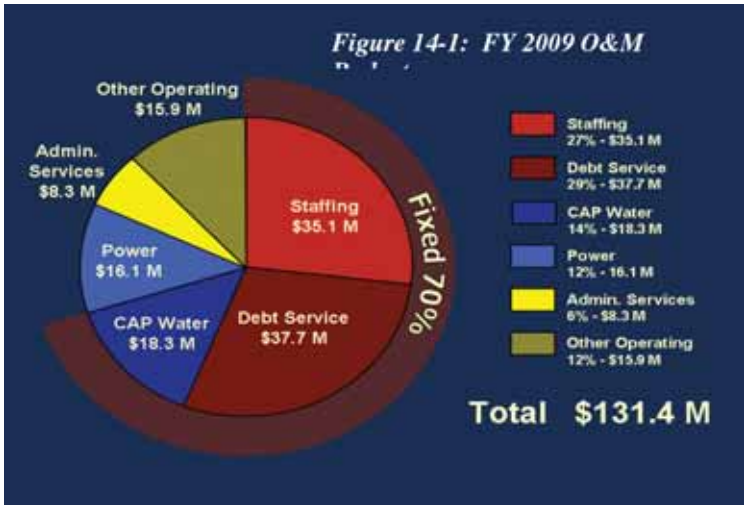

Figure 22-O&M

"generally accepted accounting principles," or GAAP). GAAP reports include certain reporting elements treated differently in budget or financial plan reports (depreciation, capitalization, principal repayment, compensated absences, etc).

Financial reporting is included in the City Comprehensive Annual Report, and the Utility is subject to audit procedures in conjunction with the annual audit of the Report. In addition, Tucson Water issues a stand-alone Annual Report that includes a separate opinion letter from the independent auditor.

Financial Planning Policies

Mayor and Council have adopted several significant water policies relating to development of the financial plan:

- All costs associated with system operations (operating, maintenance, renewal and replacement, capital and debt service) shall be funded from revenues derived from water rates and other water-related income sources.
- Combinations of revenue bonds and water revenues shall be used to finance capital improvements; repayment of the bonds shall be made only from Tucson Water revenues.
- Some portion of capital improvements shall be funded from annual revenues to comply with existing bond covenants and to facilitate new debt issues by maintaining adequate debt coverage.
- Annual average debt coverage shall be maintained at a rate of at least 1.75.
- Cash reserves of at least 5 percent of annual water sales revenues shall be maintained. Current cash reserves are about $10 million. (Note: recent Financial Plans adopted by Mayor and Council have targeted reserves at the 10 percent level).

In addition, City of Tucson revenue bond covenants, binding promises to purchasers of Tucson Water Revenue bonds, also impact the financial plan. These covenants include the following elements:

- The City will maintain the infrastructure in good repair and working order.
- The City will establish rates and fees to sufficiently cover operational expenses and meet a coverage requirement of 175 percent on senior lien bond debt. (Note: Water Infrastructure Finance Authority debt is junior lien debt.)
- All water revenues will be used for water-system purposes (operating and capital requirements, or contributing to Tucson Water cash reserves).
- The City will not provide free water or service to any department of the City or to any person or other entity.

The current CIP for Fiscal Years 2009-2013 includes $50.7 million from the 2005 bond authorization to fund capital projects. However, the remaining bonds are insufficient to fund all the projects in the current CIP and a new bond election will need to be conducted by late Fiscal Year 2009 to ensure bond funding to complete those projects.

Budget Preparation

Tucson Water conforms with all City of Tucson requirements relating to development of its operating and capital budget. However, due to the Utility's commitment to providing a financial plan to Mayor and Council in advance of their City budget reviews, the Utility targets CIP budgets to be completed by October and Operations and Maintenance (O&M) budgets to be completed by November to allow the financial plan, based on those budgets, to be presented to Mayor and Council by no later than the following spring.

Utility Billing Services

Tucson Water provides billing system services to both Pima County (wastewater) and City of Tucson's Environmental Services Department for garbage pickup. As payment for this service Tucson Water currently receives approximately $3 million annually. The sharing of billing system costs is beneficial to all three entities. The billing system and the City's financial system track billings, revenues, and cash receipts in separate funds for the three utilities.

Low-Income Bill Assistance Program

The City of Tucson and Pima County Community Action Agency (PCCAA) participate in a low-income bill assistance program. Administered by the Pima County Community Action Agency, the program provides for paying the full amount

of the utility services bill, both the current amount due and any past due amount, for customers meeting income criteria. In recent years the program has been modified to include other fees, such as residential refuse and brush and bulky fees. [13]

Customer Outreach and Water Conservation Assistance
Tucson Water administers a significant customer outreach and water conservation assistance program. The proposed Financial Plan for FY 2009 includes $2.4 million for public outreach, including $450,000 for ongoing conservation programs, $455,000 for new programs resulting from the Conservation Task Force recommendations, and $350,000 for the Zanjeros complimentary customer water-use audit program. Conservation programs immediately impact the financial plan in two ways: increasing program expenses, and if effective, reducing water system demand, and therefore revenues. By encouraging greater water-use efficiency, water conservation programs also can have a significant impact on the timing of critical decisions on water-resources and system-planning projects.

1.2 Pima County Regional Wastewater Reclamation System

Figure 23-The first wastewater treatment facility in Pima County, west of the Santa Cruz River on Ft. Lowell Road, Built in 1928 by the City of Tucson

The Pima County Regional Wastewater Reclamation Department (PCRWRD) operates and maintains the second largest wastewater reclamation system in Arizona. It has a 700-square-mile service area; 259,883 customers; 500 employees; a conveyance system of 3,400 miles of pipes, 73,000 manholes and cleanouts, and 31 lift-stations; and a treatment system of 11 wastewater reclamation facilities processing more than 70 million gallons of wastewater every day.

The composition of a local wastewater system, such as the County's Regional Wastewater Reclamation Department, can be captured by: (1) the way it has been shaped by history, geography and climate, among other factors; (2) its complexity and dependence on technology and energy; (3) the expenses involved in building, operating and maintaining it; and (4) the complex regulatory system to which it is subjected.

The pressures of growth and expansion, perennial increase in regulatory standards and requirements, and aging infrastructure pose great challenges to a wastewater system. In Pima County, these challenges are exemplified by the original Roger Road Wastewater Treatment Plant built in 1951, and the Ina Road Water Pollution Control Facility built in 1977.

This section provides an overview and inventory of the County's Regional Wastewater Reclamation Department.

1.2.1 History of the Wastewater System in Pima County

Early History (1900 – 1970)
Pima County and the City of Tucson have a long history of wastewater collection and treatment activities dating to the beginning of the 20th century. The first public sanitary sewers in Pima County were installed in Tucson in 1900, and the first wastewater treatment facility was constructed in 1928. Prior to construction of the treatment facility, wastewater was used directly for farm irrigation. In 1942, the wastewater treatment facility was enlarged, with the continued use of effluent for irrigation. For the purpose of handling wastewater matters within the county, and outside the City limits, a Sanitary District was formed in 1948.

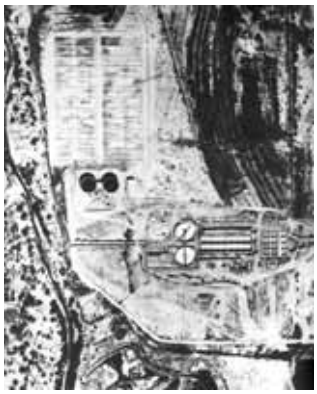

Figure 24-The Roger Road WWTP during Phase I construction, 1950
(Consolidated Aerial Survey)

In 1951, Phase 1 of the Roger Road Wastewater Treatment Plant (WWTP) began operation as a 12 million gallons per day (MGD) activated sludge treatment plant on West Sweetwater Drive. In 1961, the Pima County Sanitary District #1 installed

[13] *For more information, see Mayor and Council Resolutions 20295, 20358, and the 2002 intergovernmental agreement authorizing the program.*

the first wastewater treatment lagoon at the site of the present Ina Road Wastewater Reclamation Facility (WRF). This sanitary district was dissolved in 1968 and replaced with the Pima County Department of Sanitation, which was renamed the Pima County Wastewater Management Department in 1978, and the Pima County Regional Wastewater Reclamation Department in 2008.

The metropolitan area system has grown significantly from the initial wastewater collection system of several miles (with the treatment process being agricultural irrigation with the raw wastewater) to the present 3,400 miles of interceptors and collector sewers with 69+ MGD of advanced wastewater treatment capability. A chronology of early 20th Century activities is shown in the following table.

Year	*Operational History*
1900	Installed first sewer on Main Avenue between 17th Street and St. Mary's Road. Raw wastewater was used for irrigation.
1917	Installed 30-inch outfall paralleling Southern Pacific Railroad tracks from St. Mary's Road north to Sunshine Lane and west across Santa Cruz River. Raw wastewater was still used for irrigation.
1928	Constructed primary treatment plant at outfall terminal. Primary effluent was used for irrigation.
1942	Enlarged and improved existing primary plant. Primary effluent still used for irrigation.
1948	Formed Sanitary District, resulting from a study to handle problems within the County and outside city limits.
1951	Constructed a 12 MGD activated sludge treatment plant and put into operation at West Sweetwater Drive near highway (present site of the Roger Road WRF). Old, primary plant abandoned and flows diverted to new plant through a 42- and 48-inch outfall sewer extending from Sunshine Lane.
1955	Sold balance of effluent for irrigation use.
1960	Completed expansion of facilities to increase combined treatment capacity to 24 MGD. New plant was a high-rate trickling filter in parallel with existing plant.
1968	Completed expansion of facilities to increase combined treatment capacity to 36.9 MGD. New plant was activated sludge treatment in parallel with other two plants.

Table 2-Early 20th Century Wastewater Activities

Early History of Federal Water Quality Regulations – The 1948 Water Pollution Control Act (WPCA)[14] was authorized by the Surgeon General of the Public Health Service in cooperation with other federal, state and local entities, to prepare comprehensive programs toward eliminating or reducing the pollution of interstate waters and their tributaries and toward improving the sanitary condition of surface and underground waters. The intent of WPCA was to ensure that the development of such programs paid due regard to the (1) improvements necessary to conserve waters for public water supplies, (2) propagation of fish and aquatic life, (3) recreational purposes, and (4) agricultural and industrial uses.

The Environmental Protection Agency (EPA) was created in 1970 to (1) protect public health and the environment, (2) comply with environmental laws, (3) prevent pollution and ensure clean up where necessary, (4) enhance state environmental protection programs, (5) perform scientific research, and (6) promote environmental education.

In 1972, an amendment to the WPCA was passed by Congress. The new law, called the Clean Water Act (CWA), focused on the protection of surface water. The Clean Water Act employs a variety of regulatory and non-regulatory tools toward the (1) sharp reduction of direct pollutant discharges into waterways, (2) financing of municipal wastewater treatment facilities, and (3) management of polluted runoff.

The wastewater treatment planning aspect is primarily covered under Section 208 of CWA. Congress declared "to the extent practicable, waste treatment shall be on an area wide basis and provide control or treatment of all point and nonpoint sources of pollution, including in place or accumulated pollution sources". [15] The mandate required that a framework be established through which state, regional, and local authorities could coordinate waste treatment on an area wide basis.[16] This framework incorporates a regional planning mechanism referred to as 208 Plans.

[14] *Ch. 758; P.L. 845*

[15] *33 U.S.C. § 1281(c)*

[16] *33 U.S.C. § 1288*

Recent History (1970s to Present)
Development of the Regional Structure – In 1972, Pima Association of Governments (PAG) was established in Pima County as a 501(c)(4) nonprofit association, to create programs that focus on cross-jurisdictional planning issues, such as air quality, water quality, transportation and population growth.

In the early 1970s, to protect the public health and to conserve water resources in the water-conscious Tucson area, a comprehensive review of water, wastewater, and refuse handling was undertaken. A study was authorized by PAG that resulted in "A Regional Plan for Water, Sewage, and Solid Waste Management." The report concluded that the most economical way to meet the wastewater treatment needs of the rapidly growing Tucson Metropolitan area would be to construct a regional treatment facility at the Ina Road lagoon site to the north and west of Tucson. In addition, the PAG study recommended reusing the wastewater generated at the local and regional treatment plants whenever economically and institutionally possible.

In 1974, through an intergovernmental agreement (IGA), the City of Tucson and Pima County created the Metropolitan Utilities Management Agency to coordinate the operations of water and sewerage systems within the Tucson city limits and the unincorporated areas of Pima County (PAG, 1975). However, the City of Tucson and Pima County continued to operate their respective sewerage systems. The joint agency was dissolved in 1976.

Also in 1974, the Governor of Arizona designated PAG as the Designated Planning Agency (DPA) for Pima County. The PAG 208 Plan, completed in 1978, identified both Pima County and the City of Tucson as Designated Management Agencies (DMAs) responsible for sewerage facilities. However, the EPA preferred a single management agency, and the 1978 PAG 208 Plan recommended consolidation of sewage treatment programs in the metropolitan area.

1979 City/County Intergovernmental Agreement – A major milestone was achieved in 1979 regarding a regional approach to wastewater conveyance, treatment and reuse: the ownership and all responsibilities for the construction, operation, and maintenance of the City of Tucson's sewerage systems were transferred to Pima County through an historic IGA. The IGA with the City of Tucson gave Pima County the responsibility to construct all capital projects and maintain and operate the facilities necessary to ensure compliance with existing Federal (EPA) and State (ADEQ) wastewater requirements.

In recognition of the pending consolidation of facilities, the PAG Regional Council passed resolution 78-12-07 in December 1978 requesting that the Governor designate Pima County as the single 208 DMA for municipal wastewater treatment and sewer system operations. This designation is noted in a 1980 amendment to the 1978 PAG 208 Plan.

The 1979 IGA stipulated that the City of Tucson would own and have unilateral control over the use and disposition of effluent discharged from metropolitan treatment facilities. The IGA stated that Pima County was entitled to up to 10 percent of the effluent for use on County parks, golf courses and recreational facilities. The 2000 Supplemental IGA between Pima County and the City of Tucson further addressed control of effluent from non-metropolitan facilities and access by other water providers to effluent derived from their water supplies, and established a conservation pool of up to 10,000 acre feet (AF) per year for use of effluent in habitat conservation plans or other approved projects. Subsequently, the 2003 Wheeling Agreement addressed the wheeling of reclaimed water, to various users.

