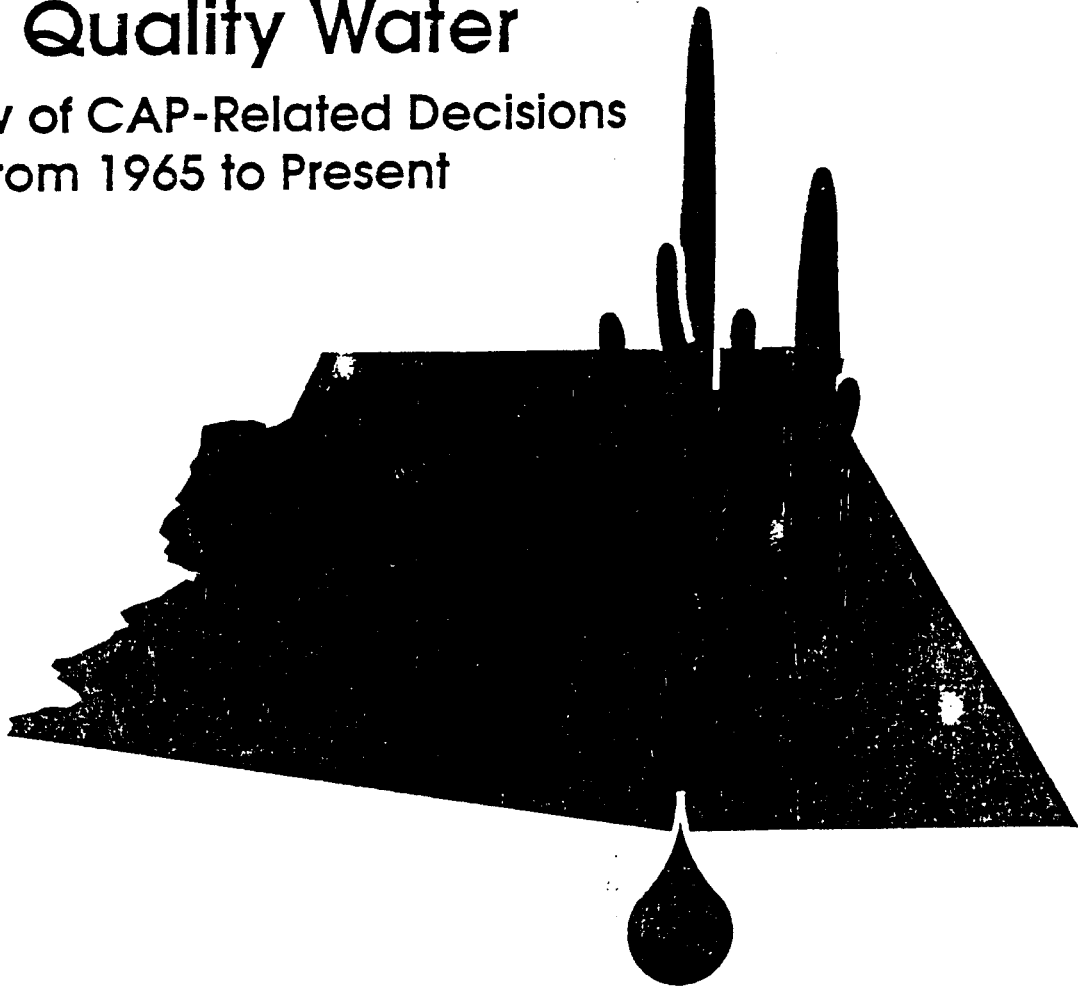


Plan

CAP Use Study for Quality Water

A Review of CAP-Related Decisions
from 1965 to Present



Submitted by
Dames & Moore

to
City of Tucson

April 26, 1995

A REVIEW OF KEY CAP-RELATED DECISIONS FROM 1965 TO
PRESENT

CAP USE STUDY FOR QUALITY WATER

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A REVIEW OF KEY CAP-RELATED DECISIONS FROM 1965 TO PRESENT CAP USE STUDY FOR QUALITY WATER

Preface and Introduction

Life in the desert community of Tucson has always depended on the ability to obtain enough water - whether it is used for drinking or recreation, irrigating yards, farms or ranches, cooling industrial processes, extracting and processing mineral resources, or left in streams to maintain riparian environments. Because Tucsonans live in an arid environment, they must make sound use of their water supply. This includes matching specific uses to a variety of water sources including reclaimed effluent, Central Arizona Project (CAP) water, and ground water. The quality of the water supply must be appropriate and safe for each use. Innovative mechanisms such as leasing, recharging, or transferring portions of the supply can be used to accommodate certain types of water use. Cost of water varies according to its sources and the price must reflect its value to the community and the community's willingness to pay for it. Within this complicated array of issues, Tucsonans as a community have worked with federal, state, and local governments to make decisions about water supply and water quality.

This report, prepared under the CAP Use Study for Quality Water, describes the key decisions made regarding the acquisition, use, and quality of the major renewable water source, CAP water, served in the Tucson area. This study was commissioned in 1994 by the Mayor and Council who appointed members of the Tucson community in November 1993 to serve on the CAP Oversight Committee. This committee developed the scope for the CAP Use Study for Quality Water and worked with Tucson Water and the City Manager's Office in 1994 to oversee its development and completion. The Committee saw the need for a historical review that would provide "perspective and understanding" on the City's CAP-related decisions beginning in 1965 and continuing through the present. This report includes the Committee's request for "a chronology of events, discussion of alternatives, and assumptions that were considered in arriving at each decision".^{1,2,3} This report also includes a description of the public involvement that took place in conjunction with each major decision, to the extent that information was available.

¹City of Tucson, "Scope of Work," Request for Proposal No. 941174, 1994, p. 5.

²At the time this document became final, Mayor and Council determined that the work of the Oversight Committee was completed. Other plans are being developed to obtain input on and review of the consultant's work.

³See, for example, Southern Arizona Water Resources Association (SAWARA), Waterwords, "Wanted: Citizen Involvement in the CAP Use Study for Quality Water," Vol. 13, No. 1, January/February 1995.

This historical review is divided into five chapters and four appendices. A chronology of the CAP follows this preface and introduction section. The organization of the chapters is:

- 1- Historical Framework
- 2- Decisions to Bring CAP to Tucson
- 3- CAP Aqueduct Phase B - Building the Aqueduct to Tucson
- 4- Decisions on When and How to Use CAP Water in Tucson
- 5- Decisions on CAP Water Quality

Certain characteristics of the City's CAP-related decision making process and public participation efforts became evident as this historical review was conducted:

First, the key city decisions documented in this report focus on Mayor and Council Resolutions and, in at least one instance, an electorate (community) choice. These key decisions were based upon a number of intermediate less formal "decisions," including Tucson Water staff recommendations, consultant findings and recommendations, correspondence between government agencies or representatives, and position statements of the Southern Arizona Water Resources Association (SAWARA). News reports over time also reflected decision making on a real time basis.

Second, some important decisions about the CAP system and water use in Tucson were formalized by government entities other than the City of Tucson, although significant input from the Tucson area was sought as these decisions were made. For example, the U.S. Bureau of Reclamation (USBR) had the authority to recommend a Tucson aqueduct route to the Secretary of the Interior (Chapter 3). The Arizona Department of Water Resources (ADWR) made recommendations to the USBR on CAP water allocations for the Tucson area, and these were approved by the Secretary of the Interior (Chapters 2 and 4). Tucson's basic rules for use of CAP water are influenced by the delivery and payment requirements specified in its subcontract with the Central Arizona Water Conservation District (CAWCD) and the USBR (Chapter 2). Congress defined important settlement terms for Tohono O'odham water claims that involve Tucson's water supplies including ground-water and CAP water (Chapter 1).

Third, the role of formal, key decisions changed with time. A key decision at one point in Tucson's CAP history may have evolved to become an assumption or an alternative considered in a later key decision. For example, decisions made prior to 1984 became assumptions during the 1989 long-range planning process. Components of the long-range plan adopted by Mayor and Council,

such as maximizing early use of CAP water became the basis for Tucson Water's implementation of CAP water deliveries beginning in 1992 (Chapter 4). Key decisions to keep treatment costs as low as possible and to set limits for certain water quality parameters were adopted by Mayor and Council as a result of recommendations in the 1984 Water Quality Objectives Report (Chapter 5). These decisions became assumptions in the design of the City's water treatment plant and have a bearing on the current colored water problems associated with CAP water. A community vote defeating an aill-recharge initiative in 1987 contributed to the assumption that recharge would not be considered as the mechanism for treating CAP water (Chapter 5).

Fourth, over time, particularly in the case of the CAP water supply, Tucsonans have learned that some of the choices made in the past when circumstances were different do not reflect their values or adequately meet their needs today. These decisions were based on legal, technical, and economic assumptions brought to light as choices were being considered. It was not always clear from the historical record how well understood these assumptions were by the general public. Some assumptions that were made as CAP was developed (1940s to 1980s) may have been overly optimistic or incorrect. For example, official assumptions overestimated agriculture's ability to use and pay for CAP water, as reported by the state's Task Force to discuss underutilization of CAP by agriculture in 1992 (Chronology, Chapter 2). In addition, there were differing expectations about the potential for corrosion to be a problem with CAP water distributed to customers. Tucson's treatment plant was designed with a corrosion control system, but the system was not implemented until these problems occurred (Chapter 5). Finally, Tucson's population has grown and changed. Many relatively new residents may find it difficult to accept decisions made through past planning processes.

Fifth, the CAP has been controversial since its inception. There are those that have steadfastly questioned both the wisdom and economics of the Central Arizona Project. The state's political leaders have generally been strong supporters, however, and have tended to downplay any critique, no matter how valid, that did not strengthen the state's position in its negotiations with the federal government who would fund and build the aqueduct. A result of this long running difference of opinion is a high degree of distrust surrounding almost any facet of the debate, from population projections to Colorado River flow volumes.

This document is as complete as practicable a chronology of Tucson's CAP-related decisions between 1965 and September 1994. It is not intended to be a comprehensive analysis of the multifaceted and complex history of the City of Tucson's use of CAP water. For example, this document does not present the views of all users or voices that may have an interest in the City's use of CAP water. Information about stakeholders and their perceptions about the City's actions are not typically available in published sources, which are the basis for this review. Much debate and decision-making occur beyond the grasp of the newspaper or printed page. The scope of this historical review does not allow an in depth analysis of the many economic and social issues

surrounding CAP. What it does attempt to do is provide the reader, whether a member of the City Council, an experienced water professional, or a member of the general public, with a framework for understanding how the City got to where it is today in its development and use of CAP water.

While this document was being written, there was a high level of public mistrust of Tucson Water.⁴ This historical review was not intended to rationalize CAP-related decisions between 1965 and 1994; rather, its purpose was to identify them. Both negative and positive comments were received on drafts of this document. Oral comments received during the November 3, 1994 Oversight Committee meeting are summarized in Appendix D. Changes to the final document were based on these oral comments and on written comments submitted by some of the Oversight Committee members and SAWARA.

⁴See also Darnes & Moore's "Findings and Recommendations for Convening a Consensus - Building Process," August 12, 1994, in which perceptions and attitudes related to CAP use are reported.

A REVIEW OF KEY CAP-RELATED DECISIONS FROM 1965 TO PRESENT

CAP USE STUDY FOR QUALITY WATER

CENTRAL ARIZONA PROJECT CHRONOLOGY

- 1921 Congress authorizes Colorado River Compact. Seven Colorado River Basin states are authorized by Congress to negotiate and enter into a compact that ultimately allocated water from that river to each state.
- 1928 Congress passes the Boulder Canyon Project Act and, by so doing, allocates a portion of the Colorado River to Nevada, California and Arizona.
- 1944 Arizona legislature ratifies the Colorado River Compact and Arizona contracts with the Secretary of the Interior for 2.8 million acre-feet of Colorado River water annually.
- 1946 Central Arizona Project Association is founded to promote Congressional approval of the Central Arizona Project (CAP).
- 1947 First bill to authorize the Central Arizona Project is introduced in Congress and hearings are held in Congress in the Subcommittee on Public Lands.
- 1952 *Bristor vs. Cheatham*. The final ruling of this case in the Arizona Supreme Court retained the doctrine of absolute private ownership of the right to use water underlying the land.
- 1956 Trial of Arizona vs. California begins before a Special Water Master in San Francisco. Despite passage of the Colorado River Compact, Arizona and California continue to disagree about the security of Arizona's allocation of Colorado River Water; therefore, the trial is initiated by Arizona.
- 1961 The Bureau of Reclamation plans to extend the main CAP aqueduct to Tucson and utilize the Charleston Dam on the San Pedro River for Tucson's water supply.
- 1962 Tucson Water projects its water demand in the Tucson Basin for 1963, 1980 and 2000 (96,100 acre-feet (AF); 142,400 AF; and 315,000 AF, respectively).
- 1963 Arizona vs. California Decision - U.S. Supreme Court finds that Arizona has secure and legal title to its 2.8 million acre-feet allocation to Colorado River water after 12 years of struggle with California and other western states.