The remainder of Pima County, excluding tribal lands, is within PCRWRD's DMA area. At the request of adjacent counties and with the concurrence of any impacted local jurisdictions, Pima County may consider providing service to customers outside the Pima County limits to benefit the general health, environment and economy of those areas. As an example, PCRWRD, at the request of Pinal County, currently provides service to an area north of the Pima/Pinal County line along Route 77, because service by Pima County is the most practical alternative in this area. Pima County remained the sole DMA in the PAG planning area until March 1999, when the PAG Regional Council approved a 208 Plan Amendment designating the Town of Sahuarita as a management agency. The area designated for the new Sahuarita DMA encompassed the incorporated Town of Sahuarita limits excluding areas already served by Pima County.

Since the Sahuarita 208 Plan Amendment was approved, the Town has annexed a number of areas. In recognition of the Town's annexations, and in order to ensure that the citizens of the Town and Pima County receive the best and most affordable wastewater service, the Town's DMA area was expanded. The basis for delineating the boundaries is the agreed upon concept that areas should be served by the wastewater treatment facility (i.e., either in Sahuarita or Pima County) to which it is most practical, technically feasible and economically feasible to route the flows. Areas near Sahuarita that could be served in the future by either the Town's facility or a Pima County facility are designated as "Joint Planning Areas." These areas are not officially assigned to either DMA at this time, and the County and Town will work together to decide

who will serve these areas when the need for service arises. Service of the Joint Planning Areas by either DMA will be considered consistent with the 208 Plan, provided that the DMAs agree.

Several sewage treatment facilities are operated by entities other than the Town of Sahuarita or Pima County. These facilities are within Pima County's management area, but they were either constructed prior to implementation of the 208 Plan, or PCRWRD declined to provide service to the areas. Sewage treatment facilities currently operated or proposed to be operated by entities other than the two DMAs include:

- Adonis Mobile Home Park (at Grier Road east of I-10)
- Ajo Improvement Company
- Arizona State Prison (South Wilmot Road)
- Lukeville Border Station
- Marana High School
- Milagro Subdivision (west of Silverbell Road and north of Goret Road)
- Management Training Corporation (Marana Community Correctional Facility)
- Organ Pipe Cactus National Monument
- Saguaro Ranch Guest Ranch (Tortolita Mountain Foothills east of Heritage Highlands)
- Sahuarita High School Wetlands
- University of Arizona Science and Technology Park
- U. S. Forest Service – Palisades Ranger Station

Figure 25-Ina Road WPCF, 1979

All of these facilities are located within the Pima County DMA area. No expansion to these facilities' service areas is permitted without an approved and certified 208 Plan Amendment.

A Brief History of the Major Metropolitan Facilities

Ina Road Wastewater Reclamation Facility (WRF) – The 1970s PAG recommendations led to the construction of the 25 MGD Ina Road Water Pollution Control Facility (WPCF, now WRF) in 1975. This plant replaced Pima County's existing treatment facility, which was made up of 22 acres of evaporation ponds. The new plant was constructed as a high-purity oxygen (HPO) activated sludge system for Pima County.

The Ina Road WRF has recently been expanded by 12.5 MGD with a new process train that runs parallel to the existing HPO plant. The new train is a biological nutrient removal (BNR) system (via nitrification-denitrification) using anoxic and aerobic basins. This activated sludge treatment system was designed to further reduce nitrogen in effluent discharges to the Santa Cruz River.

Roger Road WRF – Pima County completed its first major plant retrofit at the Roger Road Wastewater Treatment Plant (WWTP, now WRF) in 1982 by modifying the high-rate trickling filter (Plant 2) to bio-towers and increasing the capacity of Plant 2 from 12 MGD to 30 MGD. At the same time, the two activated sludge treatment systems, Plants 1 and 3, were taken off line. This resulted in a reduction in the total net capacity of Roger Road WWTP from 36.9 MGD to 30 MGD. The activated sludge plants were taken off line due to operational problems.

To improve handling efficiencies of digested sludge (biosolids) generated at the Roger Road WWTP and Ina Road WPCF, a 5.3-mile sludge force main was constructed in 1987. Since its startup, all sludge thickening and disposal operations for both the Roger Road WWTP and Ina Road WPCF have been conducted at the Ina Road WPCF.

Figure 26-Construction of the BNRAS facility at the Ina Road WRF

It became apparent in the early 1990s that capacity at the Roger Road WWTP needed to be increased. Prior to any major plant improvements, the plant operators utilized Plant 3 activated sludge processes during periods of high flow to ensure that the effluent from the Roger Road WWTP was within

Figure 27-Construction at Roger Road WWTP

permit limits. The first major retrofit was accomplished in 1997 with the installation of additional primary and secondary digesters, two more primary clarifiers, and other components to the activated sludge process. The resulting capacity increase was 11 MGD from the activated sludge improvement with a net capacity of 41 MGD at the Roger Road WWTP. At present, the activated sludge portion of the Roger Road WRF facility is utilized for supplemental treatment during a majority of the year in order to produce high quality effluent for delivery to the Tucson Water reclaimed water system and discharge into the Santa Cruz River. The current regulatory discharge permit requires that the Roger Road WWTF reduce its effluent nitrogen amount by January, 2015. An assessment of the present facility found that due to the age and conglomerated process streams of the facility, the most cost-effective solution to meet the new discharge requirements is to construct a new facility and demolish the existing one. This plan is moving forward under the Regional Optimization Master Plan (ROMP), with the demolition of the existing facility to occur after the 2015 start-up of the new Water Reclamation Campus.

Figure 28-Installation of membrane at the Randolph WRF

Randolph Park WRF – As part of the 1970's PAG report recommendations, a 1.5 MGD plant was constructed by the City of Tucson at Randolph Park in 1975. The facility was designed to utilize treated effluent for irrigation of the park's two golf courses and to relieve wastewater conveyance capacity issues in the area. This facility was transferred to the County under the 1979 IGA.

Figure 29-Randolph Park WRF

In 1996, the Randolph Park WRF was taken out of service and reclaimed irrigation water for the park was provided by the City of Tucson's reclaimed water distribution system utilizing effluent from the Roger Road WWTP. In 2003, the Randolph Park WRF underwent a major upgrade and expansion to produce 3 MGD of effluent for reuse with an ADEQ reuse classification of A. The plant utilizes an activated sludge membrane bioreactor (MBR) treatment process. The effluent from the Randolph Park WRF is discharged to the Tucson Water Reclaimed Water System for beneficial reuse, such as golf course irrigation and riparian restoration.

1.2.2 Pima County Wastewater Institutional and Regulatory Framework

Pima County is authorized to own and operate the regional sewer system by Arizona Revised Statutes 11-264. Pima County RWRD has been appointed as the DMA by the governor for the majority of Pima County excluding the Town of Sahuarita. Pima County operates its programs and facilities under the umbrella of the PAG 208 Areawide Wastewater Plan. The County has adopted wastewater ordinances and entered into IGAs with the local jurisdictions in support of the 208 Plan mandate for the regionalization of wastewater services in Pima County. Pima County is governed in regard to effluent quality by the State of Arizona Pollutant Discharge Elimination System (AZPDES) for surface discharge standards and the Aquifer Protection Program (APP) for aquifer discharge standards.

As noted above, under the 1979 IGA with the City of Tucson, Pima County retained 10 percent of the effluent from its treatment facilities and 90 percent was owned by the City of Tucson. This IGA has been subsequently modified. The total effluent available from the treatment plants to the City and County is subject to the 1982 Southern Arizona Water Rights Settlement Act (SAWRSA) with the U.S. Department of Interior, which provides 28,200 acre feet to the Secretary. The City has also entered into IGAs with other water providers as described elsewhere in this document.

PCRWRD operates financially as an enterprise fund to devote all its revenues to the operation, maintenance, rehabilitation / replacement and expansion of the regional wastewater system. PCRWRD charges new users for connecting to the system and collects sewer fees from users. PCRWRD has secured funding for large projects both through selling sewer revenue bonds and obtaining public infrastructure loans. As a result, PCRWRD is required to maintain and finance its operations

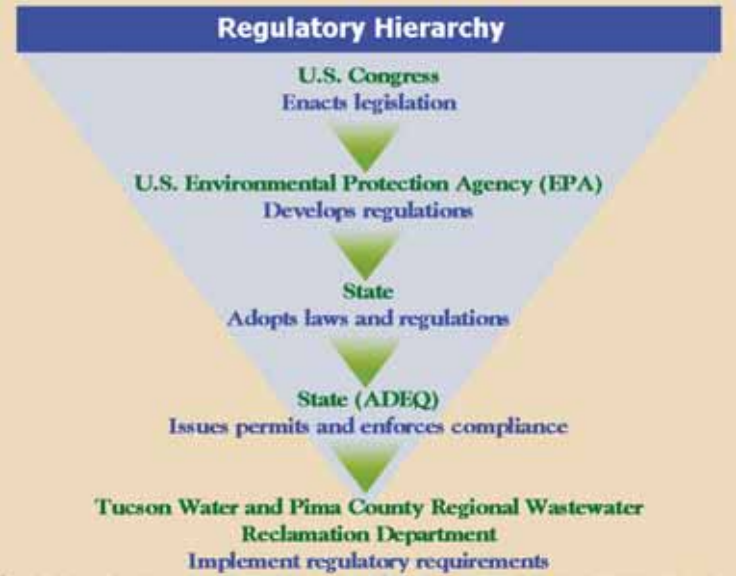

Figure 30-Regulatory Hierarchy

in compliance with covenants to the bond purchasers and the public financing authorities.

In summary, PCRWRD operates within the institutional framework established by the State enabling legislation; the PAG DMA designation and PAG 208 Plans; the IGAs with local jurisdictions; and the sewer revenue bond covenants.

Regulatory Drivers

The purpose of this section is to discuss the regulatory drivers governing PCRWRD wastewater treatment and conveyance facilities. Primary regulatory drivers include surface water, groundwater (or aquifer) and reclaimed water regulations. Other regulatory drivers include programs such as biosolids and air quality.

Surface water protection requirements are governed by regulations administered by the Arizona Department of Environmental Quality (ADEQ), many which have their genesis in Federal Clean Water Act (CWA) requirements. In contrast, groundwater and reclaimed water quality requirements are governed solely by State of Arizona state-specific regulations.

Federal Clean Water Act

Quality of the nation's surface waters is regulated under what is commonly known as the Clean Water Act (CWA). Today's CWA is the result of an evolution of water quality legislation. The first comprehensive legislation for water pollution control was the Water Pollution Control Act of 1948. The concepts in this act were continued in the Federal Water Pollution Control Act (FWPCA) of 1956 and the Water Quality Act of 1965. Under the 1965 Act, states were directed to develop water quality standards for their water bodies. Because of enforcement complexities and other problems, Congress passed the FWPCA Amendments of 1972, which established a discharge permit system.

The 1972 Act along with major amendments in 1977, 1981, and 1987 comprise the current CWA. The requirements of the surface water quality standards program are contained in Section 303(c) of the CWA. The key elements of Section 303(c) include:

- Water quality standards are provisions of laws and regulations that include the designated uses of waters protected under the CWA and the water quality criteria needed to protect those uses.
- The minimum designated uses that states are to consider when establishing water quality standards are public water supply, propagation of fish and wildlife, recreation, agricultural uses, industrial uses, and navigation.
- A state's water quality standards must protect public health and welfare, enhance the quality of water, and serve the purposes of the CWA.
- States must review their standards at least once during a 3-year period.

Within the CWA, water quality standards implementation occurs through issuance of a National Pollutant Discharge Elimination System (NPDES) permit, which provides two types of control: technology-based limits (based on the ability of dischargers in the same industrial category to treat wastewater) and water-quality-based limits (if technology-based limits are not sufficient to provide protection of a water body). In Arizona, since the State issues the discharge permits, they are called the Arizona Pollutant Discharge Elimination System (AZPDES) permits.

Figure 31-Overview of Federal and State Environmental Law

Figure 32-Standards for Protection of Surface Water

Surface Water Protection

Surface water protection requirements and activities are currently one of the primary regulatory drivers dictating treatment requirements at PCRWRD facilities. Water quality standards establish the basis for effluent quality requirements. These requirements evolve as the standards are revised approximately every three years. Often these requirements become more stringent with passing time. In addition, ADEQ regularly assesses water quality in jurisdictional waters. If the State identifies a water quality impairment in a surface water receiving treated effluent, a strong likelihood exists that treatment requirements will become more stringent. The following section discusses these regulatory drivers.

Surface Water Quality Standards – The 1972 Clean Water Act provides the current framework for surface water quality regulation in the United States and Arizona. The objective of the CWA is "to restore and maintain the chemical, physical, and biological integrity of the Nation's water" (Section 101(a)). CWA Section 303 requires states to establish water quality standards for all surface waters under CWA jurisdiction. ADEQ administers this duty for Arizona. Water quality standards are based on designated uses and water quality criteria.

Designated Uses – ADEQ has established designated uses on jurisdictional waters throughout Arizona, which must be protected when treated effluent is discharged. Most PCRWRD facilities are permitted to discharge to jurisdictional waters for specific uses that must be protected, including:

- Avra Valley WRF – Black Wash; Aquatic and Wildlife (ephemeral), Partial Body Contact.
- Green Valley WRF – Santa Cruz River (Tubac Bridge to Roger Road WRF Outfall); Aquatic and Wildlife (ephemeral), Partial Body Contact, Agricultural Livestock.
- Ina Road WRF – Santa Cruz River (Roger Road WRF Outfall to Baumgartner Road); Aquatic and Wildlife (effluent-dependent water), Partial Body Contact.
- Kino Enviornmental Restoration Project (ERP) – Santa Cruz River (Tubac Bridge to Roger Road WRF Outfall); Aquatic and Wildlife (ephemeral), Partial Body Contact, Agricultural Livestock.
- Marana WRF – Santa Cruz River (Roger Road WRF Outfall to Baumgartner Road); Aquatic and Wildlife (effluent-dependent water), Partial Body Contact.
- Mount Lemmon WRF – Unnamed Wash; Aquatic and Wildlife (ephemeral), Partial Body Contact.
- Roger Road WRF – Santa Cruz River (Roger Road WRF Outfall to Baumgartner Road); Aquatic and Wildlife (effluent-dependent water), Partial Body Contact.

Water Quality Criteria – Water quality criteria are established to protect the designated uses and include both narrative and numeric criteria. The narrative criteria generally require all waters, regardless of the designated uses, be "free from pollutants in amounts or combinations" that could have various adverse effects, such as being "toxic to humans, animals, plants, or other organisms." The numeric criteria provide protection for each of the designated uses; the numeric thresholds vary depending on the type of receptor (e.g., humans, fish or wildlife).

Arizona Pollutant Discharge Elimination System (AZPDES) Permits – Discharges to jurisdictional waters require an AZPDES permit. These permits require compliance with "technology-based" limits for certain constituents (e.g., biochemical oxygen demand and total suspended solids, and, where necessary, "water-quality-based limits"). Water-quality-based limits are required where it is determined the effluent discharge has a reasonable potential to cause an exceedance of a receiving water quality standard. Because effluent-dependent waters are created by the effluent discharge, applicable water-quality-based effluent limits are typically equivalent to the water quality criteria.

AZPDES permits are generally valid for a 5-year period, but may be amended at any time if the circumstances that formed the basis of the original permit application change (i.e., as a result of the establishment of a more stringent water quality standard).

Aquifer Protection Regulations

The State of Arizona established the Aquifer Protection Program to protect water supplies in groundwater aquifers. State regulations require that the operation of a wastewater treatment facility cannot cause an exceedance of a groundwater

quality standard. These standards are generally equivalent to the Federal maximum contaminant levels (MCLs) established to protect drinking water supplies. Compared to the surface water quality standards, the MCLs are relatively static, and only rarely change. Accordingly, more certainty exists regarding regulatory expectations for the protection of groundwater.

Aquifer Protection Permits – Aquifer Protection Permits (APP) are required for any discharge of wastewater either directly or indirectly to groundwater. Permits are issued either as individual or general permits. PCRWRD facilities generally require individual permits, which include specific treatment performance requirements for new and existing facilities, as well as a broad requirement to apply "best available demonstrated control technology."

Permit requirements for new facilities differ from requirements for existing facilities. If an existing facility is expanded or facility operations are changed, such as increased design flow, significant increase in pollutant discharge, or re-designation of point of compliance, the new facility permitting requirements are applied to the modified facility.

Capacity, Management, Operations and Maintenance (CMOM) Permits – ADEQ has established a new general permit for CMOM [17] in the APP program. This program allows for a sequenced improvement of the conveyance system over a 10-year period. Compliance actions for sewage overflows under the CMOM program weigh the scope and progress of the maintenance program and conveyance system improvements. Accordingly, this new permit will allow for planned improvements to the conveyance system to be considered by ADEQ in accommodating regulatory enforcement of small sewage overflows that do not pose a hazard to human health or the environment.

PCRWRD participates in the CMOM program. Elements of this permit include:
- 10-year timeframe for the participant to fully maintain system capacity.
- Addressing management of upstream sewage systems—even those not under County jurisdiction, which may require establishment of agreements with tribal nations.
- Comprehensive maintenance plan with mandatory maintenance requirements.
- Mandatory scheduled cleaning cycles.
- Handling of emergencies without altering the cleaning cycle.
- Reporting requirements for sewage system releases.
- Capacity sizing criteria.

Reclaimed Water Regulations

An alternative to direct surface water discharge of treated effluent is to reclaim the water for reuse. Wastewater effluent that is treated and directly land applied for beneficial use, termed "direct reuse," must meet specific requirements for reclaimed water. ADEQ has established three primary classes of reclaimed water: A, B and C. Classification is based on treatment technologies that yield a particular effluent quality. For two of these classes, A and B, additional "+" classes (A+ and B+) have been established to recognize treatment technologies that result in reclaimed water nitrogen concentrations of less than 10 milligrams per liter. A decision on the treatment technology that should be applied to effluent to produce a particular quality of reclaimed water is dependent on the end use.

Figure 33-Standards for Protection of Reuse Water

Applicable Permits

The choice of where and how to discharge treated effluent determines which permits are necessary for facility operation. Each of these permits contains treatment requirements based on the final or end use of the water. It is important to recognize that the primary regulatory driver for treatment requirements is not the permit per se, but the requirements established to protect the end use of the treated effluent. For example, if the treated effluent is discharged to jurisdictional water, the treatment requirements are dependent on the uses of that water body. Similarly, if the treated effluent is reused, then the treatment requirements depend upon the type of reuse.

[17] *R18-9-C305, 2.05 General Permit*

Permitted Facilities – PCRWRD currently operates 12 permitted wastewater treatment facilities (including the Kino Environmental Restoration Project). The permits required for each facility are dependent on how the facility disposes its effluent. Effluent is discharged or reused in the following ways:

- Surface Water: Requires an Arizona Pollutant Discharge Elimination System (AZPDES) permit.
- Groundwater: Requires an Aquifer Protection Permit (APP).
- Reuse: Requires a Reclaimed Water Permit (but may be issued as part of an APP).

In addition to these discharge-permitting options, each facility may also need to comply with stormwater discharge, air quality and biosolids regulations.

Figure 34-Pima County Regulatory Structure

Of the 12 permitted PCRWRD facilities, seven hold permits to discharge treated effluent to surface waters under the jurisdiction of the CWA ("jurisdictional waters"). Most of these facilities have aquifer protection permits and several have permits for reuse of treated wastewater. The remaining facilities do not discharge to jurisdictional waters, but have other applicable permits (e.g., aquifer protection or reuse).

It should be noted, as ADEQ places more stringent limits on AZPDES permit requirements for PCRWRD wastewater facilities, the pretreatment program (Industrial Wastewater Control or IWC) must reassess levels of pollutants that can be discharged into the conveyance system. If more stringent requirements are needed, local industries will have to upgrade pretreatment, at a potentially significant cost to those users. The IWC group itself must also expand in order to inspect and sample more frequently to provide the necessary stringent quality control on the discharge to the wastewater treatment plants.

Figure 35-Record of Regulatory Compliance at Wastewater Reclamation Facilities

Other Applicable Regulatory Permits – There are other regulatory programs that affect treatment requirements either within the treatment facility or associated with the wastewater conveyance system. These programs include, but may not be limited to, wastewater pretreatment, biosolids handling, stormwater management and air quality. Although the cumulative regulatory requirements of these programs are significant from a management standpoint, none of these programs are currently important regulatory drivers with regards to treatment facility expectations for the quality of the discharged effluent. Some of these programs require permits, but others are self-implementing and only require compliance with reporting requirements.

An example of this is the biosolids program: The biosolids program is self-implementing and imposes requirements on the generators of biosolids as well as the entities that further treat, distribute, or use the biosolids. In Arizona both the EPA and ADEQ have regulatory requirements for biosolids handling; however, ADEQ has received the complete jurisdiction of the biosolids program from EPA. Currently, compliance includes the submission of an annual report to both ADEQ and EPA.

Permit Compliance Status – Currently, PCRWRD holds 38 separate permits to operate the facilities providing wastewater treatment services to Pima County residents. PCRWRD is in compliance with existing Federal, State and local permit requirements, and is the recipient of numerous awards from the Association of Metropolitan Sewerage Agencies (AMSA) for its compliance history with surface water discharge permits. For example:

- Roger Road WRF – Gold Awards in 1989, 2005 and 2007; Silver Awards in 1987, 1990, 1991, 1992, 1995, 1998, 2000, 2001, 2004 and 2006.
- Ina Road WRF – Silver Awards in 1990, 1991, 1994, 1996, 1999, 2001, 2003, 2004, 2005 and 2007.
- Gold Awards for the Avra Valley WRF (2004, 2005, 2006, 2007), Green Valley WRF (2004, 2005, 2006 and 2007), Marana WRF (2004, 2006 and Silver in 2005 and 2007), and Randolph Park WRF (2006 and 2007).

Pima County Wastewater Future Regulatory Compliance Efforts
Mandatory regulatory compliance requires a sustained program effort. Frequent changes in regulations result in changes in the discharge requirements associated with each of PCRWRD's facility discharge permits. Maintaining compliance in all facilities all the time remains a constant challenge.

Changes in environmental regulations, associated permit renewals and facility expansion plans all contribute to an ever-changing regulatory landscape for the Department. Currently, the AZPDES permits for the two largest metropolitan treatment facilities, the Ina Road WRF and Roger Road WRF, include specific requirements for nitrification / denitrification improvements at both facilities as well as acute and chronic Whole Effluent Toxicity testing for potential in-stream toxicity to the aquatic environment. These requirements will require substantial improvements to both facilities and have triggered the $1+ billion Regional Optimization Master Plan (ROMP).

Figure 36-ROMP

1.2.3 Inventory of Pima County Regional Wastewater Reclamation Department

This section describes the Regional Wastewater Reclamation Department, first in terms of its geography and location; second in terms of its facilities; and last in terms of the treatment processes.

Pima County Wastewater Management Department owns and operates the regional wastewater conveyance and treatment systems within a 700 ± square mile sanitary sewerage system service area in eastern Pima County. PCRWRD's conveyance system includes 3,400 miles of public sanitary sewers, 73,000 manholes and cleanouts, 15 siphons, 4 flow management structures and 31 lift stations. These sewers are located in the cities of Tucson and South Tucson; the towns of Marana, Oro Valley, and Sahuarita; and unincorporated communities such as Summerhaven (Mt. Lemmon), Arivaca Junction, Avra Valley, Green Valley, Corona de Tucson, and Catalina. Approximately 400 miles are considered trunk or interceptor sewers of 18 inches internal pipe diameter and larger.

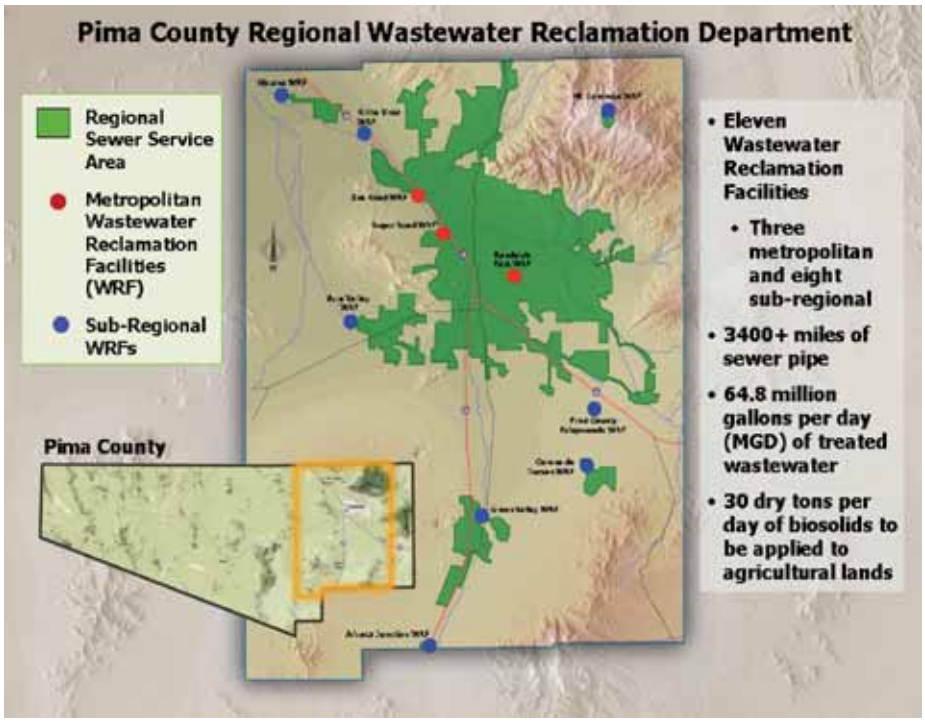

Figure 37-An Overview of the Department

Geography and Topography of Eastern Pima County
Located primarily in Eastern Pima County, the service area for PCRWRD is surrounded by mountains on most sides including the Santa Catalina, Rincon, Santa Rita, and Tortolita ranges. The generally gentle slope of the basin floor tends to increase rapidly as it nears the various mountain ranges. Surface runoff generally flows northward and westward through the basin. Elevations in this basin range from 3,720 feet in the southeast to 2,030 feet in the northwest. The Santa Cruz River is the major surface drainage channel and flows northward through Pima County to Pinal County. The two major wastewater treatment plants, Roger Road WRF and Ina Road WRF, are located on

the Santa Cruz River in low-lying areas on the western edge of the basin to take advantage of the gravity flow provided by the shape and slope of the basin.

Reclamation Facilities and Processes
252 employees operate and maintain the treatment facilities of the regional wastewater system. As shown in **Figure 37**, the treatment system comprises metropolitan and sub-regional wastewater reclamation facilities. The metropolitan systems account for most of the area, with the Ina Road WRF service area encompassing approximately 198 square miles and the Roger Road WRF service area covering approximately 275 square miles.

The Department treats over 69 million gallons of wastewater each day at the metropolitan facilities (Ina Road, Roger Road and Randolph Park WRFs) and the sub-regional facilities (Avra Valley, Arivaca, Corona de Tucson, Fairgrounds, Green Valley, Marana, Mt. Lemmon, and Rillito Vista WRFs).

This section first describes the Department's treatment facilities and then describes its treatment processes.

Reclamation Facilities
The Department is divided into the metropolitan area and sub-regional area treatment facilities.

Metropolitan Area Reclamation Facilities
There are three metropolitan Tucson wastewater reclamation facilities (WRF): Roger Road Wastewater Reclamation Facilitiy; Ina Road Water Pollution Control Facility; and the Randolph Park Wastewater Reclamation Facility.

The **Roger Road WRF** is a trickling filter and activated sludge facility located at 2600 W. Sweetwater Drive, north of Prince Road between Interstate 10 and the Santa Cruz River. It began operation in 1951 as a 12-million gallons per day (NGD) activated sludge facility and was expanded with a separate 13-MGD trickling filter plant in 1960. The Roger Road WRF is the older of the two major metropolitan WRFs with a combination of several expansions and a capacity of 41 MGD average dry weather flow (ADWF). In 2007, the average influent flow was approximately 36.4 MGD.

The **Ina Road Water Pollution Control Facility** (WPCF) is a 25-MGD high-purity, oxygen-activated sludge system and a new 12.5- MGD biological nutrient-removal activated-sludge facility capable of nitrification / de-nitrification. In 2007, the average influent flow was approximately 25.7 MGD.

Figure 38-(left to right) – The Ina Road WRF BNRAS Facility, Roger Road WRF Biotowers, Randolph Park WRF Membrane

The **Randolph Park WRF** is a 3-MGD membrane bioreactor facility capable of producing denitrified Class A re-use water for discharge into the Tucson Water Reclaimed Water System. In 2007, the average influent flow was approximately 2.6 MGD.