- 1965 Bringing CAP to Tucson** - Tucson Chamber of Commerce Water Resources Committee begins its 12-year long campaign to bring the CAP to Tucson.

City Council approves \$41,000 contribution to push CAP through Congress. Arizona Daily Star editorial on October 24, "City Council Deserves Praise...for being farsighted enough to put its solid hopes ... on importation of water into the Tucson Basin."

- 1966 Mayor and Council authorize \$25,000 to fund CAP Association** (Resolution 6552).

- 1967 Mayor and Council pass a resolution to endorse the CAP and to push further action by Congress** (Resolution 6902).

"The Economics of Arizona's Water Problem" by Robert Young and William Martin appears in the Arizona Review. This article warns that the official assumptions on agricultural use of CAP water is overly optimistic.

- 1968 Congress passes the Colorado River Basin Project Act.** This Act provides funding for the Central Arizona Project as authorized by Congress and signed into law by President Johnson. The price of California's support for the bill was priority for its Colorado River water allocation in times of water shortage.

- 1969 Jarvis I.** The Arizona Supreme Court rules that the City of Tucson cannot transport water from one critical ground-water area to another.

- 1970 Jarvis II.** The Arizona Supreme Court rules that if the City of Tucson retires land from farming use within a critical ground-water area, it can then export the amount of water historically used for irrigation into the city.

- 1971 Central Arizona Water Conservation District is formed** for the three counties that directly benefit from CAP: Maricopa, Pima, and Pinal. The CAWCD contracts with CAP water users and with the federal government and is responsible for Arizona's repayment of construction costs and operation of the CAP system.

- 1972 CAWCD develops a contract with USBR for repayment of CAP construction costs and CAP construction begins.**

The USBR completes its overall Environmental Impact Statement (EIS) for the CAP.

1972 Citizens' Water Resources Coordinating Council convenes to facilitate the HUD 701b Plan, which will be completed in 1973.

1973 CAP construction begins at the Bill Williams River along Lake Havasu.

701b Plan completed. The Pima Association of Governments (PAG) develops a Regional Plan for Water, Sewerage, and Solid Waste Management (701b Plan). The objective of this plan was to develop short-, medium-, and long-range programs for water (including CAP), wastewater, and solid waste management at a minimum cost to the resident population of Pima County. This was the first plan to assess the recharge of reclaimed water as an element of supply management.

1974 The USBR begins purchasing rights of way for CAP aqueduct and negotiating construction contracts.

1975 Letter of intent signed. City of Tucson signs a letter of intent to take 100,000 AF of CAP water annually and submits it to the Arizona Water Commission.

Tohono O'odham Nation, the United States, and two individual Indian allottees sue the City of Tucson for mining ground-water reserves beneath the reservation. Local entities, such as the Citizens' Water Resources Coordinating Council, are involved in the negotiations with the United States and the lawyers for the Indian parties from 1975 until 1982.

1976 Ground-water pumping from inside a "critical ground-water area" to an outside area was the basis for the establishment of the amended State Groundwater Codes as a result of the Farmers Investment Company (FICO) case in Tucson. In this case, the mines and municipal interests struggled against agriculture with the result being a system for grandfathering existing transfers of water from critical ground-water areas through the issuance of certificates of exemption.

Jarvis III. The Arizona Supreme Court limits Tucson's importation of ground water from the City's retired farmland in Avra-Altar Valley to the amount "consumptively used" in the previous irrigation of those lands. Consumptive use is the difference between the amount of water pumped for use and the amount of water eventually returned to the aquifer by use.

1977 President Carter attempts to cut funding for the CAP and stop the project by adding it to his "hit list." Funding was continued contingent upon ground-water law reform in Arizona and the deletion of several dams from the project. This included Charleston Dam which was to function in place of terminal storage.

1977 Recall of three members of Tucson City Council in January. Tucson recalls three members of its City Council over water rate increases and growth issues.

Citizens' Water Advisory Committee (CWAC) is established by the Mayor and Council to advise Tucson Water, the City Manager, and Mayor and Council on water policy. The duties of CWAC are formalized in City Code.

Public hearing on use of CAP water allocation. In February, the City of Tucson holds a public hearing to air the public's preference for use of the CAP water allocation. Four people attend the meeting and all four back the project. The four include: City Manager Joel Valdez and three mining representatives.

CWAC supports increased water rates to promote conservation, to reduce peak summer usage, and to fund necessary water system improvements.

Pima County precinct leaders (Democratic) will vote against CAP funding until ground-water laws are reformed, as reported by the Citizen on April 14.

\$10,000 to CAP Association. City of Tucson votes to contribute \$10,000 to the Central Arizona Project Association (May).

Allocations recommended for Tucson - On June 22, the Arizona Water Commission recommends to the Secretary of the Interior that the City of Tucson receive 54,300 AF per year of CAP water in 1985 with the allocation increasing to 97,800 AF per year by the year 2034. The Secretary does not act on the recommendation.

"Beat the Peak" begins. Tucson's "Beat the Peak" program is introduced as a means of reducing peak demands for water and providing a way of delaying costly improvements in the water delivery system.

1978 The USBR begins researching alternatives to the dams deleted from the CAP system, including the Charleston Dam for Tucson.

Plan 6 Agreement under development. This agreement among several central and southern Arizona water users and the federal government is developed to establish local funding commitments for needed water storage and flood control components of the CAP. Terminal storage of CAP water for Tucson is included.

- 1979 Southern Arizonans for the Central Arizona Project (SAFE-CAP) and the water committee of Tucson Tomorrow organize separately to help ensure the completion of CAP to Tucson. These groups recognize the need for a unified Tucson voice on the CAP.

Public hearings are held early in the year to present Tucson's need for the CAP. By the fall, Tucson Metropolitan Chamber of Commerce is one of the signatories on a letter to President Carter supporting the CAP.

The Army Corps of Engineers presents a report on Tucson route alternatives in July.

USBR presents preliminary CAP alternatives for eastern Pima County in August. The document presents descriptions of the preliminary water supply, quality and route alternatives.

Mayor and Council approve agreements to supply water service to the Rancho Vistoso Water Company, Metropolitan Water District, and Canada Hills Water Company in the northwest area as part of the Northwest Area Plan. The Northwest Area Plan assumes that CAP water and Avra Valley ground water will be delivered to the northwest area.

- 1980 Arizona's Groundwater Management Act (GWMA) is passed. Its primary goal is to balance ground-water supply and demand through the principle of safe yield in the Tucson Active Management Area (Tucson AMA) by the year 2025. The successful passage of the Act was critical for continued federal funding of the CAP. The ADWR is established. This act specifically (1) preserved the private ownership of the right to use ground water, (2) directed the State Land Commission to designate "Critical Ground-water Areas" in the state, (3) prohibited further expansion of agricultural acreage to be irrigated by ground water in the Critical Ground-water Areas, (4) prohibited drilling of new agricultural wells, (5) allowed drilling of new wells for any purpose other than agriculture.

ADWR recommends a revised CAP allocation for Tucson of 148,420 AF per year.

The Tucson section of the CAP is redesigned to deliver water by enlarging the main aqueduct and adding Phase B, deleting the Charleston Dam on the San Pedro River, and proposing to place terminal storage at Cat Mountain. Terminal storage would provide a means for Tucson to store CAP water in the event of delivery system outages.

1981 Tucson's aqueduct capacity is augmented to 550 cubic feet per second as a result of lobbying efforts by the Citizens' Water Resources Coordinating Council, convened to facilitate the HUD 701b Plan completed in 1973.

1982 Secretary of Interior James Watt allocates 148,420 AF of CAP water per year to the City of Tucson based on ADWR recommendations. The Tucson AMA is allocated 241,707 AF.

The Southern Arizona Water Rights Settlement Act (SAWRSA) is adopted to settle tribal water claims of the Tohono O'odham Nation adjacent to Tucson. To address this claim, 66,000 AF of the CAP is allocated to the Tohono O'odham Nation. The City is also directed to provide an additional 28,200 AF of effluent at a later date. The eventual siting of the Tucson CAP aqueduct to the west of the Tucson Mountains (1983) is affected in part by this legislation. A final agreement with the Nation and its allottees is still pending in 1994.

The State legislature authorizes the CAWCD to be the operating agent of the CAP.

SAWARA is established in Tucson to promote the extension of the CAP Phase B aqueduct to Tucson and to foster a water conservation ethic in this community.

The City of Tucson contracts with Dr. Raymond A. Sierka, a University of Arizona scientist and water quality specialist, to advise on the CAP Water Treatment Plant project (Mayor and Council Resolution 12069).

1983 SAWARA forms the CAP Alignment and Terminus Storage Committee (CATS) at the request of the USBR to help decide the alignment of the Tucson Phase B aqueduct and evaluate Cat Mountain as the site for terminal storage of CAP water. The City of Tucson ultimately endorses an alignment west of the Tucson Mountains with several mitigating measures to address environmental concerns and costs of delivery to Tucson Water customers.

Montgomery-Johnson-Brittain is retained by City of Tucson to do the preliminary design report for the CAP Water Treatment Plant.

City of Tucson identifies water quality objectives - Montgomery-Johnson-Brittain begins an ambitious public involvement program to establish acceptable water quality treatment goals. The Mayor and Council adopt the water quality objectives contained in the "Water Quality Objectives Report," including basic treatment - no softening or demineralization and trihalomethanes (THMs) under 20 parts per billion (Mayor and Council Resolution 12188).

1983 Mayor and Council adopt and approve the draft report "Site Selection of Tucson Water Treatment Plant Project" on December 12 (Resolution 12516).

1984 Initial Plan 6 Agreement is approved by Secretary of Interior William Clark. Impacts on eagles at Cliff Dam in central Arizona and cost sharing among entities in Arizona who benefit from Plan 6 is an issue. The Plan undergoes several revisions in the 1980s.

Tucsonans support conventional treatment of CAP water. Tucsonans participating in the water quality treatment surveys, presentations, and meetings conducted by Montgomery-Johnson-Brittain support standard conventional treatment of CAP water at low cost to consumers.

The "Base Plan," a set of pre-1984 assumptions authorized by the Mayor and Council, provides for direct use of 60,000 AF of CAP water in 1991, no recharge, and a 100 million gallon/day (mgd) treatment plant with an expansion to 200 mgd in 2007.

Tucson voters support the CAP in a bond issue for construction of CAP facilities.

The CAWCD changes the CAP water pricing schedule to encourage municipal water users to use as much water as possible in the early years of the project.

ADWR First Management Plan is adopted and contains mandatory reductions in per capita use for all water providers.

1985 The first Colorado River water arrives in Phoenix via CAP.

USBR issues its final EIS on the Tucson Phase B Aqueduct. A westside alignment is selected. Cat Mountain is eliminated as a terminal storage site due to community environmental concerns, and the issue of terminal storage is set aside until the following year. At the same time, an analysis of a recharge alternative is suggested by Brent Cluff.

Tucson Water retains the engineering consulting firm of CH₂M Hill to begin an extensive three-phase recharge assessment study to consider the potential and locations for recharge in the Tucson Basin.

1986 The Plan 6 Agreement is signed by the USBR and Arizona interests to provide regulatory storage, conservation, and flood control for central Arizona. Various state water interests support the Agreement through upfront funding in exchange for assurances of municipal water supplies and benefits. These interests include CAWCD, Maricopa County Flood Control District, five cities in the Phoenix metropolitan area, and Salt River Project. Non-federal funds in the amount of \$348.75 million are also to be advanced by Arizona signatories to construct components of the Agreement. The City of Tucson does not support upfront funding of the Agreement.

City of Tucson signs a subcontract with USBR and the CAWCD for 148,420 AF of CAP water per year.

USBR begins studies on the reliability of the Tucson Aqueduct and the need for terminal storage.

The Animal Defense Council and other plaintiffs sue USBR on the claim that the Phase B EIS is inadequate to determine environmental impacts of all alternatives considered. The lawsuit is dismissed later this year.

The implementation of the State Underground Storage and Recovery Act allows recharge and provides for the accounting and recovery of recharged waters. It also develops further policies for water rights and ground-water management.

Mayor and Council award a contract for the design of the Tucson CAP Water Treatment Plant to John Carollo/Black and Veatch to perform pilot studies, and conduct public and neighborhood involvement program (Resolution 13719). Assumptions of the treatment process include (1) blending CAP water with ground water, (2) using some CAP water would be used for mines and farms, and (3) recharging ground water with some CAP water.

1987 USBR issues a Finding of No Significant Impact (FONSI) for the Environmental Assessment of the CAP Water Treatment Plant.