Sub-Regional Reclamation Facilities
The sub-regional treatment facilities are smaller capacity plants located throughout eastern Pima County. They include Avra Valley, Corona de Tucson, Pima County Fairgrounds, Green Valley, Marana, Rillito Vista, Arivaca Junction and Mount Lemmon. These facilities are described below.

Arivaca Junction Wastewater Reclamation Facility – The Arivaca Junction WRF is located in unincorporated Pima County at 3,080 feet above mean sea level (MSL), on the southern border of Pima County approximately 30 miles south of Tucson and east of Interstate 19. The facility's service area consists of 323 parcels with approximately 840 people; it serves an entirely

residential area. The facility has a permitted treatment capacity of 100,000 gallons per day (GPD) and a maximum daily flow average of 60,000 GPD. The facility treated an average daily influent flow of 59,000 GPD in 2006 (59 percent capacity).

Avra Valley Wastewater Reclamation Facility – The Avra Valley WRF is located in unincorporated Pima County at 2,382 feet above MSL, in a rapidly growing area about 20 miles southwest of Tucson in southern Avra Valley, north of Highway 86 (Ajo Way) and east of Three Points. It is located on a 138-acre parcel of land owned by Pima County. The current service area is roughly four miles to the north, south and west and three miles to the east from the center of the intersection of Hwy 86 and San Joaquin Road. The service area is about 70 percent rural residential and the other 30 percent is made up of federal and state land, urban residential, industrial, commercial, and multiple use. The facility served about 12,104 people in 2005. In 2006, the Avra Valley WRF treated an average daily influent flow of 1.08 MGD (49 percent of the available 2.2 MGD capacity).

Corona de Tucson Wastewater Reclamation Facility – The Corona de Tucson WRF is located in unincorporated Pima County at 3,090 feet above MSL, approximately 15 miles south of Tucson in an area that is currently rural but facing very rapid population growth. The plant is physically located in northwest corner of the intersection of Sahuarita Road and Houghton Road. Census 2000 showed a population of 993 for the Traffic Analysis Zones (TAZ) in which the service area is located. Almost half of the service area is entirely residential, while the other half consists of specific plans, commercial areas, offices, etc. The facility has a permitted treatment capacity of 1.3 MGD. In 2006, the average daily influent flow was 135,000 GPD (10 percent capacity).

Green Valley Wastewater Reclamation Facility – The Green Valley WRF is located in Sahuarita at 790 feet above MSL, south of Tucson along the east side of the Santa Cruz River. In 2005, the facility served about 17,469 people. The facility was built in 1964, expanded in 1972, 1981 and 2004. The 2004 expansion included the addition of a 2.0-MGD treatment train utilizing BNROD, increasing the total capacity to a 4.1-MGD ADWF. The 2.0 MGD BNROD process is the primary form of treatment and the facultative pond system is used as emergency backup. In 2006, it treated an average daily influent flow of 1.76 MGD (43 percent capacity).

The Green Valley service area covers both the east and west sides of Interstate 19 and serves primarily the community of Green Valley and parts of the Town of Sahuarita. Land use in the service area is primarily residential with some commercial. Most of the property serviced is on the west side of the Santa Cruz River. The service area has an east-west width ranging from one to four miles and covers approximately 9.5 miles north to south, starting just below Twin Buttes Road and extending past Duval Mine road.

Marana Wastewater Reclamation Facility – The Marana WRF is located in unincorporated Pima County at 1,910 feet above MSL, on agricultural and park land owned by Pima County since 1980. It is one-half mile north of Marana Road, one mile west of Luckett Road, and one-half mile east of the Santa Cruz River. The Marana WRF currently serves a relatively small area in Marana, but it is under expansion to serve the rapidly growing northwest area with 66 percent residential small and medium lots and 12 percent encompassing a specific plan. Only 0.4 percent of the service area is zoned commercial. The facility serves areas north and south of Grier Road and developments south of Moore Road and east of Sanders Road. In 2005, the facility served about 2,616 people. The Marana WRF has a permitted treatment capacity of 700,000 GPD and treated an average daily influent flow of 190,000 GPD in 2007 (27 percent capacity).

Mount Lemmon Wastewater Reclamation Facility – The Mount Lemmon WRF is located in unincorporated Pima County at 8,310 feet above MSL in the small community of Summerhaven, north of Tucson. The facility was constructed in 1982 to end wastewater discharges into the Sabino Creek Watershed. In 2003, the area was severely impacted by the “Aspen Fire”, which destroyed most of the buildings in Summerhaven. The facility’s service area is primarily residential and is limited by Pima County’s agreement with the United States Forest Service, which restricts the number of parcels of land and the discharge limit to the spray field. The facility treats an average of 5,000 GPD which amounts to approximately one third of the design capacity.

Pima County Fairgrounds Wastewater Reclamation Facility – The Pima County Fairgrounds WRF is located at 3,010 feet above MSL, south of Interstate 10 and west of Houghton Road and approximately 18 miles southeast of Tucson. The facility serves the fairgrounds only during the Pima County Fair and other events during the year. The fairgrounds have measurable flow in the month of April when the Pima County Fair is held. The facility has a permitted treatment capacity of 35,000 GPD.

Rillito Vista Wastewater Reclamation Facility – The Rillito Vista WRF is located in unincorporated Pima County at 2,130 feet above MSL on land owned by Arizona Portland Cement, northwest of Tucson, between Avra Valley Road and Tangerine

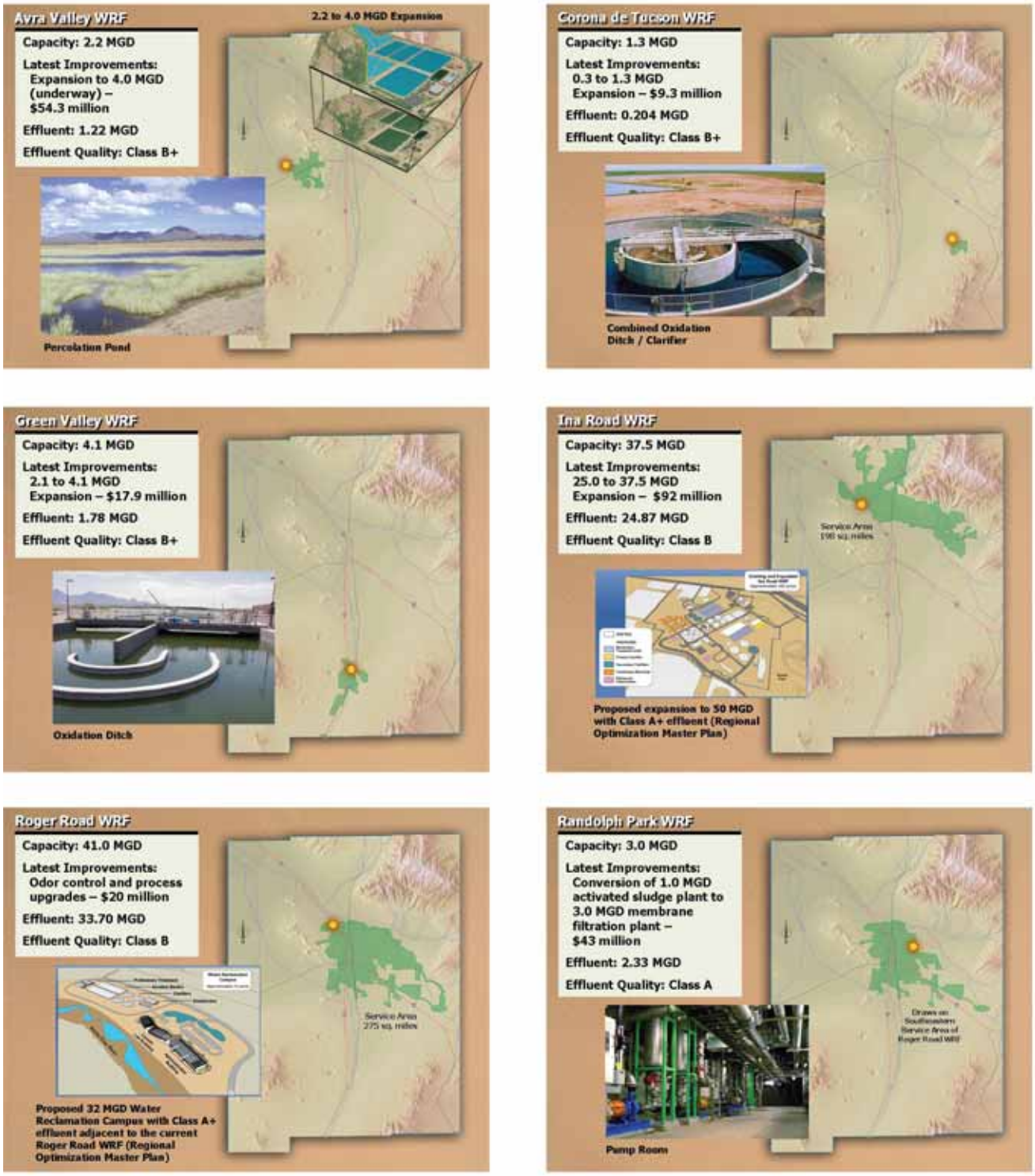

Figure 39-Significant Sub-regional Facilities

Road, and between Interstate 10 and the Santa Cruz River. The facility's service area boundary corresponds to the Rillito Vista subdivision, located northwest of Tucson. The area is entirely rural and serves 60 parcels of land. The facility has a permitted treatment capacity of 20,000 GPD and treated an average daily influent flow of 12,000 GPD in 2006 (60 percent capacity).

Treatment Processes

The Department treats over 69 million gallons of wastewater each day at the metropolitan facilities (Ina Road, Roger Road and Randolph Park WRFs) and the sub-regional facilities (Avra Valley, Arivaca, Corona de Tucson, Fairgrounds, Green Valley, Marana, Mt. Lemmon, and Rillito Vista WRFs).

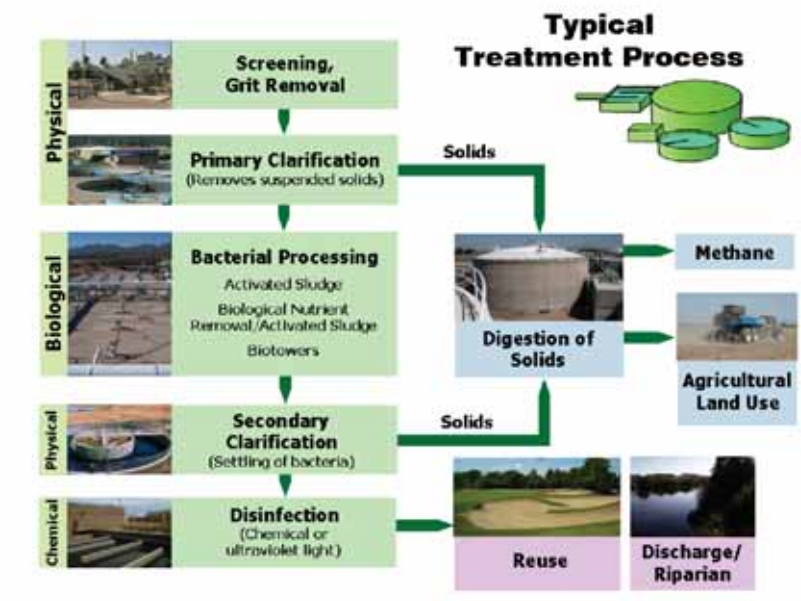

Figure 40-Treatment Process

Figure series 39 provides basic information about some of the significant sub-regional facilities (Avra Valley, Corona de Tucson and Green Valley WRFs) and the three metropolitan facilities (Ina Road, Roger Road and Randolph Park WRFs). This data includes capacity, recent significant improvements, and effluent quantity and quality.

Treatment System Processes

A typical treatment process includes a number of steps, such as screening, primary clarification, bacterial processing, biological processing, secondary clarification and disinfection. These phases or components of treatment system processes can be physical, biological or chemical, as shown in **Figure 40**.

These processes are employed at various different components of a WRF or reclamation facility, such as the headworks, clarifiers, membrane bio-reactor, and chlorine contact chambers, among others. **Figure 41** illustrates some of the physical, chemical and biological processes utilized in the WRFs and sub-regional facilities.

After treatment, the Department engages into two processes: effluent reuse and biosolid management.

Effluent Reuse

After treatment, the Department discharges effluent, which is used in the Tucson Water Reclaimed Water System, discharged into the Santa Cruz River, or disposed of by evaporation / percolation ponds and spray fields.

As the major producer of effluent in Eastern Pima County, PCRWRD has a major interest in effluent reuse. While PCRWRD is the major producer of effluent, the 1979 IGA with the City of Tucson provides that, after the allocations in the Southern Arizona Water Rights Settlement Act (SAWRSA), which entitles the U.S. Department of the Interior to the first 28, 200 acre feet (AF) of effluent, ownership of the remaining effluent is split between the City (90%) and the County (10%). The City of Tucson subsequently entered into IGAs transferring ownership of specific percentages to the Town of Oro Valley and the Metropolitan Domestic Water Improvement District (Metro Water). In calendar year 2007, this resulted in about 22,000 AF being owned by the City and about 3,000 AF being owned by

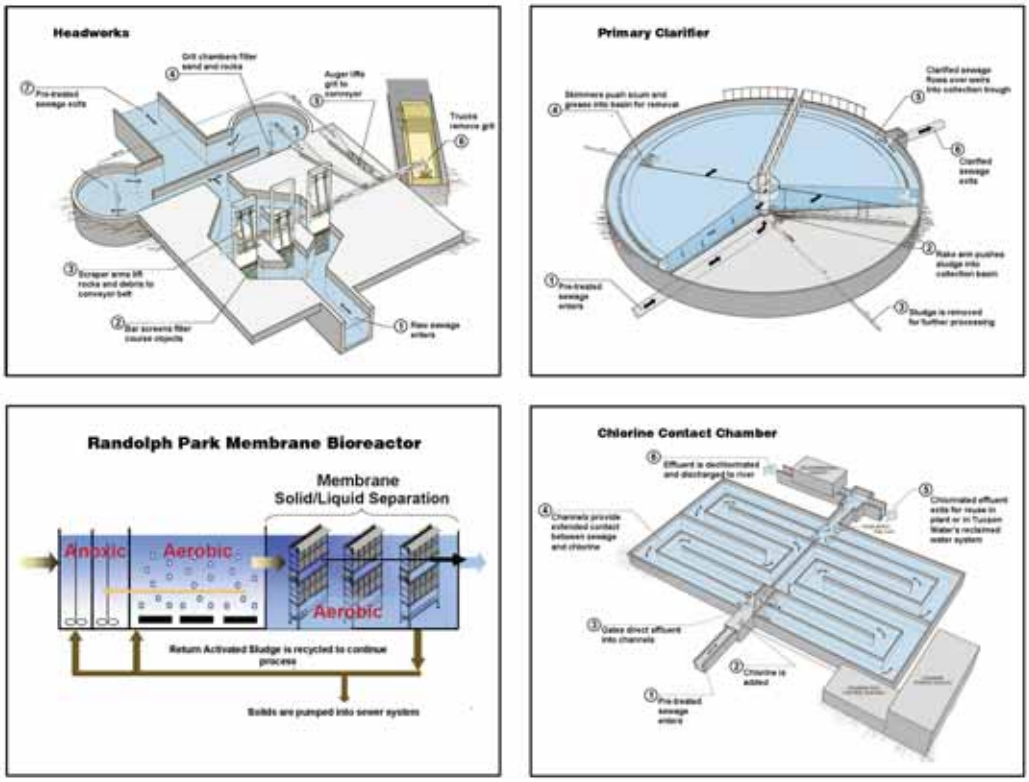

Figure 41-Treatment Processes

the County. Under a 2000 Supplemental IGA, up to 10,000 AF of effluent is available in a Conservation Effluent Pool for environmental restoration projects, and will be deducted in the future from the effluent total after the SAWRSA entitlement is deducted but before the local ownership percentages are applied.

The water-quality standards for the Pima County wastewater reclamation facilities after discharge are largely regulated by the Aquifer Protection Program (APP), the Arizona Pollutant Discharge Elimination System (AZPDES), and Reclaimed Water Standards.

The Reclaimed Water Standards comprise of five key categories, which have specific uses associated with each, such as (1) Class A: irrigation for landscaping, food crops and golf courses; (2) Class A+: the same uses as those of Class A but requires that nitrogen standards be met; (3) Class B: landscape irrigation (fenced sites), golf course irrigation (fenced), dust control and concrete mixing; (4) Class B+: the same uses as those of Class B but requires that nitrogen standards be met; and (5) Class C: irrigation and watering of non-food crops and for consumption by animals.

Biosolids

The PCRWRD biosolids management program involves anaerobic digestion at the Roger Road and Ina Road WRFs and conveyance to the centralized biosolids handling facility (Regional Biosolids Facility) at the Ina Road WRF for moisture reduction, storage, handling and disposal. The majority of the biosolids are utilized in the land application / disposal program but some biosolids are applied to mine tailings in addition to agricultural lands. The recommended future biosolids improvements include transfer of all solids treatment to the Ina Road WRF. This will include pumping undigested solids from the Roger Road WRF to the Ina Road WRF. In addition, the Facility Plan recommends evaluating conversion of anaerobic digestion facilities to produce Class A biosolids in the future.

These practices have been dramatically altered with the advent of technology and the adoption of heightened regulations, requiring increased capital investments to upgrade facilities.

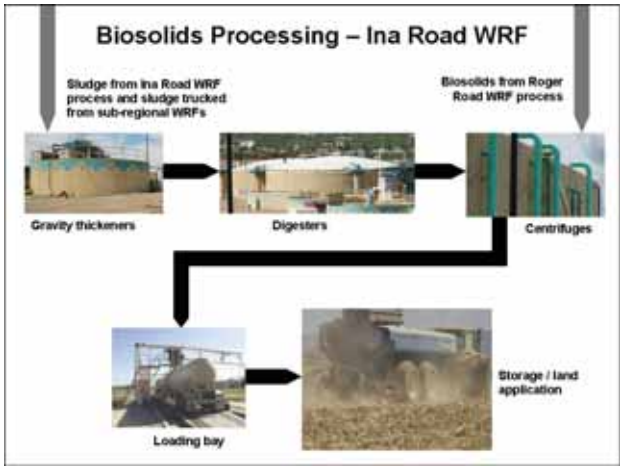

Figure 42-Biosolids Processing

Technology has improved the processing of biosolids through higher levels of de-watering. The de-watering process has been evolving over a number of years. It reduces the amount of material to be hauled and improves treatment options. This approach has allowed re-use to replace disposal to a large extent. The recent innovation of high-solids centrifuges has enhanced technology to achieve much higher extents of de-watering.

Regulations such as the U.S. EPA's 503 biosolids rule (40 CFR part 503) have required changes in the way biosolids are processed and disposed / re-used. Other factors include the potential cost and environmental advantages of beneficial re-use and the increasingly stringent landfill restrictions.

Pima County facilities generated 10,300 tons of biosolids in 2007, which can be equated to 5,850 truck-loads. The biosolids are applied to non-food crops such as cotton. **Figure 42** illustrates the generation and use of biosolids.

Treatment System Programs

The programs of the treatment system are (1) Operations, (2) Maintenance, (3) Corrosion Control, (4) Odor Control, (5) Support, (6) Asset Management, and (7) Treatment System Rehabilitation.

Operations – There are 73 operators with Grade 1 through Grade 3 state certifications who work in the metropolitan and sub-regional facilities. The Roger Road and Ina Road WRFs each have 24 operators.

All facilities in the PCRWRD employ Supervisory Control and Data Acquisition (SCADA) remote telemetry. A baseline SCADA system consists of (1) a Human-Machine interface – the apparatus which presents process data to a human operator, and through which the human operator monitors and controls the process; (2) a supervisory (computer) system, gathering (acquiring) data on the process and sending commands (control) to the process; (3) Remote Terminal Units (RTUs) connecting to sensors in the process, converting sensor signals to digital data, and sending digital data to the

supervisory system; and (4) Communication infrastructure connecting the supervisory system to the RTUs.

New and improved SCADA systems are being installed at Pima County facilities. Currently, there are 20 SCADA employees supporting PCRWRD.

Maintenance Program – The maintenance program employs 46 employees, of which 18 are employed at the Ina Road WRF, 19 at the Roger Road WRF and nine at the various sub-regional facilities. These employees have expertise in electrical, mechanical and specialty craft areas. The PCRWRD desires multiple, journeyman skill sets composed of pipe fitters, pump repair specialists, etc.

Corrosion Control Program – This program focuses on preventive measures. The painters who are employed are industrial coating specialists. The preventive maintenance efforts includes cleaning and painting to prevent corrosion. The capture of corrosive gases through odor control is part of the corrosion control efforts.

Odor Control Program – A system-wide Odor Control Plan was developed to address short-term, interim and long-term solutions to odor problems. Approximately $7 million were spent on short-term projects during FY 2007/08; these projects have been completed with substantial reduction in odors. Long-term solutions have been integrated into the Regional Optimization Master Plan (ROMP) with a budget of $39 million.

Figure 43-Odor Control Program

A department-wide, inter-disciplinary management team, in consultation with the Director's office, meets regularly to manage the program and recommend modifications where and when needed. The odor control team tests ambient air at the perimeter of the WRF and measures hydrogen sulfide levels in neighborhoods where odor complaints originate. For odor generation from non-conveyance system sources, i.e. private

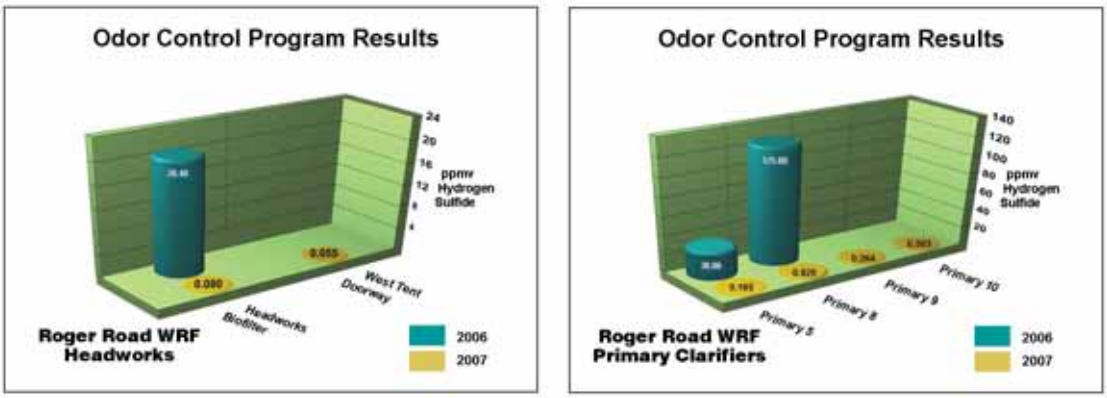

Figure 44-Odor Control Results at the Roger Road WRF Headworks (l) and Primary Clarifiers (r)

sources, RWRD works to the best extent possible to offer odor-control advice and odor-reduction techniques and practices.

Figure 43 shows a few of the odor control projects at the Roger Road WRF. The effort has been toward reducing hydrogen sulfide at the headworks, bio-filters and clarifiers. **Figure 44** shows the remarkable success between 2006 and 2007 in the reduction of hydrogen sulfide at the headworks and primary clarifiers.

In early-2008, RWRD completed an odor control project on the south biotower of the Roger Road WRF, and put it into operation. The project for the north biotower was completed in July 2008.

Support Programs – Support programs promoted by PCRWRD include (1) Industrial Wastewater Control, (2) a State-certified laboratory, (3) an in-house training center, (4) the Compliance and Regulatory Affairs Office, and (5) the Community Relations Office.

Asset Management Program – The Computerized Maintenance Management System (CMMS) – the hallmark of asset

management programs – went into effect on July 1, 2007. The program focuses on (1) better tracking of costs for asset repairs and operating costs for plants, and (2) increased productivity from tracking and reduction of work-order backlogs.

It is anticipated that after two years of using this program, there will be enough data to run analyses to identify components and systems with high maintenance requests. This will enable the Department to concentrate efforts and funds on trouble spots, thereby improving the performance of the treatment facilities.

Treatment System Rehabilitation Programs – There have been several treatment system rehabilitation projects, since FY 2006, pertaining to the Ina Road and Roger Road WRFs.
A total of $12.8 million have been spent on rehabilitation projects for the Roger Road WRF. The breakdown of expenses are (1) $6.1 million on nine odor control projects, (2) $2.5 million on six solids processing projects, (3) $1.1 million on two aeration projects, and (4) $3.1 million on 18 general rehabilitation projects.

The rehabilitation projects at the Ina Road WRF and sub-regional facilities, for a total amount of $7.8 million awarded so far, include (1) $2.1 million on six Ina safety projects, (2) $4.1 million on 28 general rehabilitation projects at the Ina Road WRF, and (3) $1.6 on seven sub-regional facilities projects.

Regional Conveyance System Facilities
The extensive conveyance system facilitates wastewater flow of over 70 MGD, from a variety of industrial, commercial and residential uses. The conveyance system can be divided into metropolitan and sub-regional conveyance systems.

Metropolitan Conveyance System
The largest element of the regional conveyance system is the metropolitan conveyance system, which conveys flow primarily by gravity to PCRWRD's two major wastewater treatment plants, the 41 MGD Roger Road WRF and the 37.5 MGD Ina Road WRF. The metropolitan conveyance system presently transports approximately 62 MGD Average Dry Weather Flow (ADWF) to these facilities.

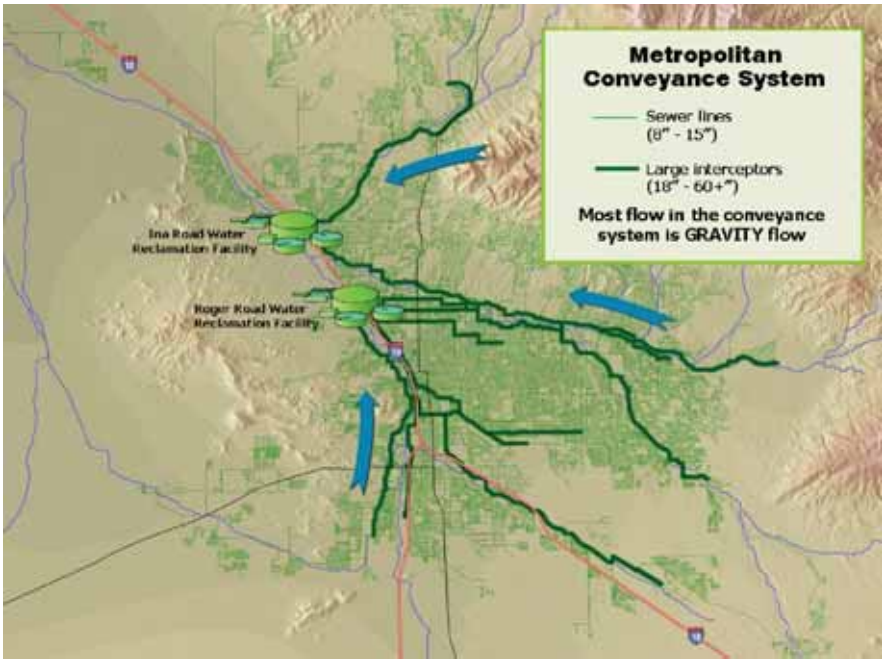

Figure 45-Metropolitan Conveyance System

The metropolitan conveyance system is primarily based on gravity flow. It includes approximately 3,000 miles of 8- to 15-inch pipes, while the remaining 400 miles are trunk and interceptor lines ranging in diameter from 18 inches to over 60 inches, as shown in **Figure 45**. The interceptor system is composed of 10 primary interceptor and trunk lines.

The sewer lines in the metropolitan conveyance system date from 1900 to the present and were constructed using various pipe materials including reinforced concrete (lined and unlined, centrifugally-spun, vertically cast), asbestos cement, ductile iron pipe (DIP), salt glazed clay pipe, vitrified clay pipe (VCP), plastic truss pipe, and polyvinyl chloride pipe (PVC). Conveyance system materials are depicted in **Figure 46** and the conveyance system age distribution is depicted in **Figure 47**. Of particular note is that lined and unlined reinforced concrete pipe (RCP) represents only 2 percent of the conveyance system and clay pipe represents 48 percent of the system. The sewer system is a gravity system, as opposed to a pressure system, and is designed to be water tight. Leakage is not a problem with the sewer system.