Cliff Dam is removed from Plan 6 Agreement. An environmental coalition successfully removes Cliff Dam from the Plan 6 Agreement and the Arizona Congressional delegation works diligently to retain the remainder of the Agreement. This action is crucial for continued funding of the CAP, its completion to Tucson, and terminal storage.

Construction of the Tucson CAP Water Treatment Plant begins.

1987 Final Draft of First Phase of the Tucson Recharge Feasibility Assessment is completed in June.

USBR revises the firm delivery capacity of Snyder Hill Pump Station, which delivers treated water from the City's treatment plant to the Clearwell Reservoir, from 200 mgd to 225 mgd in October. This increase means more treated water can be delivered to municipal and industrial (M&I) customers.

Tucson voters reject an all-recharge alternative as a method of treatment for CAP in November. A public education effort is initiated. Of those who voted, 65 percent decided against recharge as the sole treatment method.

Tucson Water evaluating increase direct use of CAP water in the early years of the project as noted by CWAC in their recommendation to the Mayor and Council on the 1988/89-1997/98 Ten-Year Capital Improvement Program.

1988 ADWR proposes assured water supply rules for cities, towns, and developers in Active Management Areas requiring proof of an adequate and safe water supply for 100 years prior to moving forward with residential development. A CAP water allocation could be used as presumption of an assured water supply until 2005 for cities and towns.

Mayor and Council reaffirm their commitment to the 1984 "Base Plan" through adoption of 10-year Capital Improvement Program. Staff is directed to continue refining possible alternatives and to use the base plan as the standard for comparison.

CWAC recommends to Mayor and Council on January 22 that the CAP Water Treatment Plant initial capacity be increased from 100 mgd to 150 mgd, with an ultimate capacity in the later project years to increase from 200 to 225 mgd. This change provides for more flexibility in developing water resources programs utilizing CAP.

Mayor and Council approve contract with CH₂M Hill to develop a 110-year water resources plan (sometimes referred to as the "Long Range Plan") for Tucson Water on June 3. Extensive public participation and a citizen advisory committee (Water Resource Advisory Committee or ADCOM) are components of this project. This effort was stated because of community perception that Tucson's planning process was inadequate and not sufficiently public.

1988 **City of Tucson subcontracts with CAWCD and USBR** for its allocation of 148,420 AF of CAP water. The provisions of the subcontract have bearing on future decisions that Tucson makes about using its allocation, particularly holding costs.

1989 **ADWR withdraws its proposed assured water supply rules** in the face of severe opposition from development interests and concern about impacts on Arizona's real estate markets.

ADCOM, SAWARA and CWAC endorse the proposed Tucson Water Resources Plan, 1990-2100 and recommend its adoption by the Mayor and Council.

Pima County Board of Supervisors adopt their final recommendation of the Tucson Water Resources Plan, 1990-2100 on June 20. The only major issue is that the Tucson Water Resources Plan, 1990-2100 fails to require effluent utilization by the City.

Mayor and Council adopt the Tucson Water Resources Plan, 1990-2100 on July 3 (Resolution 14963). This plan sets forth the program of maximizing early direct use beginning in 1992. A public involvement effort is associated with the development of this plan. The plan establishes basic criteria for management decisions regarding all elements of Tucson's water supply through the year 2100, and includes plans for regular review and updating.

Mayor and Council adopt Resolution 15014 to allow modification of the CAP Plan 6 Agreement as part of the settlement of the Pima/Maricopa Indian litigation.

1990 **The 1980 GWMA is amended to promote indirect recharge of ground water** but limits the use of CAP water for indirect recharge projects to excess CAP supplies. Indirect recharge permits cannot extend beyond 2025.

Mayor and Council adopt a memorial urging ADWR to adopt a series of operating principles to reallocate uncontracted CAP water.

The Arizona legislature passes a law providing for the creation of an Augmentation Authority in the Tucson AMA. The purpose of this district is to facilitate access to renewable water supplies for entities outside of the Tucson metropolitan area. This Authority can acquire water supplies for assured water supply purposes. This Authority later becomes the Santa Cruz Valley Water District.

1991 Statewide agricultural demand for CAP water decreases from 745,000 AF in 1990 to 420,000 AF.

CAP water arrives in Tucson.

The Arizona legislature passes the Groundwater Transfers Act, which limits the importation of ground-water supplies from rural areas outside of Active Management Areas (AMA) to AMAs seeking an assured water supply and gives City of Tucson credit for a maximum of up to 2 million AF of ground water saved through retirement of agriculture in Avra Valley.

Tucson's CAP Select Water Quality Panel, a volunteer group comprised of physicians, health care professionals and engineers, is formed in September to assist in technical issues.

USBR dedicates the Tucson Water Treatment Plant in November.

Tucson Water publicity begins on conversion to CAP water and continues through 1992.

1992 Governor Symington's 16-member Task Force convenes to discuss CAP underutilization issues. The resulting study focuses primarily on agricultural water use and finds that USBR economic and financial feasibility studies of the 1960s, 1970s and 1980s are not based on sound assumptions and are overly optimistic. Arizona must have a strong CAP utilization (and repayment) plan to ensure its ability to repay the Federal government for Arizona's share of the construction costs.

CAWCD tries to encourage CAP water use by farmers through its in-lieu recharge program and reduced water prices. According to the Governor's Task Force, this action does not result in a long-term solution for agricultural utilization of CAP nor strongly increased short-term usage. By contrast, ADWR notes that several hundred thousand AF of CAP water was sold in this way.

CAWCD appeals for a repayment extension of one year from the USBR for reimbursable project costs, in part as a result of CAP underutilization problems. USBR grants the extension.

ADWR repropose assured water supply rules in March by preparing a concept paper for public input with three alternative proposals for requirements in AMAs like Tucson.

1992 CAP Select Water Quality Panel holds press conference in August on the CAP treatment process, water quality, and the issue of health risks from residual disinfection by chloramine.

Mayor and Council authorize an asset purchase agreement in September of the Metropolitan Water Company (Northwest Area) by the Metropolitan Domestic Water Improvement District. The agreement states that treated CAP water will be 80 percent of their supply by May 1995. The District can take this water directly, but must pay for it whether or not it is taken.

USBR's Plan for CAP terminal storage at Black Wash southwest of Tucson combines surface and underground storage for about one month's water supply in the event of an outage of the CAP system. Mayor and Council are briefed by USBR and by Tucson Water staff on this issue in September.

First Draft of assured water supply rules available for comment in October.

Delivery begins in Tucson with "CAP Water Phase I" in November. Phase I includes delivery to Tucson Water customers who live in the east, northeast, and southeast areas of Tucson and near the Tucson International Airport and the Tucson Water Treatment Plant.

Mayor and Council support terminal storage plan in November by adopting a memorial supporting Tucson Water's proposal as the preferred alternative in USBR's EIS on terminal storage of CAP water. SAWARA also supports the preferred alternative.

1993 Governor Symington appoints a second CAP Advisory Committee to examine options to increase Arizona's utilization of Colorado River allocations. The committee provided a number of recommendations focused on resolving the financial problems surrounding the CAP. Several of the recommendations result in legislation.

The 1980 GWMA is amended to allow the CAWCD to act as a ground water replenishment district (CAGRDR). This change provides an alternative source of water for communities and developers seeking an assured water supply, including the communities northwest of Tucson.

Economic Impact Assessment for the Draft Assured and Adequate Water Supply Rules are available.

1993 CAP water quality problems are experienced and reported in increasing numbers by a significant number of Tucson Water customers including colored water, odors, and damaged appliances (20,500 complaints by January 20, 1995). Complaints were first recorded in 1993.

Water quality expert is hired by the City - Dr. Edward Singley is hired by the City for assistance with the CAP problems. His first report in July identifies pipe corrosion from CAP water as the cause of colored water and prescribes zinc orthophosphate to correct it. He also notes that similar problems have been experienced by Colorado River water users in California.

Tucson Water announces water bill adjustments to be available to customers with colored water.

Colored water neighborhood flushing program begins at the end of August and information is provided to the community through a series of press conferences on zinc orthophosphate and other water quality issues.

Tucson Water's Neighborhood Service Center and other resources, such as news releases, fact sheets, advertisements, and news conferences are used to address the growing frustration with CAP in the community and to provide information about the CAP.

CAP Select Water Quality Panel releases a report examining Tucson Water's corrosion control activities to the Mayor and Council and the media. The report concluded that the corrosion control activities of Tucson Water were adequate with some problems relating to staffing and reduced demand of the treatment plant.

In a compromise vote, 50 percent of the Phase I CAP service area is returned to ground water service in October at the direction of Mayor and Council who, like Tucson Water, have been inundated with calls and complaints regarding CAP water.

A few days after the vote to halt 50 percent of the CAP water delivered to Tucson residents, the Mayor and Council meet with Governor Symington on issues concerning the City's use of the CAP allocation and the need to address the complaints of a broad cross-section of the community on CAP.

- 1993 Northwest Alliance is formed.** Members include: Avra Valley Irrigation and Drainage District, Avra Water Coop, Canada Hills Water Company, Community Water Company of Green Valley, Cortaro-Marana Irrigation District, Green Valley Community Coordinating Council, Marana, Metropolitan Domestic Water Improvement District, Oro Valley, Pima County, Pinal County, and Rancho Vistoso Water Company.

Director of Tucson Water, Michael Tubbs, resigns in November.

CAP Oversight Committee is appointed by Tucson Mayor and Council in November to facilitate an evaluation of CAP water uses that are feasible, achieve long-term water supply goals, and are acceptable to the community.

The City of Tucson votes to terminate the Santa Cruz Valley Water District. There is community opposition to this decision.

- 1994 California, Nevada and Arizona engage in heated negotiations and Congressional hearings** that may affect the allocation of Colorado River water as Nevada and California seek additional supplies. Arizona submits a plan for a water bank in view of USBR's conceptual rules for opening a water market to address unused entitlements to Colorado River water and Nevada's proposal for Lower Basin State Commission.

The State Legislature passes a comprehensive recharge package that liberalizes opportunities for recharge.

Northwest Area Agreements - The City of Tucson, Rancho Vistoso Water Company, Canada Hills Water Company, USBR, and the Metropolitan Domestic Water Improvement District intensify efforts to come to agreement on the use of CAP water in this area in March. The Metro District requested amendments to the 1992 purchase agreement, including the delivery of untreated CAP water with a recharge option, as a result of being unable to take water directly and because of negative publicity regarding CAP. Options are being negotiated, particularly since the CAGRD was established and Tucson Water is not the only source of CAP water for this area. Deadline for "take or pay" for CAP water is set at July 1995. Results of these negotiations may impact Tucson Water customers.

The consulting firm Dames & Moore is selected in May to work with the City's Oversight Committee on the comparison of CAP alternatives and the involvement of the community in identification of viable solutions for CAP water use.

A REVIEW OF KEY CAP-RELATED DECISIONS FROM 1965 TO PRESENT

CAP USE STUDY FOR QUALITY WATER

Chapter 1: Historical Framework

Before considering key city decisions related to the Central Arizona Project (CAP), this section introduces the broad historic agreements and decisions that set the stage for CAP use in Tucson. The decision to obtain and use CAP water in the Tucson Basin is part of ongoing struggles of the western states to secure long-term water supplies. The concerns and focal points of these struggles extend beyond the Tucson metropolitan area, yet local decisions are affected by and may have an effect on their outcomes.

The historical framework of CAP begins early in this century with the fight between western states for firm allocations of Colorado River water. Congress recognized the importance of this fight and in 1921 authorized the seven Colorado River basin states to negotiate and enter into a compact to divide the river's estimated annual flow of 14 to 18 million acre-feet¹ (MAF) of water. Commerce Secretary Herbert Hoover guided the 11-month-long negotiations in which the river was partitioned at Lee's Ferry, Arizona into an upper basin and a lower basin, each of which was allocated 7.5 MAF. About 1.5 MAF was reserved for Mexico. Each group of basin states² was left with the more difficult task of allocating the remaining water among the states involved. Nonetheless, this cornerstone of the "Law of the River" was signed by all delegates and submitted to Congress in 1922 for approval. Arizona was entitled to waters from both the upper and lower basins and was concerned that its rights to the river would be abridged, particularly by the lower basin states of California and Nevada.

Amidst this continuing fight, Congress passed the Boulder Canyon Project Act in 1928, contingent upon ratification of the Colorado River Compact by six of the seven basin states. Arizona disputed its allocation and was the only state to withhold its ratification of the Colorado River Compact. The passage of the Boulder Canyon Project Act, however, resulted in a de facto allocation of 2.8 MAF to Arizona. The lower basin states were given 7.5 MAF, of which 4.4 MAF were

¹An acre-foot of water is the amount of water it takes to cover an acre with one foot of water (325,848 gallons). M. Reisner reports that the U.S. Reclamation Service estimated the annual flow of the river to be 17.5 MAF, a rate that has since been disputed as optimistic (Reisner, Marc, Cadillac Desert. The American West and its Disappearing Water, Viking Press, New York, 1986, p. 131).