Sub-Regional Conveyance System
The major sub-regional conveyance systems exist around the Marana, Green Valley and Avra Valley WRFs and convey wastewater flows from their respective service areas to those facilities.

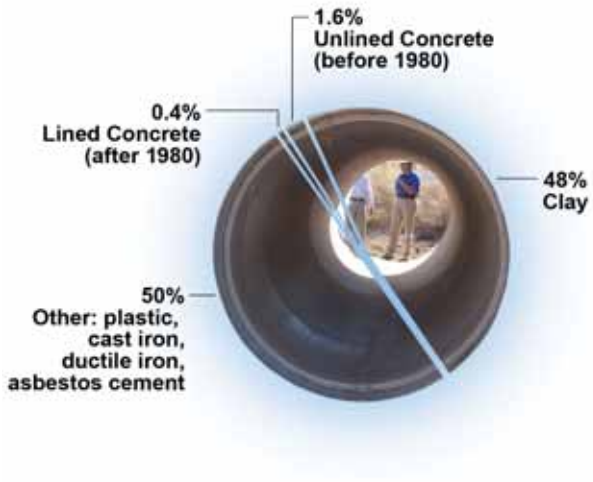

Figure 46-Conveyance System Materials

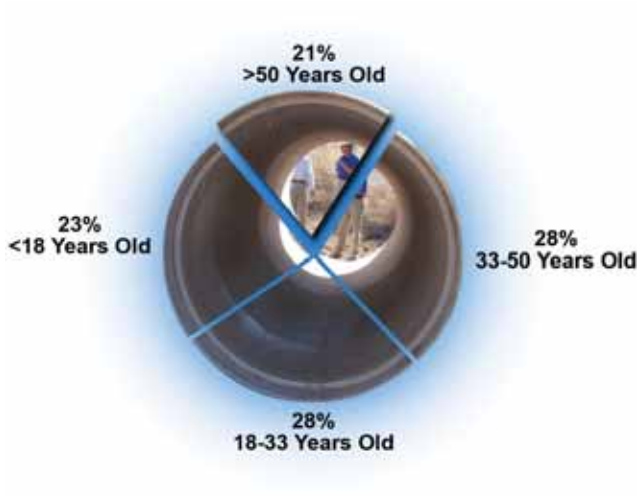

Figure 47-Conveyance System Age

Regional Conveyance System Processes

The conveyance system is sustained by 108 of the department's employees, who work on (1) unscheduled, preventive and scheduled maintenance, (2) operations, (3) odor control, and (4) roach control.

The wastewater reclamation system has an extensive flow meter system of permanent and temporary meters, as shown in **Figure 48**. Flow-metering is a critical component of a wastewater system, since the system reacts to whatever is placed in the sewers and metering is the key tool to monitor operation. Flow meters can be simple devices or highly complicated ones with digital Doppler radar velocity sensing technology and remote data collection devices.

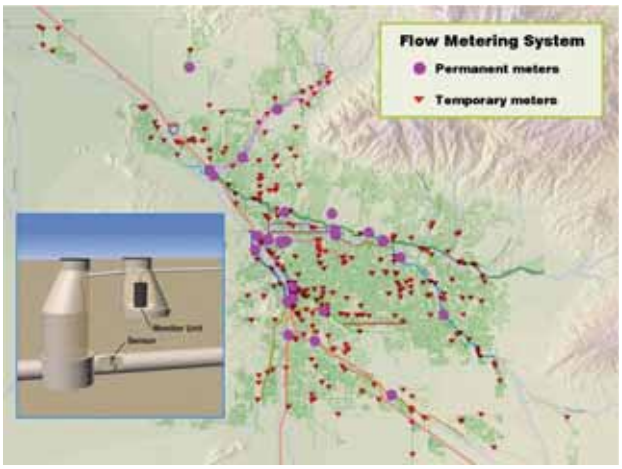

Figure 48-Flow Metering System

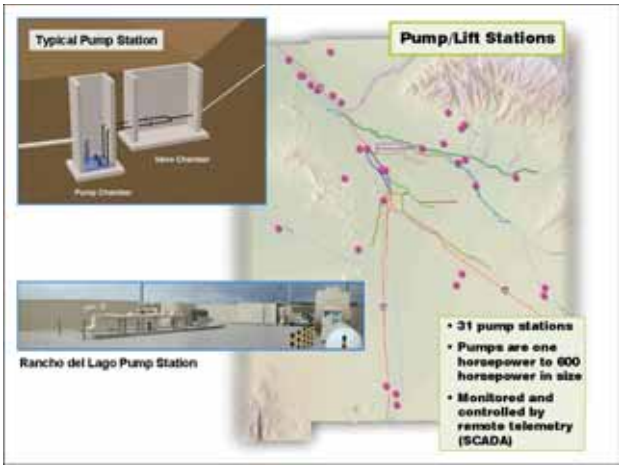

Figure 49-Pump/Lift Stations

The regional wastewater reclamation system includes 31 pumps and lift-stations, ranging from one to over 600 horsepower, and monitored and controlled by telemetry (Supervisory Control and Data Acquisition – SCADA). **Figure 49** shows the location of these pumps and lift-stations.

The typical pump station operates on a float-type system, where wastewater flows into the wet well by gravity then rises until the maximum operating level is reached. At this high level, a float switch is actuated to turn on a pump, and with the pump running, the water level begins to fall until the water level reaches the low level. At the low level, another float switch is actuated to turn off the pump. The cycle is repeated several times during the day.

The conveyance system is sustained by a number of programs, including the (1) preventive maintenance program, (2) scheduled maintenance program, (3) emergency response plan, (4) fats, oils and grease program, (5) roach control program, (6) odor control program, (7) asset management program, and (8) conveyance condition assessment.

Figure 50-Rodder Truck

The Preventive Maintenance Program includes the "area rodding program," which is applied to all sewer lines that are 15 inches in diameter or smaller. The process utilizes industrial size "plumbers' snakes," operated from "rodder trucks" to cut tree roots, break up debris and clear blockages in wastewater lines. This program is conducted to cover the more than 73,000 reaches in the wastewater system, and lines are cleaned out at least once every five years.

The Scheduled Maintenance Program is carried out utilizing the six combination vacuum / pressure trucks in the RWRD fleet of vehicles. The program centers on scheduled responses to problem areas that are identified by work crews often through the use of remote-control inspection devices in sewer lines. This program focuses on the removal of roots, grease, debris, etc. that potentially cause sewer overflows. The program's maintenance cycle varies between three and 48 months.

The purpose of the Emergency Response Plan is to contain, remediate and mitigate conditions of any real or potential emergency. The Sanitary Sewer Overflow (SSO) Response Program is the key component of the emergency response plan, ensuring rapid responses to overflows. Overflows are invariably caused by blockages and / or breakages of sewer pipes, primarily resulting from root-growth, grease and vandalism. All sanitary sewer overflows are reported as Clean Water Act exceedances, even one drop of wastewater. **Figure 51** shows the Department's success in reducing SSOs.

The Fats, Oils and Grease Program educates the general public about the consequences of dumping grease and oil down the drain. The educational program uses several brochures, including, "Are You Committing Sewercide" and "Fat Free Sewers," which teach how to properly dispose of fats, oils and grease. The County organizes recycling events around holidays, such as the annual Thanksgiving Grecycle Event.

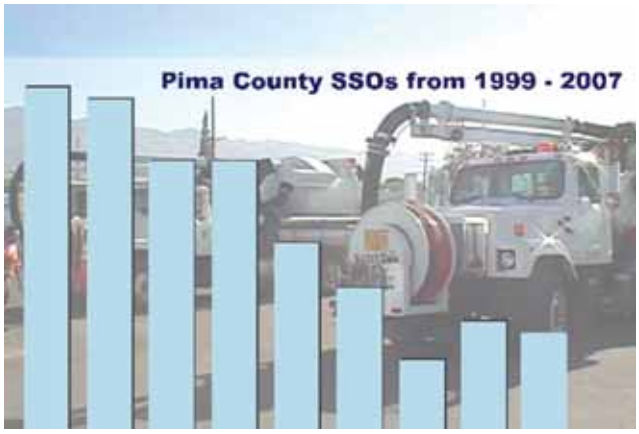

Figure 51-Sanitary Sewer Overflow Response System

An improved Roach Control Program started in November 2005; follow-up tests on manholes have demonstrated the program's success. This program coats manhole interiors with a latex-based insecticide, operating on a continuous cycle. The program targets the Americana Peripleneta roach, the only kind that can survive in sewer lines. The Americana Peripleneta roach is also often confused with other "above-ground" roaches by the general public. For roach infestations in and around households, the RWRD recommends professional services or do-it-yourself products.

The purpose of the Odor Control Program is to treat odors at problem areas identified throughout the conveyance system, at pump stations and in gravity sewer lines. The program currently operates 12 chemical dosing units and three vapor phase units in the system.

Figure 52-Spraying a Manhole for Roaches

The Computerized Maintenance Management System (CMMS) is the key component of the RWRD Asset Management Program. Its main purposes are to manage all conveyance system assets and maintenance activities, and to maintain 1.5 million historical records.

Conveyance condition assessment includes the Sanitary Sewer Inventory and Inspection Program (SSIIP), Closed-circuit Television Inspection (CCTV), and assessment using the Pipeline Assessment Condition Program (PACP).

The SSIIP has compiled the global positioning system (GPS) location

and condition data for more than 60,000 manholes, and efforts continue toward the collection of data for new and outlying manholes.

As part of CCTV inspection, all large-diameter pipes have been inspected and are on scheduled inspection intervals. During fiscal year 2007, roughly 189 miles of sewer pipes were inspected utilizing CCTV.

Pima County requires PACP-certified operators to work on this program. International standards for defect codes are utilized, and grading and evaluation is carried out on a scale of 1 (very good) to 5 (needs immediate attention). **Figure 54** illustrates examples of defects in sewer pipes, which are assessed by CCTV and PACP.

Figure 53-Chemical Dosing Unit

Figure 54-Manhole Defects and Report

During FY 2006/07 and 2007/08, Pima County spent approximately $6.4 million for rehabilitation of sewer pipes and manholes.

ISO and OHSAS Certification

The Pima County Regional Wastewater Reclamation Department's Conveyance Division is the first U.S. public sector entity to receive three simultaneous International Organization of Standardization (ISO) and Occupational Health and Safety Assessment Series (OHSAS) certifications in safety, environmental and quality excellence.

In April 2007, the Department set out to achieve a formal certification for the quality and structure of its procedure and process in the Conveyance Division. The Department determined to pursue the ISO 9001 (Quality), ISO 14001 (Environmental), and OHSAS 18001 (Health & Safety) standards and certification.

The process of obtaining ISO/OHSAS certification involved a complete review of existing conveyance system activities and their impact on the environment, employees and public safety and quality, and the development of standardized written processes and procedures to deliver services in accordance with these standards. In November 2007, the ISO and OHSA auditors completed their audits.

On February 5, 2008, the Conveyance Division received formal notification from TÜV SÜD America, Inc. of the certification in all three categories—ISO 9001:2000, ISO 14001:2004 and OHSAS 18001:1999. The Department is the first wastewater utility in North America to achieve all three certifications at the same time.

Figure 55-ISO and OHSAS Certification

1.2.4 New Wastewater Infrastructure

This section presents the Department's infrastructure investment outlook, looking at (A) factors that drive the need for new investments, (B) the Regional Optimization Master Plan, and (C) the Department's Core 5-Year Capital Improvement Plan.

Drivers of Infrastructure Investments

The Pima County Regional Wastewater Reclamation Department (PCRWRD) looks at a 20- to 30-year planning horizon in its Capital Improvement Program (CIP), focusing on four key drivers as shown in **Figure 56**. PCRWRD assembles a system-wide strategic plan periodically, as required by significant developments in these "key driver" areas. The latest major plan (the Metropolitan Area Facility Plan update) was completed in 2006, following earlier versions in 1978 and 1990. The current plan outlines not only a look ahead to 2030, but also the Five-Year CIP. With this plan, PCRWRD identifies when it will need bond funding to complete capital projects. This plan estimated $1.4 billion through 2030.

Regulatory Drivers

PCRWRD tries to look ahead at the regulations coming from the U.S. Environmental Protection Agency and the Arizona Department of Environmental Quality and gears toward building plants suitable to meet water quality standards. The regulatory environment moved PCRWRD into a separate master planning effort called the Regional Optimization Master Plan (ROMP). This plan was directed at additional effluent nutrient reduction for the Ina and Roger Facilities, but it was also an opportunity to focus on capacity planning and to revisit other major system components, including biosolids management, sub-regional facilities, conveyance systems, and general treatment processes. The ROMP updates the 2006 Facility Plan and provides standardization and framework – a roadmap – for PCRWRD to expand capacities.

Figure 56-Infrastructure Investment Drivers

Asset Management

PCRWRD has to look ahead to keep the useful life of its infrastructure in place by either extending it or replacing it. For the conveyance system, the Department visually inspects and monitors every foot of pipe, analyzing whether it is in good enough condition to last another five to ten years, or whether it needs immediate repair. (See **Figure 58** for pipe ages.)

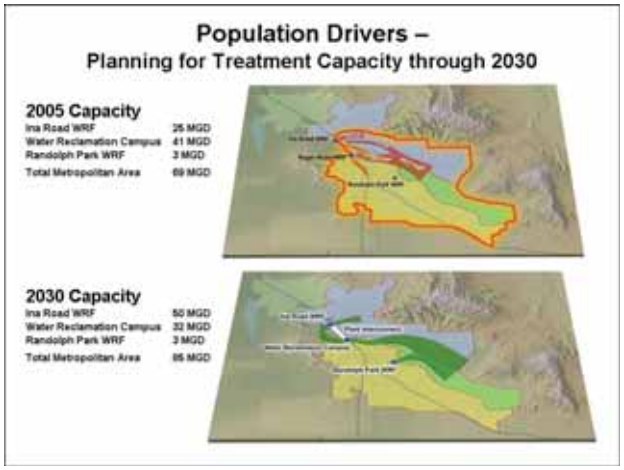

Figure 57-Population Drivers: Capacity

Although sewer-line infrastructure typically has a 50-year useful life, PCRWRD has 100-year-old sewers that are still operating perfectly. The clay pipe that was installed in the 1900s will not erode or decay for the most part, but root intrusions and other defects can require repairs. Based on inspections, pipe assets are replaced when needed. For the treatment plants, asset repair and replacement is also based on visual inspection. When plants are expanded for capacity, the Department conducts retro-fitting of older facilities and equipment.