²The basin states are Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming.

allocated to California and 300,000 acre-feet (AF) to Nevada.^{3,4} In 1944, twenty-two years after the Boulder Canyon Project Act was negotiated, and with a need for secure water supplies, Arizona's state legislature voted to ratify the Colorado River Compact and contracted with the Secretary of the Interior for its 2.8 MAF share. Within two years, the Central Arizona Project Association was formed to promote Congressional authorization of funds for a U.S. Bureau of Reclamation (USBR) project that would bring Colorado River water to the farms of Arizona's central valleys. In 1947, the first bill to authorize the CAP was introduced in Congress, and Arizona began its 20-year fight to obtain federal consent to build the USBR project.

Despite passage of the Compact, Arizona and California continued to disagree about the security of Arizona's allocation of Colorado River water. One key item of dispute was California's argument that Arizona's allocation included the waters of the Salt and Gila rivers, both tributaries of the Colorado. Therefore, California thought that Arizona would be receiving water from the Colorado River and these two rivers. In 1952, Arizona sued California and the trial of Arizona vs. California began four years later before a Special Water Master in San Francisco. During the course of the trial, Arizona based its case on the need for water for agriculture uses.⁵ According to some sources, California nearly successfully argued that the agricultural uses envisioned for Arizona were subordinate to the needs of the thirsty residents of Southern California.⁶ In response, Arizona altered its strategy and subsequently based its claim on the Compact, the Boulder Canyon Project Act, its contract with Interior, and a California law limiting its own river allocation,⁷ among other precedents.

The landmark case proceeded to the U.S. Supreme Court, which found in favor of Arizona in 1963. A written opinion confirming Arizona's secure and legal title to 2.8 MAF of the main stem of the Colorado was issued in 1964. A series of new CAP bills was introduced in Congress shortly following this legal victory.⁸

³Southern Arizona Water Resources Association (SAWARA), Waterwords, Vol. 9, No. 5, Tucson, Arizona, 1991.

⁴Johnson, Rich, The Central Arizona Project, 1918-1968, University of Arizona Press, Tucson, Arizona, 1977, p. 6.

⁵In the early 1960s, the Arizona Interstate Stream Commission paid the USBR \$200,000 for an inventory of the state's water resources and a reevaluation of the need for the CAP.

⁶Wiley, Peter and Robert Gottlieb, Empires in the Sun. The Rise of the New American West, University of Arizona Press, Tucson, Arizona, 1982.

⁷California Limitation Act, 1929.

⁸Doyle, Mary, "Arizona and the Colorado River," Centennial Faculty Community Speaker Series, College of Law, University of Arizona, Tucson, Arizona, May 7, 1985.

In the 1960s, the USBR continued to adjust its plans for CAP. New studies were performed to assess the river's capacity to supply CAP water, and the bills introduced into Congress reflected the hard compromises necessary to win the reluctant support of western interests. For example, the Secretary of the Interior reported in 1967 that 1,019,000 MAF was available for the CAP over the 50-year repayment period that would be established. Arizona was to pay back about 70 percent of the construction costs for the CAP project. The USBR extended plans for the main aqueduct to the Tucson region and assumed that about one-third of the water delivered to this region would be allocated for municipal use. All of the City of Tucson's allocation was to be for municipal use. The price of an acre-foot of water was to be roughly comparable to the cost of pumping ground water: \$35/AF for municipal and industrial uses and \$12/AF for agricultural uses.⁹ The water was priced to be attractive to Arizona users, particularly agricultural interests, which was necessary to ensure that the project was financially sound. The USBR reduced the benefit-cost ratio for the project from 2.54 to 1.0 when it deleted project elements opposed by western interests outside of Arizona. A drop in the benefit-cost ratio signified that benefits are obtained from the project at a relatively higher cost.

In 1968, Congress passed the Colorado River Basin Project Act, which approved construction of CAP. Its passage occurred after 20 years of bills, debates and compromises in and out of Congress.¹⁰ The most difficult compromise often cited in the record was Arizona's pledge to defer its Colorado River allocation to California in times of shortage.

During the 1970s, many efforts were related to funding and construction of CAP. Congressman John Rhodes took a lead in getting the first federal funding to begin pre-construction planning for CAP in 1970. The establishment of the Central Arizona Water Conservation District (CAWCD) by state legislation in 1971 was aimed at organizing contracting mechanisms for CAP water and arranging the repayment of about 70 percent of the construction costs (ultimately \$2.5 billion in 1994).^{11,12} The CAWCD represented the three counties that were to directly benefit from the CAP: Maricopa, Pinal and Pima. In 1972, the CAWCD developed a repayment contract with USBR that cleared the way for construction to begin by 1973 at the Bill Williams River along Lake

⁹ The agricultural cost of \$12/AF in 1961 increased from an initial cost of \$4/AF in 1941 (Johnson, 1977, p. 140). This report later notes that economic assumptions may not have been sound; see Chapter 2.

¹⁰ See also Doyle, M., 1985 for information on points of debate and compromise on CAP bills.

¹¹ CAWCD's powers were increased by state legislation in 1982 that authorized the entity as the operative agent for the CAP and provided for the acquisition of property and electric power required to operate the project.

¹² Cohen, Marvin, Esq. and Sandra E. Price, Esq. "CAP Policy Review Briefing Paper," March 1, 1994. See also SAWARA, Waterwords, "Decision Time for the Central Arizona Project," Vol. 11, No. 3, May/June/July 1993.

Havasus.¹³ In 1974, the USBR began purchasing rights of way and issuing contracts for construction of the CAP aqueduct. Uncertain funding of CAP was a recurring problem throughout the 1970s. Arizona's Congressional delegation and other prominent business figures continued to lobby with nearly the same persistence that was necessary to authorize the project in 1968.

Tribal Concerns

In 1975, the City of Tucson was sued by the Tohono O'odham Nation (Nation) to halt the mining of ground-water reserves from beneath tribal lands. The litigation had a potential to affect the City's future ability to pump ground water and increased the need to obtain alternative supplies such as the CAP. The lawsuit was an event that triggered the march towards ground-water reform. Intensive negotiations ensued between the City and the Nation with both seeking a settlement that would provide mutual benefit. Congress intervened, and the Southern Arizona Water Rights Settlement Act (SAWRSA) was passed in 1982. This act allocated 66,000 AF per year of CAP water to the Nation primarily for irrigation use. The City was also directed to provide an additional 28,200 AF of effluent to the Nation for irrigation uses.¹⁴

SAWRSA has not been fully implemented because of unresolved issues between the Nation and individual landowners within the reservation, the allottees. Congress, the City, and the Nation are continuing to work towards a settlement in 1995 and have developed two packages of proposed amendments. The first amendment package was introduced in 1992, and the most recent package, being prepared by Congressional staff, will be introduced to Congress sometime in 1995. These amendments intend to allow greater flexibility in the Nation's use of its allocations and provide the Nation with an additional 28,200 AF of CAP water.¹⁵ However, this settlement is dependent, in part, on the City's commitment to use renewable supplies of water, such as reclaimed water or CAP, rather than ground water to meet its principal demand.¹⁶

¹³SAWARA notes that the repayment contract was finally executed in 1983 (Waterwords, Vol. 9, No. 5, 1991).

¹⁴The need to settle Indian water claims also had an impact on selection of the alignment of the Tucson Aqueduct to the west of the Tucson Mountains.

¹⁵Marvin S. Cohen, "SAWRSA Amendments Briefing Paper," presented to the SAWARA Board, 1993.

¹⁶Cohen and Price, 1994, pp. iii and 12

The Link to Ground-water Reform

The issue of continued CAP funding and its link to ground-water law reform reached a climax at the federal level in 1977. President Jimmy Carter attempted to terminate the CAP in January of that year by adding it to his "hit list" of projects that were reported to have unacceptable environmental impacts and questionable benefits when compared to their costs.¹⁷ CAP was becoming one of the most expensive USBR projects in U.S. history. The estimated cost for constructing the main aqueduct, pumping stations, and other primary components was about \$1.7 billion in 1977.¹⁸

This cost did not include treatment or distribution of CAP water for specific users. Two long-term results of this challenge to the project funding had significant effects on water resources management in Arizona and on the ways in which CAP water would be used. First, the Carter Administration asserted that Arizona (or any other state) would not receive USBR dollars until it demonstrated that existing water resources would be managed in an effective and environmentally sound manner. Continued federal funding for the CAP would be contingent on the reform of Arizona's ground-water law.¹⁹ Second, it became clear that President Carter sought reform of repayment and financing provisions so that the direct beneficiaries of federal reclamation projects would have an increased obligation to pay for those benefits. President Reagan implemented the call for "cost-sharing" reform in the 1980s. Before Congress agreed to complete the CAP, Arizonans ultimately were required to commit to covering a greater share of the project costs and to paying in advance for some of its key flood control and water storage components, primarily one or more new dams or dam improvements in central Arizona known as Plan 6.

The Arizona legislature responded to the Carter Administration's first major funding condition by establishing the Groundwater Management Commission in 1977. Appointed by the legislature, this commission was comprised of representatives of major state water users, including agriculture, mining, tribal groups, labor, and municipalities. The commission became directly involved in the disputes and conflicts over the need to protect the rights of existing ground-water users, while

¹⁷ Barr, James L. and David E. Pingry, "An Economic Analysis of the Central Arizona Project," Hydrology and Water Resources in Arizona and the Southwest, Vol. 7, pp. 15-27; Proceedings of the 1977 meetings of the Arizona Section of the American Water Resources Association and the Hydrology Section of the Arizona Academy of Science.

¹⁸ Barr and Pingry, 1977. An April 1989 USBR fact sheet on CAP estimated that the federal cost of constructing CAP in 1989 dollars was \$3.44 billion and actual dollars spent were about \$2.7 billion (U.S. Department of Interior, USBR, Lower Colorado Region, Arizona Projects Office Fact Sheet, Central Arizona Project, April, 1989)

¹⁹ Funding was also contingent on deletion of several dams that were to provide "regulatory storage" of CAP water, but which also involved potentially significant environmental concerns. One of these was Charleston Dam on the San Pedro River, which was to store waters that would ultimately be diverted to Tucson.

providing a mechanism to manage and conserve the state resources. The product of this commission was the 1980 Groundwater Management Act (GWMA). The key provisions^{20,21} included:

- Management of the State's under ground water supplies by Arizona Department of Water Resources (ADWR).
- Designation of four Active Management Areas (AMAs), consisting of: Tucson, Phoenix, Prescott, and Pinal, and three irrigation non-expansion areas, including Douglas, Joseph City, and Harquahala.
- Establishment of a system of controlled rights and uses of ground water. Present users are largely "grandfathered" under the law. New permits are allowed only under very limited conditions.
- Requirement to produce a series of five enforceable management plans establishing methods to control or reduce withdrawals from the underground supplies. Methods include mandatory conservation for all water use sectors, augmentation of the water supply, and purchase and retirement of farmland.
- Demonstration of an assured water supply for 100 years (relying primarily on sources other than ground water) prior to approval of new developments.
- Provision for other management methods including well construction and registration regulations, requirements for measuring devices on large well facilities, and a requirement that amounts pumped be reported to ADWR on an annual basis.
- Achievement of balanced water supply and demand through a concept known as "safe yield" by the year 2025 in the AMAs where ground-water depletion is of critical concern.

As mentioned in the above key provisions, the GWMA has established a system of controlled rights and uses of ground water. While this system emphasizes conservation and reducing dependence on ground water for all users, some have rights to use ground water that others do not have. Many of the users with these rights included are farms and mines. Users without are often municipalities.

²⁰Kyl, Jon L., "The 1980 Arizona Groundwater Management Act: From Inception to Current Constitutional Challenge," University of Colorado Law Review, Vol. 53, 1982.

²¹City of Tucson, Tucson Water brochure, "Serving You Today, Planning for Tomorrow," 1985, p. 14.

These rights are called grandfathered rights, which are based on historic withdrawals. There are three types of grandfathered rights: irrigation, Type 1 non-irrigation, and Type 2 non-irrigation. These rights differ in how they are used and in the rules governing how the rights may be sold.

The irrigation grandfathered right is the right to use ground water to irrigate specific acres of land. That land must have been irrigated with ground water between 1975 and 1980 and if it was not irrigated, then it may not be irrigated with ground water in the future. This right may only be sold in association with the land.²²

A Type 1 non-irrigation grandfathered right is a right to use ground water for non-irrigation purposes. It is associated with farmland that has been retired from cultivation for a non-agricultural use, such as a golf course or an industrial plant. This non-irrigation right may also be sold only with the associated land. The GWMA, in addition, provides a fund to purchase and retire farmland after the year 2006.²³

A Type 2 non-irrigation grandfathered right is similar to Type 1 except its right is based on historical pumping of ground water for a non-irrigation use and equals the maximum amount pumped in any year between 1975 and 1980. Examples include mines and other industries, livestock watering, and golf courses. Unlike Type 1 and irrigation grandfathered rights, Type 2 rights can be sold separately from the land or well. For example, the owner of a Type 2 right may, with ADWR approval, withdraw ground water from a new location within the same AMA.²⁴

Although it signalled the beginning of a new water management era for Arizona, the passage of the GWMA emphasized the need for the CAP in the view of many observers. In fact, the safe yield objective of the GWMA was effectively linked to completion of the CAP because many state water managers viewed CAP water as a means to reduce dependence upon ground water, assist the achievement of safe yield in AMAs and still provide a safe and reliable water supply. The assured water supply provisions of the GWMA positively affected the completion of the CAP (and Tucson's subsequent CAP use) because CAP allocations were considered a primary means of demonstrating an assured water supply. The quantification of ground-water rights also had implications for CAP because state limits on access to ground water meant other supplies, such as CAP water, would be necessary to meet demands not met by the limitations of grandfathered Type I or Type II ground-water rights, permits, or service area rights.

²²ADWR, "Overview of the Arizona Groundwater Management Code," 1986.

²³Ibid

²⁴Ibid.

A REVIEW OF KEY CAP-RELATED DECISIONS FROM 1965 TO PRESENT

CAP USE STUDY FOR QUALITY WATER

Chapter 2: Decisions to Bring CAP Water to Tucson

This chapter discusses Tucson's early interest in Congressional authorization of the CAP and its eventual subcontract with the CAWCD and USBR for 148,420 AF of water. By 1965, the City recognized that ground-water supplies would be insufficient to meet the projected population growth in the Tucson area without mining ground water.¹ Water importation from the Colorado River was identified as the primary means of addressing this problem. Once the CAP was authorized by Congress in 1968, the City continued a steady push for its completion to Tucson. Twelve years later the City faced the additional concern of meeting the requirements of the 1980 Groundwater Management Act. Upon subcontracting for and using CAP water, the City had the potential to demonstrate its assured 100-year water supply to ADWR by 1998. The chronology provides a list of events between 1965 and 1988, the approximate time period associated with these decisions.

Early Activities (1965 - 1980)

By 1965, the Mayor and Council, Director of Tucson Water, and the Tucson Chamber of Commerce Water Resources Committee were campaigning to bring the CAP to Tucson. As early as 1962, Tucson Water files show internal reports identifying and projecting water demand in the Tucson Basin for 1963, 1980 and 2000 (96,100 AF; 142,400 AF; and 315,000 AF, respectively).² Tucson Water records show a concerted effort to determine whether ground-water reserves understood at that time were sufficient to support growth in the basin.³ On New Year's Eve, 1964, the City of Tucson became a voting member of the CAP Association to lobby Congress for the "construction of facilities to bring Colorado River water into Arizona to augment the declining municipal, industrial and agricultural sources of water supply." A resolution⁴ signed by the Mayor and Council the previous week declared that "the City of Tucson is in desperate need of a supplemental water supply and will benefit from the Colorado River water source upon completion of the facilities for the transportation of said waters... It has been found by Mayor and Council to be

¹ Paul Beerman, Director of Tucson Water, Arizona Daily Star, "Tucson Officials Hopeful," April 3, 1965.

² City of Tucson, Water Utility files, Consumptive use of Water in the Tucson Basin and Water Demand, Exhibits for City of Tucson at Interstate Stream Commission meeting, 1962.

³ Paul Beerman, Director of Tucson Water, Arizona Daily Star, "Tucson Officials Hopeful," April 3, 1965.

⁴ City of Tucson, Mayor and Council Resolution #6008, December 21, 1964.

in the best interest of the City of Tucson and its inhabitants to actively and financially participate in the objects and purposes of the CAP Association."

City decisions associated with the early support for CAP include:

1. Beginning in 1965, resolutions supporting the CAP show varying levels of financial backing for the CAP Association in its Congressional lobbying efforts. Some of these early demonstrations of support include:
 - On October 25, 1965, the Mayor and Council approved a \$41,000 contribution to push CAP through Congress (Resolution 6336).
 - On May 1, 1967, the year before the CAP was authorized by Congress, the Mayor and Council passed a Resolution to endorse the CAP and to push further action by Congress (Resolution 6902).
2. Mayor and Council's, as well as the Metropolitan Utilities Management Board's and the County Board of Supervisors', 1975 Letter of Intent to the Arizona Water Commission to take 100,000 AF of CAP water annually.⁵

The Letter of Intent enacted safeguards that would allow "our community to withdraw from the project, if it so desired, if the community's cost became excessive." The conditions allowing the community to reconsider its participation included:

- project costs exceeding \$1.2 billion
 - the CAWCD tax rate exceeding 10 cents per \$100 assessed valuation, and the price of water exceeding \$32.50 per acre-foot.
3. From 1966 through 1972, the City Council contributed \$25,000 annually to the CAP Association to help support their promotional and education program. During the years 1973 and 1974, the City made no contributions. Membership was renewed in 1975 with a \$10,000 contribution but no payments were made in 1976.⁶

The basic assumption behind the early decision to support the CAP was that it was the City's "best bet" for stabilizing the aquifer if ground-water withdrawals were limited. This realization was

⁵City of Tucson, Mayor and Council Resolution #9408, January 30, 1975; approving the letter of intent.

⁶Memorandum to Mayor and Council from City Manager Joel Valdez, May 1977.

made well before the 1980 passage of the state's Groundwater Management Act. A 1965 Arizona Daily Star article stated:

But the water table under the city - our only current source of supply - is dropping from 3 to 7 feet annually and as the city goes deeper for water, it finds the quality is becoming progressively poorer. The results of recent deep test drillings have not been encouraging. Here are some general figures: In the area of Tucson we probably are pumping 150,000 AF of water out of the ground every year. Maybe about 75,000 AF of water gets back into the ground from rainfall in this area. So, we are over pumping by about 75,000 AF. We are "mining" water that won't be replaced in the soil. This is a water deficit.⁷

In the 1973 HUD 701b Plan, "A Regional Plan for Water, Sewerage, and Solid Waste Management" by the Pima Association of Governments (PAG), four options for declining ground-water supplies were presented:

- decrease the amount of water used by municipal customers
- use reclaimed wastewater for landscape and agricultural irrigation, mines, and ground-water recharge
- retire agricultural lands
- import water from outside sources

In addition, secondary sources such as the Arizona Daily Star report that water importation from the Colorado River was identified by City officials as the primary means of addressing the problem of insufficient ground-water supplies:

Previously, it was thought the basin fill of this valley went down about 3,000 feet and that we could go on mining water for a long time before we had any real problems....However, the four deep test wells the city recently has drilled showed, in general, that it isn't true...The ideal answer would be to stabilize the basin by pumping maybe about 75,000 Acre Feet per year out of it and deal with other needs by bringing in fresh water supplies from elsewhere...The best answer is to import water, preferably from a surface supply, so it can be mixed with the local supply and overcome some of the quality problems.

⁷Paul Beerman, Director of Tucson Water, Arizona Daily Star, "Tucson Officials Hopeful," April 3, 1965.

The Central Arizona Project looks like the best bet to bring us this water....Under present planning, Tucson is scheduled to get 100,000 Acre Feet per year of water each year from the project. But officials think this is too little and have asked for three times that amount, although we might not need it until into the next century.⁸

Public involvement from 1965 to 1980 included:

- Mayor and Council meetings associated with resolutions to provide financial support for the CAP Association.
- 1975 public hearing associated with the City's Letter of Intent to take CAP water.
- Regular newspaper reporting of CAP events in Washington, D.C. and in Phoenix.
- 1979 - two groups appear in the record to promote local water interests - Southern Arizonans for the Central Arizona Project (SAFE-CAP) and the water committee of Tucson Tomorrow.
- Public hearings were held early in 1979 to present Tucson's need for the CAP. Information on attendance was not obtained from sources reviewed.

Records of public involvement were not readily obtained and efforts that were reported were limited.

Support for the CAP, however, was not entirely unified. One key example appeared in a 1967 Arizona Review article, written by University of Arizona agricultural economists, who warned that the CAP water would not provide an economic benefit to farmers based, in part, on rising water costs and low crop prices.⁹ The findings of this article suggested that Arizona's existing ground-water supplies could support anticipated urban growth under certain constraints. Conservation methods must be implemented. These included implementation of conservation methods, curtailment of ground-water use by agriculture, application of water to other uses with a higher economic value than agriculture, and appropriate water pricing.¹⁰ These economists questioned the assumptions behind

⁸Ibid.

⁹Robert A. Young and William E. Martin, "The Economics of Arizona's Water Problem," Arizona Review, College of Business and Public Administration, University of Arizona, Tucson, March 1967. See also "Mines and Agriculture Decline CAP Water," in this report.

¹⁰Ibid.

the CAP and Arizona's ability to financially and economically support the project. Despite the merit of some of the questions raised, dissent neither deterred official advocacy of the project, nor did it appear to alter many of the assumptions on which the project was based. Problems with CAP assumptions related to agricultural water use, in particular, are noted later in this chapter.

Mines and Agriculture Decline CAP Water

At the beginning of the CAP allocation process, both the mining and agriculture industries indicated a desire to use CAP water and were participants in the Congressional lobbying effort to bring Colorado River Water to Central Arizona. In the late 1980s, however, the mines began to indicate that CAP water quality and the interruptability of the supply would be detrimental to their operation. They also indicated that the use of CAP water would not be economically feasible.¹¹ Upon completion of the CAP project agriculture was expected to buy approximately sixty to eighty percent of Arizona's Colorado River allotment of 1.5 MAF over the next several decades.¹² Upon delivery of CAP water, only fifty percent of the agricultural land in the CAP service area contracted for the water and no agricultural users in the Tucson AMA contracted for CAP. Between 1989 and 1991, these agricultural purchases of the water declined by forty-eight percent. Further declines in CAP water use by agriculture are predicted. Some of the reasons for farmers not contracting with the CAWCD were and are:¹³

- Lower cost of other water sources such as ground water, surface water, and effluent
- Higher than expected CAP water prices
- Lack of financing
- Farm bankruptcies
- Decisions not to plant (including set aside programs, low crop prices, lack of financing, etc.)

Subcontract With USBR and CAWCD (1988)

The result of these early activities was the City's 50-year subcontract with the USBR and the CAWCD for up to 148,420 AF of CAP water annually signed on November 28, 1988. In 1980, on the basis of population projections and a target water use of 140 gallons per capita daily (gpcd), ADWR recommended a revised CAP allocation for Tucson from about 100,000 to 148,420 AF/yr.

¹¹Memorandum to Mayor and Council from John Jones, Acting Director of Tucson Water, July 1, 1994.

¹²Wilson, Paul , "An Economic Assessment of Central Arizona Project Agriculture," November 1992, p. vii.

¹³Ibid.

The larger Tucson AMA, designated by ADWR for ground-water conservation and management, was to receive 241,707 AF of water, about one-third of which was envisioned for agricultural uses. The allocation was accepted by the Secretary of the Interior. Under the 1988 subcontract, the City has the option of obtaining excess CAP water if available. Key components of the subcontract are noted below.¹⁴

- Tucson has no obligation to take CAP water. Instead, the subcontract allows the City to order up to its full allocation by October of each year for the next fiscal year. Changes to the delivery schedule can be made with 15 days advance written notice.
- Three types of payments must be made on the water: capital repayment charges; fixed operation, maintenance and repair costs (OM & R); and energy costs to pump the water to Tucson. Capital costs must be paid on Tucson's entire allocation whether or not the City takes CAP water. Fixed OM & R costs must be paid on scheduled water whether or not that water is ultimately taken. Energy costs are paid only on water that is both scheduled and delivered.
- Capital charges are used by the CAWCD to repay its obligation on construction costs to the federal government. In 1994 the capital costs are estimated to be \$10.50 per acre-foot. Capital charges are payable twice each year on June 1 and December 1.
- Fixed OM & R costs are based on estimates developed by CAWCD and are paid monthly in advance. Water deliveries can be withheld if these costs are not paid. In 1994, the payments are set below actual costs for the next five years at the request of municipal customers like the City of Tucson. CAWCD is using property tax funds accrued during the last 15 years to make up the shortfall.
- Energy charges are based on the total cost of electricity to pump water from the Colorado River to all CAP customers divided by the total number of acre-feet delivered, "a postage stamp rate." This rationale is beneficial to Tucson, which is located at the end of the system.
- In 1994, combined OM & R and energy costs are \$59.50 per acre-foot. By 1999 they will increase to an estimated \$104 per acre-foot.

¹⁴Cohen, Marvin S., Esq. and Sandra E. Price, Esq., "A Briefing Paper for CAP Policy Review," Sacks, Tierney & Kasen, P.A., Phoenix, Arizona, March 1, 1994, pp. 10-11 and Appendix A.