Population

Looking ahead to the 2030 planning horizon requires a look at population growth, using a population model. Growth patterns will dictate where the capacity has to be increased, both for line infrastructure and treatment plants. **Figure 59** shows the areas where interceptor systems would require some type of augmentation if growth occurs as projected. As for the treatment plants, the Roger Road Facility is approaching its capacity. (See **Figure 57** for 2005 capacity and projections to 2030.) An interconnect between the Roger Road and Ina Road facilities is being constructed to transfer existing and future flows from the south and southeast areas to the Ina Road Facility.

Good Neighbor

PCRWRD has developed a system-wide Odor Control Plan. Interim odor control projects, funded in part by 2004 Bonds and completed by June 2008, have achieved noticeable reduction of odors. Additional odor control at the Ina Facility and the new Water Reclamation Campus will be incorporated into ROMP through a $40 million proposed 2009 Bond request. In addition to odor control, noise abatement and aesthetics at the plants are good-neighbor priorities

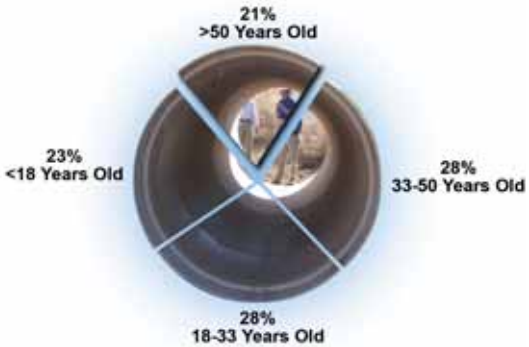

Figure 58-Pipe Ages

Regional Optimization Master Plan

Program Development

As noted earlier, the initiation of the Regional Optimization Master Plan (ROMP) was regulatory-driven, but other related components of this program were added during development, such as rehabilitation, modernization, and planning for growth. During the initial planning for the ROMP, three major alternative centralized treatment options were considered including (1) Transfer all of Roger Road flows to Ina and expand Ina to an 82 million gallon per day (MGD) facility; (2) Transfer some of Roger Road flows to Ina and expand Ina to an 80 MGD facility and reduce Roger Road to 32 MGD with a new facility; and (3) Transfer none of the Roger Road flows. The evaluation determined that alternative 2 – Transfer some of the flows to Ina Road -- was the most efficient way to achieve the required capacity.

Figure 59-Population Drivers: Conveyance System

The primary focus of ROMP is the two Metropolitan Regional Facilities at Ina Road and Roger Road, which have nearly 500 square miles of service area.

There were two main challenges envisioned at the outset of this program: meeting regulatory requirements to reduce nutrients in the form of nitrogen and ammonia in the effluent that is discharged to the Santa Cruz River (by 2014/2015 deadlines); and maintaining existing facilities to ensure they are in compliance while continuing to be operated.

Other challenges included population growth needs and the funding mechanism (substantial wastewater rate increases).

The scope of work for the program included the following requirements:

- Develop the optimal treatment process and plan to comply with regulatory requirements to reduce total nitrogen concentrations in the discharged effluent and, in the event of increasing regulations or new regulations, be easily adaptable to meet new requirements.
- Master plan foreseeable future regulatory requirements, including Arizona Department of Environmental Quality's (ADEQ) "Triennial Review" of water quality standards, the reduction of phosphorous concentrations in discharged effluent, the upgrade of biosolids to "Class A" for more reuse potential, and the discussion of pharmaceutical wastes and personal care products.
- Determine the long term capacity needs of the County as related to the two regional facilities to accommodate growth up to the year 2030.
- Develop a long-term plan for the treatment, handling and reuse of system biosolids and bio-gas. These byproducts of wastewater treatment were traditionally disposed of as a waste. Today, the Class B sludge is used for farming operations, and the bio-gas produced in a digestion process (primarily methane) is used at the Ina Road co-generation facility to generate electricity. In the future, all of PCRWRD's solids will be consolidated at the Ina Road facility to have more bio-gas there and more fuel to run the power generators at that plant.
- Develop a detailed implementation schedule to implement this program over a 15-year period and within a 9-year period for the regulatory portions.
- Develop a financial plan to support the system's regulatory and other needs for the next 15 years. The PCRWRD Facility Plan shows an overall CIP need of $1.4 billion (in 2006 dollars), about half of which is for ROMP, and all of which will be built over the next 20-25 years.

Regulatory Implementation Requirements to Reduce Total Nitrogen Concentrations

	Ina Road WRF	Roger Road WRF
✓ Complete initial engineering study ✓ Recommendation for upgrading treatment plants ✓ Submit recommended plan letter to ADEQ	February 1, 2007	January 30, 2007
✓ Award contract for construction	December 31, 2010	January 30, 2011
✓ Treatment of effluent to non-toxic nitrogen levels	January 30, 2014	January 30, 2015

Figure 60-Regulatory Compliance Schedule

Figure 60 shows the regulatory compliance schedule mandated

- ✓ Expand Ina Road WRF to 50 mgd
- ✓ Construct new 32 mgd Water Reclamation Campus (in vicinity of existing Roger Road WRF)
- ✓ Plant Interconnect – 28 mgd average, 72 mgd peak flow
- ✓ Good neighbor facilities
- ✓ Decommission existing 41 mgd Roger Road WRF
- ✓ Meet growth needs to year 2030

by ADEQ, with compliance upgrades to be completed at the Ina Road WRF in January 2014 and at the Roger Road WRF in January 2015.

These are the driving forces of the ROMP Program, and ADEQ accepted the plan in early 2007.

Figure 61-Ina Road Facility

ROMP Plan at a Glance

As a major part of ROMP, the Ina Road WRF will be expanded from a capacity of 37.5 MGD to 50 MGD, and existing processes will be improved. The biological nutrient removal process and the high-purity oxygen process will be upgraded to a new process known as "Bardenpho."

The 12.5 MGD expansion will also use the Bardenpho process. The whole facility will operate as one process when complete.

In addition, all biosolids processing will be centralized at Ina. In looking at the costs of treating biosolids at the new Campus versus Ina, the estimates indicated a benefit to centralize the operation at Ina and then provide for co-generation of the bio-gas and one-point distribution of the biosolids.

This very complex expansion and upgrade program also includes significant facility rehabilitation.

Figure 61 shows the Ina Road WRF ROMP expansion, which will occupy about 160 acres of property at Ina Road. Much of the existing facility will also go through some type of upgrade and rehabilitation. The entire expansion program at Ina Road will be within the property currently owned by PCRWRD.

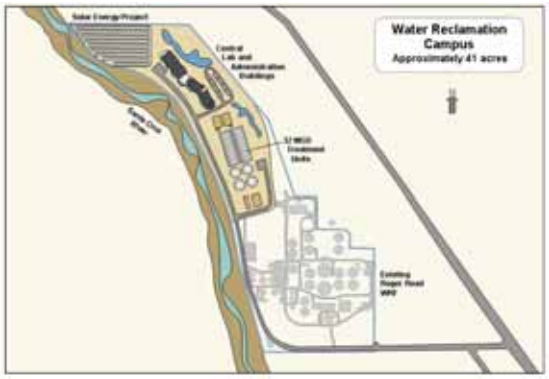

Figure 62-New Water Reclamation Campus

ROMP will provide the construction of a new Water Reclamation Campus in the vicinity of the existing Roger Road Facility (**Figure 62**). It will include a 32-million-gallon-per-day (MGD) Bardenpho treatment train, and it will house the PCRWRD Central Laboratory Facility. The new Water Campus will be a showcase for cultural and biological resources, particularly in the setting that it will have along the banks of the Santa Cruz River, and it will lend itself to environmental enhancements partnered with the City of Tucson, parks development, cultural resources, economic development and many other features.

The Water Campus facilities will be LEED-certified (Leadership in Energy and Environmental Design) at the silver level, and the grounds will include a solar power plant. Once this facility becomes operational, it will provide power to the existing Roger Road Facility. When the new Water Campus is constructed and operational, it will take over using the solar power source, and the existing Roger Road facility will be decommissioned.

ROMP will include the construction of a plant interconnect that will enable the PCRWRD system to convey flows by gravity from the Roger Road WRF to the Ina Road WRF. The capacity of this service-area interconnection will be 72 MGD for peak flows, while average flows will be about 28 MGD. The intent of this component is to convey flow from the Roger Road service area to the Ina Road reclamation facility where additional capacity currently exists. This is an up-front ROMP construction project, because the Roger Road WRF is approaching capacity. With Ina and Roger plant upgrades, sewer treatment capacity in 2030 will be 85 MGD.

ROMP will place a high priority on constructing and operating “good neighbor” facilities. Being a good neighbor has various components. These facilities have to be architecturally-pleasing to neighbors. They also have to provide noise control and odor control. In the ROMP Program, $40 million is for odor control at the Ina and Roger Facilities. ROMP will meet the region’s growth needs to the year 2030.

ROMP Cost Estimate
(2006 dollars)

Ina Road WRF Upgrade/Expansion	$243,900,000
Electrical Upgrades	$35,000,000
Plant Interconnect	$22,300,000
Water Reclamation Campus	$211,000,000
Roger Road WRF Demolition	$23,800,000
Total Estimated Cost	**$536,000,000***

*Cost estimate includes design costs, UV disinfection and 5% contingency.

Figure 63-ROMP Cost Estimate

ROMP Implementation Costs

Initial Estimated Cost (2006 dollars): $536 million

ROMP budget with cost Inflation (assuming an inflation rate of 5%): $720 million

Bonding / Debt Service: $1+ billion

Largest Capital Improvement Program in Pima County to date

Figure 64-ROMP Implementation Costs

ROMP Implementation Costs

Figure 63 shows the major cost components in ROMP. Although the initial cost estimate for the ROMP program of $536 million was based on planning-level cost estimates in 2006, PCRWRD has a current ROMP budget of $720 million. Most of the difference is the projected annual inflation rate of 5%, but it also includes all of the consulting services that need to be retained, such as those for design, cultural resources, project management, and construction inspection (**Figure 64**).

The ROMP improvements will be built through the use of bond funds. When bonds are used, they must be paid back with interest. When this "debt service" for the bonds is factored in, the total cost will be over one billion dollars.

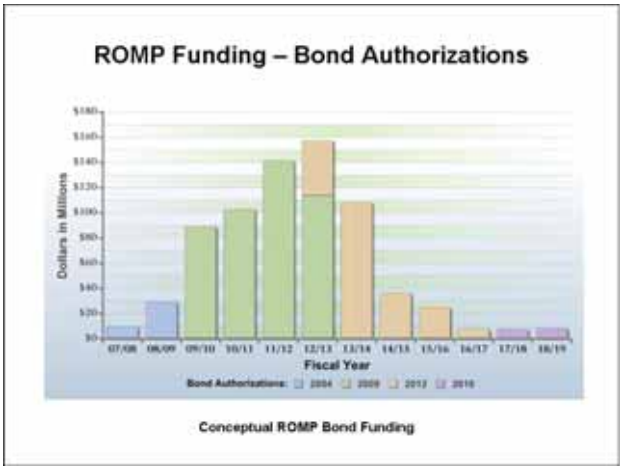

Figure 65-ROMP Funding

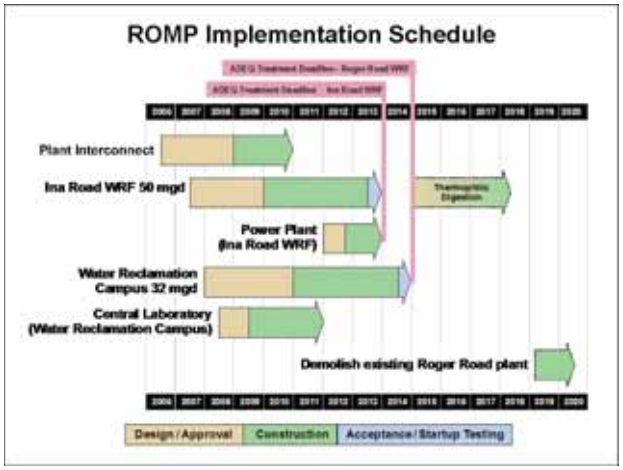

Figure 66-ROMP Implementation Schedule

This billion-dollar program, which is mandated by regulation, is the largest capital improvement program in Pima County to date. It is unique due to the magnitude and complexity of the program, as well as the prescribed schedule.

The ROMP program is being funded initially through the use of the 2004 Bond Authorization, which has only very little money remaining available (**Figure 65)**. The next component of funding ROMP will be with a bond issue that is planned for 2009 in the amount of $565 million. This amount is for all of the CIP needs in PCRWRD, and $445 million of that is for ROMP alone.

As the ROMP program continues to be implemented, PCRWRD will likely need another bond issue in 2012, and then another one in 2016. After that, future regulations may begin to drive up other program requirements, such as for

phosphorous, ammonia, Class A biosolids, and pharmaceuticals.

ROMP Implementation Schedule –

The program schedule was devised to meet the compliance dates for Ina Road at the beginning of 2014 and for Roger Road (the new Water Reclamation Campus) at the beginning of 2015 (**Figure 66**).

The plant interconnect line is the most critical component of the ROMP Program, because Roger Road is approaching capacity. The design contract has been let for this project, and a contractor has been selected through a construction-manager-at-risk (CMAR) process.

The Ina Road Facility, the most complex project of the ROMP Program, has the design contract underway. A contractor was selected, again through the CMAR process, and the contractor is on site with the first construction component.

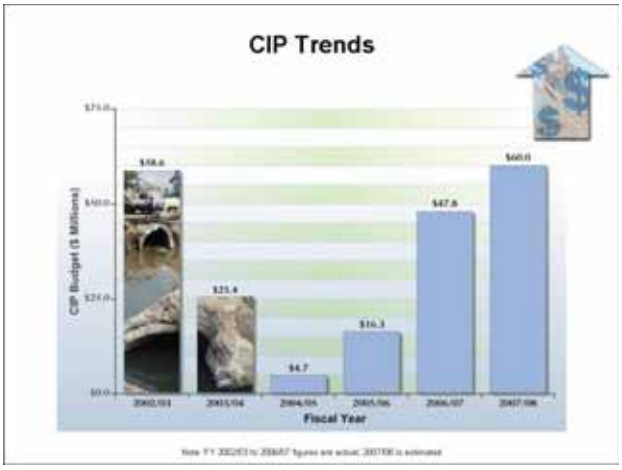

Figure 67-CIP Trends

For the power plant at Ina, PCRWRD is soliciting a public/private partnership where a private entity may come in and upgrade or build a new power plant through a partnership arrangement.