- Nothing in the subcontract is intended to conflict with the legislative settlement between the Nation and the City of Tucson.
- CAP facilities must be operated in such a manner to maintain the highest water quality level reasonably attainable as determined by the CAWCD.

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Chapter 3: CAP Aqueduct Phase B - Building the Aqueduct to Tucson

The Central Arizona Project is designed to bring 1.5 MAF of water each year from the Colorado River at Lake Havasu into central and southern Arizona. Its 335-mile water delivery system includes canals, tunnels, pipelines, and pumping plants. There are 14 pumping plants necessary to raise the water nearly 3,000 feet uphill from the lake to the end of the CAP southwest of Tucson.

In August 1979, the USBR issued its Preliminary Central Arizona Project Alternatives for Eastern Pima County; the document discussed water supply, quality and route descriptions. By the following year, the USBR redesigned the Tucson section of the CAP by eliminating the controversial Charleston Dam on the San Pedro River, enlarging the main aqueduct, and adding "Phase B" to bring the last leg of the CAP to Southern Arizona.¹ The resulting Phase B Aqueduct is 47.4 miles long, with 28.0 miles of concrete-lined channel, 19.4 miles of pipeline, and six pumping plants.² The system can deliver CAP water to the Tucson area at an approximate rate of 750 cubic feet per second annually.³ The completed canal runs southwest of Tucson through the Pascua Yaqui Reservation and on to the San Xavier District's southern boundary.

Aqueduct Siting in the Tucson Area (1984)

In the mid-1980s the question of where to site the aqueduct once it reached the Tucson area had critical implications for development of distribution systems to various users and for the location of a terminal storage facility that would enhance the CAP's reliability for southern Arizona water users. Two main alternatives for aqueduct siting were considered: (1) an alignment west of the Tucson Mountains with a terminus and treatment plant location at the south end of Tucson Mountain Park, and (2) an alignment east of the Tucson Mountains with a treatment plant location at the north end of that mountain range.

¹SAWARA, Waterwords, "The Tucson CAP Story," Vol. 9, Number 5, September/October, 1991.

²USBR, "Final Environmental Impact Statement- Tucson Aqueduct Phase B," August 14, 1985.

³Marybeth Carlile, SAWARA. An average volume of 161,900 AF/yr was reported in 1985 in the USBR "Final Environmental Impact Statement - Tucson Aqueduct Phase B."

In 1983, SAWARA formed the CAP Alignment and Terminus Storage Committee (CATS), at the USBR's request. The purpose of this committee was, in part, to examine the USBR's alternative plans in order to recommend a suitable alignment for the Phase B aqueduct.⁴ The City of Tucson and other users voiced their alignment preferences through participation in CATS.

The CATS was the extent of the public involvement for the aqueduct siting. CATS was comprised of several community leaders and representatives of business and local water use interests, many of whom were divided on the east/west alignment question. Neither alignment appeared to meet the needs of all users. For example, Avra Valley farmers pressed for an alignment to the west side to ensure that water would be available at a reasonable cost to agricultural users. Environmentalists, on the other hand, preferred an east-side alignment because it lacked an open canal and affected fewer acres of pristine desert habitat. The City of Tucson also preferred the east-side plan for the flexibility and cost savings it offered - a turnout would be directed to a CAP treatment plant on the northwest side of town but not in the original plans for the west-side alignment.⁵ Assumptions made by the City were that an east-side alignment would:

- Provide the delivery elevation (2,750 feet) required by the previous Mayor and Council action.
- Avoid the community expense of \$24 million for what the USBR named the "Tucson Delivery Line," because with an east-side alignment the farmers of the Avra Valley Irrigation District would be required to pay for the line.
- Provide the flexibility needed to build multiple turnouts and multiple treatment plants which may be required by future growth patterns and population densities.
- Allow the use of untreated CAP water for irrigation, recharge, or blending with effluent.
- Avoid some of the environmentally sensitive areas of the west-side alignment.⁶

⁴The USBR hosted most of the CATS meetings; no meeting minutes were available in the SAWARA files reviewed.

⁵Animal Defense Council vs. Hodel, Background Summary, pp. 2168 through 2174, filed February 24, 1988 for publication; as attachment to letter to SAWARA on February 29, 1988 from Steven Weatherspoon of Chandler, Tullar, Udall & Redhair, Tucson, Arizona.

⁶SAWARA, "Report from Southern Arizona Water Resources Association on Alignment, Terminus, and Storage - Tucson Aqueduct Phase B, Central Arizona Project," Adopted April 22, 1983.

An April 1983 CATS/SAWARA report on this topic suggested that these alternatives were distilled into a controversy between an alignment either east or west of the Tucson Mountains.⁷ The CATS report stated: "At its March 18, 1983 meeting, CATS was confronted by an apparent dilemma in which:

- an east-side alignment would benefit municipal users;
- a west-side alignment would benefit Avra Valley farmers;
- an east-side alignment would cost the farmers \$24 million for a feeder pipeline plus \$336,000 a year to pump the water;
- a west-side alignment would cost the municipal water users \$24 million for a feeder pipeline plus \$1.7 million a year to pump the water and operate and maintain the pumping facilities. "

CATS/SAWARA strongly suggested that the situation could be resolved if the USBR "accepts responsibility for delivery of municipal water via the CAP aqueduct" to a west-side location at 2,850 feet, as requested by the City of Tucson. In addition, a split was needed at the terminus of the aqueduct on the west side to allow direct delivery to a City treatment plant and another that served tribal, mining, and agricultural needs. While costs were estimated to be \$12 million greater with these modifications, CATS "believes this is a small amount to pay for the achievement of strong community support on a project of this importance and size."⁸ Ultimately, the report recommended the west-side plan. This alignment recommendation was acceptable to CATS/SAWARA only if the USBR implemented all reasonable measures to reduce the project's impact on the environment and agreed to define both aqueducts as project features (to help ensure federal funding). The City of Tucson agreed to the west-side alignment assuming that the above mentioned modifications would be included.

Given the need for resolution, the USBR proposed several modifications to the west-side alignment in response to CATS deliberations, such as different turnout locations and elevations for the City. Savings resulted from converting pipelines to open canal. The "spirit of compromise was emphasized" in which all the terminus of the canal is located at the south boundary of the San Xavier Reservation at an elevation of about 2,800 feet. As noted above, the elevation met the City's delivery point concerns about annual power costs even though the location still required significant capital costs to deliver to the City's customers. The revised alternative also increased the USBR's capital and operating costs over the costs of an east-side Tucson turnout farther to the north.⁹

⁷Ibid.

⁸Ibid.

⁹Ibid, p. 8.

Nine days before the Environmental Impact Statement (EIS) was issued in 1985, Avra Valley Irrigation District (AVID) asked CAWCD for an extension on executing its subcontract to take CAP water. Two weeks after the EIS was published, the AVID's deadline passed. This event affected one component of the proposed east-side alignment - six miles of open canal to transmit water to AVID. With this need eliminated, the estimated cost of the east-side plan was reduced by \$40 million which subsequently closed the cost gap between the alternatives to about \$15 to \$20 million.¹⁰ The removal of the open canal also erased most of the environmental impacts associated with the east-side alignment. The USBR provided revised cost comparison tables and concluded that their EIS did not need revision because the preferred west-side plan, now the result of local compromise, remained the least expensive.

An additional alternative raised during the planning for Phase B Aqueduct was recharge. Dr. C. Brent Cluff, an associate hydrologist at the University of Arizona, advocated recharging CAP waters and recovering them for later use. The EIS indicated that the USBR considered two plans involving recharge: one using an east-side alignment and the other the preferred proposed west-side alignment. Tables in the EIS compared relevant physical features and costs. The EIS noted that this recharge proposal had been "extensively reviewed" but it was rejected as a final alternative because the proposals were not as cost-effective as the west-side plan and they lacked sufficient public support.¹¹

On August 14, 1985 the USBR filed its EIS for Phase B of the CAP aqueduct. Five alternatives were discussed, as well as the alternative of no federal action. The USBR selected the west-side plan, which used a greater amount of open canal than the other alternatives. In so doing, the USBR recognized the biological and cultural impacts of this plan but explained that these could be reduced significantly by implementing a number of mitigation measures. Lower construction and operating costs and public support were also contributing factors to the selection of this plan. On September 24, 1985, the USBR issued a record of decision selecting the west-side alignment.

The issue of aqueduct alignment was not closed despite this record of decision. A number of environmental groups, led by the Animal Defense Council, sued the Department of Interior in 1986 under the National Environmental Policy Act over the adequacy of the Phase B EIS. The Council made three basic claims related to the alignment:

- The EIS should have been supplemented once it was learned that the AVID was not going to contract for CAP water (making the west-side alignment less attractive).

¹⁰ Animal Defense Council vs. Hodel, 1988, pp. 2168-2174.

¹¹ Ibid.

- Worst case analyses should have been conducted on the alignment west of the Tucson Mountains (required by federal regulations if the consequences of federal action are unknown or uncertain).
- A cost-benefit analysis should have been performed for recharging all or most of the CAP water delivered (as opposed to treatment and in response to Dr. Cluff's proposal during Phase B planning).

After the lawsuit was filed, a SAWARA Waterwords article noted that the CAWCD, the City of Tucson, SAWARA, and the Mountain States Legal Foundation were allowed by the Court to intervene as defendants, presumably due to their support and endorsement of the selected alternative.¹² The article also explained the Court's findings leading to dismissal of the case in 1986. The U.S. District Court judge reasoned that a supplement to the EIS was not required on a rejected alternative (the east-side alignment), that a worst case analysis was not required because consequences were not unknown or uncertain, and that the federal government should not perform a cost-benefit analysis on the recharge proposal. Recharge of the City's allocation was strictly a City decision and opportunities were not prevented by the selection of the west-side alignment. The Animal Defense Council appealed in 1987 and the Ninth Circuit Court upheld the earlier ruling.

During the 1986 hearings, the USBR was required to delay some of its progress on the Phase B Aqueduct pending the outcome of the litigation. The construction of Tucson's CAP Water Treatment Plant was also affected by the timing of the lawsuit and by some of its allegations. By 1991, however, CAP water arrived in the Tucson area through the west-side alignment of the Phase B Aqueduct.

Terminal Storage

Terminal storage was another infrastructure issue requiring local input and related to USBR's plans for the physical CAP system in the Tucson area. Unlike the pipeline to Phoenix, the Phase B Aqueduct system, which includes nine pumping stations, has no back-up in the event of a system outage due to routine maintenance or emergency. The effect of this deficiency is that CAP deliveries will be halted to Tucson during emergency and maintenance outages unless "terminal storage" provides water during these interim periods. In 1981, Secretary of the Interior James Watt directed the USBR to include regulatory storage as part of the Tucson Aqueduct planning effort.

Cat Mountain, located at the south end of Tucson Mountain Park near the Tucson-Ajo Highway, was originally identified as a suitable location for terminal storage and was preferred by

¹²SAWARA, Waterwords, "Status Report on Tucson Phase B Litigation," Vol. 4, Number 5, August 1986.

the City. On November 8, 1982, "the Mayor and Council unanimously adopted the position that delivery to the Cat Mountain storage site at 2,750 feet in elevation and a storage capability there of 35,000 AF were essential to the City's ability to assure its existing and future customers of continuous CAP water availability."¹³ Due to its location in Tucson Mountain Park, the site was later opposed by some individuals with concern for environmental impacts and by certain Pima County elected officials. SAWARA wrote: "In the spirit of compromise and in the hope that its action would lead to unanimity of position, the City modified its stand and recommended to CATS that the Cat Mountain Storage site be eliminated from consideration by the USBR with the understanding that the need for storage to serve the Tucson area should be reevaluated by the USBR after the operations reliability of the CAP system was tested."¹⁴

The USBR began studies on the reliability of the Tucson Aqueduct and the need for terminal storage in 1986 through the Tucson Aqueduct System Reliability Investigation, Phase I. The study concluded that one or more breaks in service could be expected in the Tucson area each year of an estimated duration of between 25 and 77 days. (Indeed, maintenance of the CAP system planned in October 1994 involved a system shut-down similar to those envisioned in 1986 and might affirm the need for terminal storage or other supplies to meet interim demands.) As a result of this finding, terminal storage plans proceeded and a proposed site was identified at the end of the Phase B Aqueduct on undeveloped land at Black Wash, owned by the Pascua Yaqui and a private citizen.

Late in 1991, Tucson Water proposed an alternative combining underground and surface storage at the Black Wash site. The 15,000 AF surface storage area would be located where gravity flow would drain waters to Tucson's CAP Water Treatment Plant. If surface storage is insufficient to meet demand during outages, ground water would be recovered to provide additional supplies. Recovery would be achieved through two existing wellfields and through construction of a new wellfield near the site. This alternative would provide enough water for 47 days and could serve peak flows for 20 days. The USBR reported that Tucson's proposal was one of two alternatives presented at the public meetings held in March 1992.¹⁵

Following those public meetings, a series of follow-up meetings was held among various Tucson officials, representatives of Tucson water interests, members of the Arizona Congressional delegation, and USBR officials. These meetings resulted in efforts between the USBR, CAWCD and

¹³SAWARA, "Report on Alignment, Terminus, and Storage - Tucson Aqueduct Phase B, Central Arizona Project," adopted April 22, 1983, p. 6; SAWARA explained that this position was based primarily on "reliability."

¹⁴Ibid, p. 8.

¹⁵U.S. Bureau of Reclamation, Memorandum from Arizona Projects Office, Phoenix, Arizona from Project Manager on the CAP -- Tucson Aqueduct System Reliability Investigation, February 1993, pp. 3-5.

Tucson Water to find a "mutually acceptable solution" on the question of terminal storage. In September 1992, these three parties agreed to recommend the Tucson Water proposal as the USBR's preferred alternative in the EIS. The USBR reported that the Tucson Mayor and Council and the CAWCD Board of Directors "approved the plan in concept, with the understanding that a number of issues remain to be resolved".¹⁶ SAWARA recommended that the USBR form a group of "interested parties" who could resolve some of the outstanding issues related to size of the reservoir. SAWARA asked Tucson Water and CAWCD staff to communicate the possibility for amendment of the plans to accommodate regional needs. In November 1992, the Mayor and Council adopted a memorial supporting Tucson Water's proposal as the preferred alternative in the EIS on terminal storage of CAP water.

The USBR also responded to SAWARA's action by meeting with regional entities to assist in determining an acceptable terminal storage alternative, building on the framework provided by Tucson Water. By May 11, 1993, USBR gave the SAWARA committees progress reports on terminal storage.¹⁷ The USBR found that efforts to gather these interest groups were unsuccessful, but the USBR met separately with each group instead. The USBR also reported on Endangered Species Act and Historic Preservation Act concerns identified through the EIS process. Pima pineapple cactus, a proposed endangered species, was found at the preferred site at Black Wash and thirteen archaeological sites were found eligible for national listing. At the time, these concerns were expected to limit the kind and extent of recreation available at the reservoir but not to eliminate the site from consideration. (Minutes of a joint meeting of the CATS and CAP committees on November 4, 1993, indicated that Pima County Parks and Recreation had expressed interest in recreation opportunities at the terminal storage reservoir.) The USBR reported that the feasibility study on the Black Wash site should be completed by the end of 1993 with a final design to be completed by the end of 1994.

CATS, Tucson Water and the USBR continue their work on terminal storage through the present. A 1994 memorandum estimated the schedule for USBR's adoption of a final EIS in August 1995.¹⁸

¹⁶Tbid.

¹⁷SAWARA, Annual Report, 1992-1993.

¹⁸SAWARA CATS II Committee notebook, Memorandum from Marvin S. Cohen to Tom McLean at Tucson Water on Terminal Storage, February 22, 1994.

A REVIEW OF KEY CAP-RELATED DECISIONS FROM 1965 TO PRESENT

CAP USE STUDY FOR QUALITY WATER

Chapter 4: Decisions on When and How to Use CAP Water in Tucson

The direct use of CAP water for municipal customers appears to have been a basic assumption in the City's water use equation. Direct use essentially means the City's allocation would be used as potable water. In the mid-1980s, the community was focused on decisions concerning water conservation, ending Tucson's dependence on ground water, arrival of CAP to Tucson, and the amount of CAP water to be introduced to the City delivery system. The use of CAP water to replace ground water appeared to be a reasonable alternative with few technical limitations. Recharge, as a method of storage, was considered as a corollary to CAP water use. Although there was a faction that saw recharge as a true method, a blending method or way to pump ground water instead of CAP, the decisions appear to have been based on physical limitations of the CAP system, the City's treatment plant, and changes in pricing of CAP water.

Original Assumptions (pre-1984)

Prior to 1984, the City of Tucson initially planned to serve to its customers about 30,000 AF/year of its CAP annual water allocation of 148,420 AF.¹ This low utilization, meeting only about 30 percent of Tucson's projected water demand as of the delivery date, was based on the higher cost of CAP water relative to ground water. The remaining supply requirements would be met by wells. Tucson intended to increase its utilization of CAP water over time until the total available allocation was used directly by the year 2025 and beyond.²

One alternative considered as a solution to the prohibitive pricing of the CAP water was blending of CAP water and ground water. In 1983, Montgomery-Johnson-Brittain was retained by the City to prepare the preliminary design report for the CAP Water Treatment Plant. In that report, CAP water delivery was assumed to occur throughout the entire service area.³ With a low usage of the CAP allocation, blending was assumed, and a 50/50 split of ground water to CAP water, on average, was used to simplify communications with the public. However, in 1992, when the first Tucson residents began receiving CAP water, the water was not blended with ground water. The

¹CH₂M Hill, Tucson Water Resources Plan, 1990-2100, Planning Background Report, April 1989, p. E-22.

²City of Tucson, Tucson Water, "Policy Decision Document to Optimize CAP Benefits," September 1987.

³Interviews with Tucson Water staff, May through July, 1994.

record shows no specific date of a decision not to blend; rather, it appears that this assumption gradually shifted away from blending as CAP use plans and costs changed.

In 1984, the CAWCD set sliding-scale water pricing for municipal and industrial (M&I) subcontractors, in part due to Tucson being the largest municipal customer of the CAP in the State. Without revisions to the pricing schedule, the CAWCD would lose needed revenues if its largest customers were not initially planning to take their allocations. Further, agricultural water users were not subcontracting for CAP water as anticipated due to cost and uncertainty of their supply.⁴ The revised M&I price schedule included a \$5.00/AF/yr charge on the total allocation, whether or not the water was used. Beginning in 1994, the levy would be increased each year until it reached \$40.00/AF in 2024. A SAWARA article also noted that this price reduction encouraged Tucson Water to plan for use of sixty percent of this CAP allocation directly and conserve ground water.⁵ The Arizona Daily Star affirmed this view when it published an article titled "New Rates to Encourage Earlier Use of CAP Water."⁶

In response to this pricing, the Mayor and Council authorized a base CAP water use plan in 1984 that provided for direct use of 60,000 AF of CAP water in 1991, no recharge, and a 100 million gallon per day (mgd) treatment plant in the initial phase. The plan called for a 200 mgd ultimate treatment plant capacity in 2007.⁷ During this time, Montgomery-Johnson-Brittain was studying water quality objectives for the treatment plant and initial design work was underway.⁸

Changes in physical CAP structures also increased the favorability of more direct use of CAP water by municipal customers. In October of 1987, the USBR revised the firm delivery capacity of Snyder Hill Pump Station from 200 mgd to 225 mgd. This station delivers treated water from the City's treatment plant to the Clearwell Reservoir.

⁴Non-Indian agriculture had the lowest priority for CAP water, after municipal and industrial users and Indian agriculture. By contrast, ground water was more readily available and the cost of pumping less prohibitive for economically distressed farmers and ranchers in the state.

⁵SAWARA, Waterwords, "The Tucson CAP Story," Vol. 9, No. 5, September/October 1991, p. 11.

⁶January 6, 1984.

⁷CH₂M Hill, Tucson Water Resources Plan 1990-2100, Planning Background Report, April 1989, p. E-23.

⁸In November 1987 a public initiative on treatment of CAP by recharge was defeated by Tucson's voters.

In November 1987, Citizens Water Advisory Committee⁹ (CWAC) submitted its recommendation to the Mayor and Council on the 1988/89-1997/98 Ten-Year Capital Improvement Program. This November communication noted "Tucson Water is currently evaluating the potential of directly using more CAP water in an effort to maximize the use of as much CAP water as possible in the early years of the CAP availability."¹⁰ By January 22, 1988 CWAC recommended to the Mayor and Council that the CAP Water Treatment Plant's initial capacity be increased from 100 mgd to 150 mgd.

In addition, the concept of "recharging the CAP water not directly used by either injection or surface recharge was to be considered as an alternative".¹¹ CWAC explained, "We have concluded that this change will enable the City to utilize its full allocation of CAP water through a combination of direct use and recharge at the least cost to the community while at the same time assuring the highest level of water quality..."¹²

Tucson Water Resources Plan, 1990-2100 (1989)

In 1988, the Mayor and Council directed staff to refine these alternatives while utilizing the 1984 Base Plan.¹³ They adopted the Ten-Year Capital Improvement program based on the assumption of use of 60,000 AF of the City's CAP allocation by 1991. The governing body also adopted Resolution 14327 in February of 1988 which augmented the initial treatment plant capacity from 100 to 150 mgd and increased the year 2007 capacity from 200 mgd to 225 mgd.¹⁴ Increasing the treatment capacity helped promote direct use of CAP water in Tucson.

⁹This committee was appointed by the City Manager and formed in November of 1977 in response to the 1976 City Council recall and water rate increase. Members of CWAC were selected to represent a broad base of the community. Their job was to provide independent evaluations for and recommendations to the City on sound water management practices and policies.

¹⁰Memorandum to Council Member Tom Saggau, Ward 3, from John Jones, Acting Director, Tucson Water, December 27, 1993.

¹¹CH₂M Hill, Tucson Water Resources Plan, 1990-2100, Planning Background Report, April 1989, p. E-23.

¹²Ibid.

¹³See Appendix A, Table 7-2 "Objectives and Assumptions for Base Plan and Least Cost Plan", from CH₂M Hill, "Tucson Water Resources Plan, 1990-2100," 1989.

¹⁴Ibid.

On May 9, 1988, the Mayor and Council were asked by the City Manager for approval to contract for "...a long-range water resource plan for the City of Tucson..."¹⁵ The same source reported that the scope of services was thoroughly reviewed by CWAC and SAWARA. The scope of work involved:

- plans for utilization of the present CAP allocation
- alternatives to the present utilization plan
- water quality related to storage, recharge, and the use of CAP water
- present and projected wholesale rate structure for CAP water, including potential treatment costs

The City of Tucson subsequently contracted with CH₂M Hill to develop a 110-year water resources plan for Tucson Water (referred to as the "long-range plan"). Public participation and a citizen advisory committee were components of this project. Chapter 1 of the Tucson Water Resources Plan, 1990-2100 identified the objectives of the "Master Plan" as:¹⁶

- to comply with all requirements of the 1980 Arizona Groundwater Management Act including safe yield, conservation, and the 100-year assured water supply
- to reduce pumping of ground water as soon as possible
- to maximize the use of CAP water through direct use, recharge, and recovery
- to reuse or store all effluent
- to be flexible in responding to changing conditions

In June 1988, a 15-member Water Resources Advisory Committee (ADCOM) was appointed by the Mayor and Council. ADCOM's role was to advise the consultant preparing the Water Resources Plan. The intent of the Mayor and Council in establishing ADCOM was to select members from "various water groups and interests,"¹⁷ including the following:

¹⁵Ibid., p. 8.

¹⁶CH₂M Hill, Tucson Water Resources Plan 1990-2100, Planning Background Report, April 1989, p. 33.

¹⁷Ibid., p. D-8, Table 1, lists members of ADCOM and their affiliations at the time. No neighborhoods appeared to be specifically represented on ADCOM.

- CWAC
- SAWARA
- Technical Expertise
- Neighborhood and Environmental Interests
- Business Community
- Governmental Agencies
- Farming Community
- Tohono O'odham Nation"¹⁸

Meetings were held monthly at the start of the process and later adjusted to twice monthly due to the complexity and amount of material to be covered.

The "Purposes and Goals of the Plan" (pages 1 and 2) describe it as a "flexible document representing a broad community consensus on today's important water issues." Thousands of pages of alternatives and background materials were reviewed by ADCOM and other water resources groups like CWAC, SAWARA and the Pima County Wastewater Management Advisory Committee. Interviews were also conducted with "representative citizens in the community."¹⁹ A public hearing was noted in the historical record at the time the Plan was adopted. However, broad-based efforts to reach the public during the planning process were not identified in the records reviewed for this report.

Assumptions for the Plan were stated on page 8-2. In addition to assumptions about gallons of water use per person, it stated that the Plan would satisfy the demand resulting from "the high population projection"²⁰ and that "projected demands of private water companies within the projected service area are included." The total available effluent supply was identified as 55 percent of the total water demand.

As part of the long-range planning process, ADCOM members and other key water users were interviewed about issues in five major areas: (1) regional management and service areas, (2)

¹⁸CH₂M Hill, Tucson Water Resources Plan, 1990-2100, Attachment 1, p. D-35.

¹⁹CH₂M Hill, Tucson Water Resources Plan, 1990-2100, p. D-8 and pp. D61-D-63. The representative citizens listed on Table 1, p. D-62 were southern Arizonans involved in local businesses, governments, or water resources management.