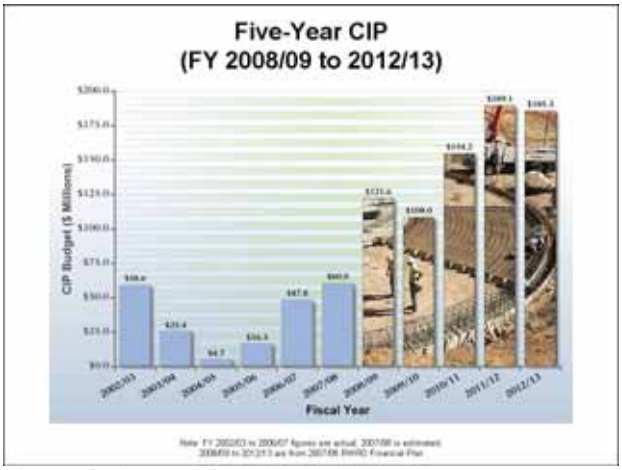

Figure 68-Five Year CIP

For the Water Reclamation Campus, the Department has selected a form of the design-build procurement method.

The final element of the program timeline is the demolition of the existing Roger Road Facility. This was placed at the end of the timeline because there is no urgency to demolish the facility, and this allowed the Department to spread out the costs of this program over subsequent years.

Five-Year Core CIP

PCRWRD has many improvements that need to be made in addition to those prescribed by ROMP. Before ROMP existed, annual expenditures varied over the previous six fiscal years, including an estimated $60 million of capital expenditures for the fiscal year ending on June 30, 2008 (**Figure 67**).

PCRWRD faced a major sinkhole incident in 2002 and, concurrent with that, it was repairing the Randolph Park Facility and constructing an expansion at the Ina Road facility. After those somewhat dramatic fiscal challenges, in 2004/2005 the Department spent very little on capital projects, while financial operations were being improved. PCRWRD has since increased the amount of financial retention now available for emergencies and has initiated a more proactive rehabilitation and repair program.

Looking ahead to PCRWRD's next five years (**Figure 68)**, there will be a large increase in CIP spending. A dominant portion of that is the ROMP. Going from $4.7 up to $60 million in three years, and then sustaining double and triple that amount for the next five years, will tax the Department's support infrastructure, its resources, as well as its processes. Doing this with internal staff initially and then acquiring additional external support has been, and will continue to be, a very demanding challenge.

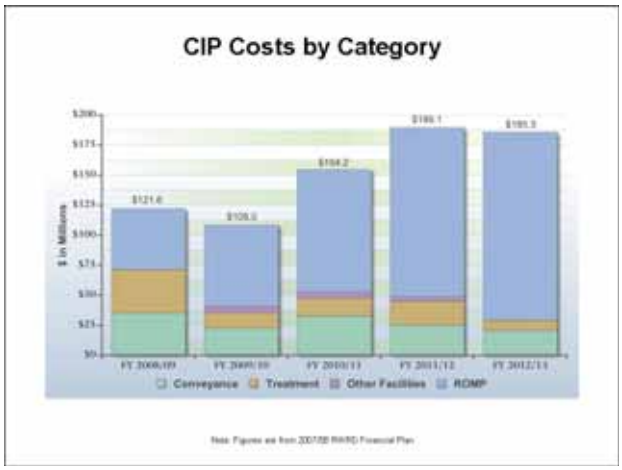

Figure 69-CIP Costs by Category

Figure 69 divides the Five-Year CIP into funding for conveyance, treatment, other facilities, and ROMP. PCRWRD has a lot of infrastructure that needs to be taken care of throughout this period, and resources can not go only to the metropolitan facility upgrades—other facilities must be taken care of as well. The

Figure 70-Major Upgrades

Department is able to carry over money annually to put toward sewer rehabilitation, accounting for the larger conveyance portions. Most of the treatment facilities have been recently expanded, and these expansions have been accompanied by modernization of their facilities, which lowers treatment rehabilitation costs for the sub-regional facilities.

Proposed 2009 Bond Request

PCRWRD is seeking a bond authorization totaling $565 million, with a $445 million component for ROMP and other additional capital projects being funded by the balance. See **Figure 70** for a breakdown of the proposed Bond Request.

Looking Ahead

PCRWRD will experience a large peak of CIP expenses beginning in the current fiscal year (2008/2009). This will have to be spent, along with other resources, to address ROMP. It is expected, however, that there will be a ROMP II in the future, and probably a ROMP III and IV, as the Department goes through the cycles of requiring more significant investment and rehabilitation to achieve advanced water quality treatment (**Figure 71**).

Figure 71-Proposed Bond Authorizaion

1.2.5 Financial Planning

Revenues are calculated under our current rate structures and a determination made as to whether the amount of revenue estimated to be generated is sufficient to carry out the Department's operations and maintenance and capital improvement plans (revenue requirement).

Figure 72-Capital Project Costs through 2017

Revenue requirements are determined by performing a cost of service analysis. What does it cost the Department to deliver our operating and maintenance programs (O&M budget) and our capital programs (Capital Improvement Plan)? Once delivery of these two programs is determined the funding source can be determined. Operations and maintenance, together with capital rehabilitation, should be funded through user fees while increases in capacity (conveyance and treatment) should be funded with connection fees.

Once revenue requirements and their source are understood there are other considerations to take into account. Can revenue stability be achieved? Stability can be described as normalized and predictable rate increases which are planned for (five to ten year planning horizon). Can the Department meet its regulatory

requirements? Keeping rates artificially low and not meeting these requirements is not an option. Lastly, forecasting revenue requirements into the future will help to prevent "pocket book shock."

Financial policies assist in keeping a business on course to achieving their objectives. Currently the Pima County Regional Wastewater Reclamation Department (PCRWRD) has two financial policies. One, contained in Board of Supervisors Resolution 1991-138, requires a debt service coverage ratio of 1.2. The second requires the Department to maintain a reserve of at least 10 million dollars to respond to unforeseen events/emergencies.

The Department has made great strides in improving efficiencies and planning efforts, which in turn may reduce total cost. The Capacity Management Operations and Maintenance (CMOM) program helps ensure that the conveyance system is operating properly, reducing costs and the possibility of system failure. The Computerized Maintenance Management System is assisting reclamation staff with preventive versus reactive maintenance, reducing overall maintenance cost and the possibility of equipment failure. Finally, in 2006, the Department embarked on a long term planning process, the Regional Optimization Master Plan (ROMP), to determine system needs through the year 2030 and identify the funding to deliver the plan.

The Department's five year Capital Improvement Plan (CIP) has grown in size to the point that it is just as large as our operations and maintenance budget. The adopted CIP budget for the last five fiscal years is as follows:

FY 2004/05	-	$4.7 million
FY 2005/06	-	$16.3 million
FY 2006/07	-	$47.8 million
FY 2007/08	-	$93.3 million
FY 2008/09	-	$121.6 million

The process used for compiling the CIP budget is to review system needs (capacity and rehabilitation), regulatory requirements, financial and staffing resources together with contractor availability to deliver projects. Projects are prioritized, matched with available funding, and a proposed CIP is forwarded through the Regional Wastewater Reclamation Advisory Committee (RWRAC) to County Administration for consideration with the final stop being the Board of Supervisors for plan adoption. The revenues required to deliver the CIP are derived mainly from connection fees (increased capacity) and user fees (rehabilitation).

A somewhat similar process is used in the development of the Department's operations and maintenance budget in those operations and maintenance programs are reviewed, revenue resources identified, and target budget allocations given to divisions within the Department. Once compiled the proposed operations and maintenance budget is reviewed by the Executive Team to determine if the goals and objectives of the Department can be met with the proposed budget. If the Executive Team is in agreement, the proposed budget is forwarded to the RWRAC for concurrence and then on to County Administration for inclusion in the proposed budget submitted to the Board of Supervisors.

In the short-term the operations and maintenance budget is fairly fixed (i.e., non-discretionary). This is due to the fact that the budget is comprised of personnel services (30%), services and professional services (24%), depreciation (20%), debt service (19%), supplies (6%) and capital outlays (1%). Very little can be done to control these costs in the short term (i.e., 12-18 months). The revenues to support the operations and maintenance of the utility are derived mainly from user fees. The current state average user fee is approximately $25.00 per month while Pima County's average user fee is $23.63.

1.3 Tucson Water Reclaimed System

1.3.1 System Overview

Tucson Water delivered more than 15,000 acre feet of reclaimed water to about 820 sites in calendar year (CY) 2007. Of this total, nearly 14,000 acre feet were delivered within the Tucson Water service area (800 sites) with the balance being delivered to the Town of Oro Valley and to a business in the Flowing Wells Irrigation District's Service area.

Although the reclaimed system is used to deliver only about 1/10 of the amount of water delivered by the potable system, it exhibits some large-system attributes. The system spans about 20 miles in a north/south direction and 30 miles from east to west. Piping in the system is as large as 72 inches, and boosters must be sized to meet peak demands that are much higher

proportionally than for a similar sized potable system. The reclaimed system consists of 160 miles of large-diameter piping, 5 reservoirs, a 10 million gallon per day filtration plant, and an 80-acre recharge facility to store water for peak-day use. Like the potable system, the reclaimed system also spans a range of elevations, necessitating isolation of pressure zones and the attendant equipment needed for that.

The reclaimed water system also utilizes recharge and recovery. The Sweetwater Wetlands was the first recharge facility constructed by Tucson Water. Effluent from the Roger Road Wastewater Treatment Facility is recharged at Sweetwater and recovered, primarily during summer months, to meet customer demand on the reclaimed water system.

1.3.2 Future Reclaimed Water System Needs

Changing times have changed the thinking about how reclaimed water systems should be designed and operated. In the early 1980s when Tucson's system was in the planning stages, the water industry saw reclaimed water as a "secondary" source of supply. This meant that interruptions of service were acceptable and that a less reliable and lower cost system would be appropriate. Reclaimed water pressure was seen as the customer's responsibility and the Class A water Tucson Water produced was seen as high quality. (Class A reclaimed water is wastewater that has undergone secondary treatment, filtration, and disinfection.) Today it is an industry standard practice for new reclaimed water systems to be as reliable as potable systems, to provide water pressure within an acceptable range for the customers and to provide water of Class A+ quality. (Class A+ reclaimed water is wastewater that has undergone secondary treatment, filtration, nitrogen removal treatment, and disinfection.)

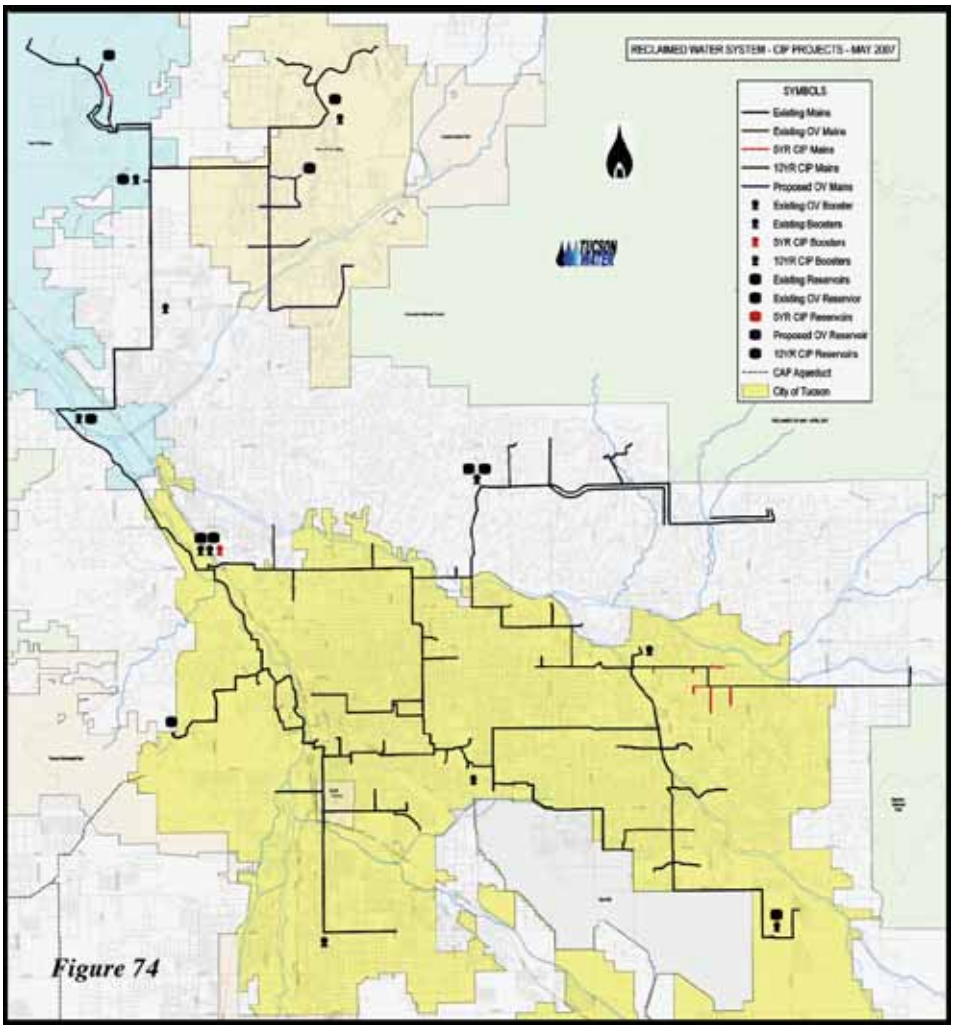

Figure 73-Reclaimed System

The current capital improvement program is focused on making the improvements to the reclaimed water system necessitated by Pima County's Regional Wastewater Reclamation Department's "Regional Optimization Master Plan" (ROMP). It is anticipated that by 2014, the County facility upgrades will be complete and Class B+ effluent will be produced by Pima County and from this, Tucson Water's reclaimed water will be further filtered or treated to Class A quality delivered to customers. During the next decade, the capital improvement program will also need to focus on increasing system capacity and water supplies as well as making improvements to system reliability and operations.

As with the potable water system, Tucson Water will continue to pursue energy efficiency and sustainability for reclaimed water facilities, including installation of additional photovoltaic arrays on reclaimed reservoir roofs. Energy is a major, recurring expense for the Utility, and energy costs are expected to rise more quickly than other costs in the future.