²⁰"It assumes that Tucson Water will continue to be the major regional water provider and that it will provide water service to 2.8 million people living in a 1,200-square-mile service area by 2100," from p. 8-1 of the Tucson Water Resources Plan, 1990-2100. It is standard engineering practice to use the highest population projection or "worst case" projection for planning purposes.

supply and demand, (3) rates, (4) reclaimed water, and (5) Tucson Water. ADCOM was asked to rank these issues, and the findings were presented in the Plan.

CAP water quality did not appear in this list. The Mayor and Council's 1984 decisions on water quality were used as assumptions. However, the most controversial issue considered at the time was the development of uses for reclaimed water and importation of non-CAP water. The Plan stated, "Finally, with few exceptions, citizens [ADCOM] favor maximum use of CAP water as soon as delivery begins, even though it will cost more than ground water."

Maximum Early Use of CAP Water. During the early years of the project, Tucson's CAP allocation will exceed demand. A cost-effective program for disposition of the surplus CAP water needs to be developed. Tucson Water is evaluating the phasing of the CAP supply into its system. This phasing will be determined in part by any incentives provided by regulatory agencies to encourage maximum early CAP use.²¹

The Master Plan, a section of the Tucson Water Resources Plan, 1990-2100, which was selected through the process of evaluating alternatives, is described in Chapter 8 of the Tucson Water Resources Plan, 1990-2100. The Plan established basic criteria for management decisions regarding all elements of Tucson's water supply through the year 2100. It uses a combination of seven water sources to meet the estimated 37.89 MAF demand for the 110-year planning period and a water service population of 2.8 million people.²² In Table 8-1 of the Plan, CAP direct use accounts for 18.97 MAF of the supply or about 50 percent. CAP recharge and recovery was targeted at 1.39 MAF and ground-water pumping at 4.18 MAF.

With regard to direct use of CAP water, the Tucson Water Resources Plan, 1990-2100 recommended on page 1-4 that "fifty percent of Tucson Water's demands during the 110-year planning period will be met with the direct use of CAP water from the Colorado River. This CAP water will be treated at the Tucson Water Treatment Plant." Initial direct use of CAP was planned at 4,000 AF in December of 1991. It would be increased to 94,750 AF/yr. over a three-year period.

Once the Tucson Water Resources Plan, 1990-2100 was completed, CWAC and the ADCOM held a joint review meeting on May 25, 1989. ADCOM recommended that the Mayor and Council adopt the Plan. They also commented on the nature of the public involvement process during the

²¹CH₂M Hill, Tucson Water Resources Plan 1990-2100, April 1989, p. 23.

²²Ibid., 1989, pp. 8-1, 8-2, and 8-9.

planning effort. "Our purpose has been to advise the consultant, CH₂M Hill, by identifying issues, communicating community preferences and attitudes toward alternative supply sources, and serving as a link between the consultant and other segments of the water community and the public...With the Plan documents, the community is able for the first time to take the various elements that will define our water future and see how each element relates to the others over time. During the past few years, a series of separate issues has been addressed relating to CAP, conservation, effluent reuse, recharge, and treatment options. But never before have we taken such a comprehensive inventory of existing and potential new sources and woven them together into a fabric that reveals costs and trade-offs. The background documents are the most comprehensive assemblage of information on water programs and issues that have ever been prepared...Because water issues in this community are continually evolving, and the regulatory framework changes frequently, it is imperative that the Plan be continually updated. The most important aspect of this work effort is the flexible process that will be used to refine the Plan."²³

After conducting a public meeting on the Tucson Water Resources Plan, 1990-2100 on June 6, 1989, CWAC adopted its recommendation for implementation on June 13. In their letter to the Mayor and Council, CWAC's chair stated "The Plan reflects this community's commitment to maintaining high-quality, reasonably-priced water supplies. Through its role in the recommended annual review and updating process, CWAC will be working to assure that the Plan continues to reflect a broad community consensus on any and all on-going water issues. The Plan provided much-needed policy focus, and CWAC urges you to adopt it as the basis of the City's long-range water resources program."²⁴

SAWARA's recommendation to the Mayor and Council dated May 31, 1989, stated "The current plan you have before you is the product of an honest debate over the relative merits and values of each of the supply options... It is a highly professional job done by the consultant with much input from a wide spectrum of community interests."²⁵

On June 20, 1989 the Pima County Board of Supervisors adopted the final recommendation on the Tucson Water Resource Plan, 1990-2100. Following these community endorsements, the Mayor and Council adopted the Plan on July 3, 1989. The Plan confirmed the program of direct use

²³CH₂M Hill, Tucson Water Resources Plan, 1990-2100, July 3, 1989, p. ix.

²⁴ Letter to Mayor and Council , from CWAC, dated June 13, 1989.

²⁵Letter to Mayor and Council, from SAWARA, dated May 31, 1989.

(beginning in 1992) and direct filtration treatment of CAP water.²⁶ Early maximum use of the CAP water allocation through direct use, recharge and recovery was a principal outcome of the Plan relevant to this portion of this report, coupled with the earliest possible reduction of ground-water pumping.

Other Issues

In 1980, on the basis of population projections and a target water use of 140 gpcd, ADWR recommended a revised CAP allocation for Tucson of 148,420 AF/yr. This allocation assumed that the City would be able to pump at least 36,000 AF of ground water per year in the year 2034, nine years after the safe yield goal was mandated. In order to meet safe yield and to meet the projected water needs of the community, the City began looking to receive an equivalent amount of CAP water (36,000 AF) through the reallocation process.²⁷ Projections from the 1990 Census indicate that total demand within Tucson Water's service area will exceed Tucson's current allocation within 10 to 15 years.²⁸ Tucson Water staff recommended that the city submit a request for an additional 36,116 AF of CAP allocation to ADWR.²⁹ Approximately 66,000 AF of M&I priority CAP water was available for reallocation. Requests for more than 300,000 AF have been filed and late requests were still being received by ADWR.³⁰

In addition to negotiations with ADWR on water reallocation, Tucson Water is also negotiating with the northwest water providers regarding wholesale water rates and related cost recovery issues. According to John Jones, Acting Director of Tucson Water, "in order for Tucson Water to establish reliable projections for wholesale water rates, it is necessary to determine the type of service (direct use or recharge), quantities, and scheduling of water deliveries. Once reliable numbers or at least a reasonable range of values have been established, alternative rates can be proposed and the northwest providers can assess the potential impacts of these rates on their financial plans and retail water rate."³¹

²⁶Mayor and Council Communication, July 3, 1989, Subject: Tucson Water Resources Plan: 1990-2100 Public Hearing and Adoption (inside and outside City).

²⁷Tucson Water Staff Position Paper, "CAP Allocation and Reallocation," September 1989.

²⁸Memorandum to Council member Tom Saggau, from John Jones, Acting Director of Tucson Water, June 10, 1994.

²⁹Ibid.

³⁰Ibid.

³¹Ibid.

These negotiations refer to the Northwest Area Water Plan, which was developed in 1979 for the City and the northwest water providers to mutually prepare and maintain a regional water development plan. This plan is still in effect. The fundamental principle of this plan was that CAP water would be used for demands above the baseline level of use (the 1979 consumption level). When this plan was completed, the only option available for these area water providers was to receive their water from Tucson Water. Since 1979, however, their options have increased. Their primary alternative to receiving water from Tucson Water is to obtain their own CAP allocation from the Central Arizona Groundwater Replenishment District.

The CAP Use Study for Quality Water

Consistent with the adopted Tucson Water Resources Plan, 1990-2100, water service to Tucson area residents using treated CAP water began in November 1992 and about 80,000 connections were served CAP water. Hundreds of residents began reporting problems. Colored water appeared to be the most prevalent problem, although some residents noted that galvanized pipes and appliances were failing. Others reported odors from the water and skin rashes from its hardness. In October 1993, Governor Symington met with the Mayor and Council to hear first hand the types of complaints that were causing the Mayor and Council to consider suspension of the CAP deliveries. The governor expressed his concern over the City's threat to discontinue use of CAP water in view of statewide repayment issues. Despite this meeting and as a result of continuing customer complaints, the Mayor and Council voted to return 50 percent of the CAP service area to ground-water service on October 11, 1993. On October 18, 1993, the Mayor and Council, in recognition of the importance of CAP water to the Tucson area, directed Tucson Water to investigate ground-water savings projects as a possible way of increasing the City's use of CAP water.³² The Mayor and Council also appointed the CAP Oversight Committee to facilitate an evaluation of CAP water uses that are feasible, achieve short- and long-range water supply goals, and are acceptable to the community. The Committee drafted the Request for Proposal for the CAP Use Study for Quality Water, and in May 1994 the Dames & Moore consulting team was selected to carry out its objectives. In December 1994, the Mayor and Council voted not to reappoint Oversight Committee members. Plans are underway to solicit public input in other ways.³³

³²Tucson Water, "Draft Groundwater Savings Projects - Opportunities for Utilizing Central Arizona Project Water," July 1994.

³³SAWARA, Waterwords, "Wanted: Citizen Involvement in the CAP Use Study for Quality Water," Vol. 13, No. 1, January/February 1995.

The CAP Use Study for Quality Water includes an extensive community involvement program as well as a technical study of CAP water use alternatives. In the scope of work for this project, the following water use alternatives were identified.

- Rely solely on ground water; make no use of CAP water.
- Current program of direct use of CAP water as defined in the Tucson Water Resources Plan, 1990-2100 and subsequent annual reviews.
- Direct recharge by well injection and by in-channel and out-of-channel surface spreading basins.
- Sale/lease/indirect recharge with local agricultural users.
- Sale/lease/indirect recharge with local mining enterprises.
- Sale/lease/indirect recharge with other jurisdictions/states.
- Demineralization or other alternative treatment.
- Blending of treated CAP water and ground water at the treatment plant, within the distribution system, and within the aquifer during recharge operations.
- Exchanges of CAP water for Pinal County's ground water.
- Any other alternative or combination of alternatives deemed worthy of analysis by the consultant.

The alternatives that advocate indirect storage and recovery through recharge are mandated by the State 1990 indirect ground-water storage and recovery legislation. This legislation provided for indirect storage and recovery projects that "will cause the direct reduction or elimination of ground-water withdrawals in an active management area or an irrigation non-expansion area by means of delivery of effluent, Colorado River water or Central Arizona Project water."³⁴ During the 1994 Legislative session, the recharge legislation was streamlined, clarified and renamed "ground-water savings." Ground-water savings projects present a short-term opportunity to increase the use of CAP water in the Tucson area by making it available to agriculture and mines through indirect recharge.

³⁴Tucson Water, "Draft Groundwater Savings Projects - Opportunities for Utilizing Central Arizona Project Water," July 1994.

The City is also able to acquire long-term storage credits that can be applied toward the assured water supply requirements. Ground-water savings also may be a cost-effective way to obtain a long-term water supply.³⁵

³⁵Ibid.

A REVIEW OF MAJOR KEY CAP-RELATED DECISIONS FROM 1965 TO PRESENT

CAP USE STUDY FOR WATER QUALITY

Chapter 5: Decisions on CAP Water Quality

Until the delivery of CAP water in 1991, ground water has always been used in the Tucson area to meet its many water supply needs. Historically, the quality of this ground water has been good, typically better than federal drinking water standards, and most Tucsonans have been satisfied with this water source.^{1,2} Tucson's ground water was not uniformly chlorinated until the City anticipated EPA's rule for disinfecting waters from underground sources before they are served to customers.

The quality of the Colorado River water that arrives at the Tucson Water Treatment Plant is inherently different from Tucson's ground water. It is harder, has more total dissolved solids (TDS), and has more calcium, sodium, magnesium, chloride and sulfate than Tucson's ground water. CAP water has a higher pH than Tucson's ground water.³ Long before treatment options were studied, a 1968 Citizen headline stated, "CAP will give us water; but it won't taste good."⁴

Water experts in the community knew that water quality would vary with a change in supply. This realization led to a series of actions since the 1980s to evaluate appropriate treatment options and solicit public preferences on the level of water quality to be achieved. "Water Quality Objectives" were identified through a detailed study, pilot treatment studies were performed, and the Tucson Water Treatment Plant was constructed by 1987. Beginning in the late 1980s the City made efforts

¹Montgomery-Johnson-Brittain, Tucson Water Treatment Plant Project, Phase I Preliminary Investigations, Appendix A to Water Quality Objective Report, Database Memorandum, (Subtasks 1.2.1 and 1.2.2), 1983, Chapter 2, Historic Tucson Water Quality.

²Wells in areas where industrial contamination has occurred and contaminants have been detected at regulatory levels are excluded from the City's water distribution system (EPA Fact Sheet from Tucson Water). For example, wells on the City's south-side, located near the Tucson Airport Remediation Project, were found to contain unsatisfactory levels of trichloroethylene and chromium. These wells have been shut down pending remediation of ground water in this area. Tucsonans living in this area have been concerned about the health effects of drinking ground water containing these constituents.

³SAWARA, Waterwords, "CAP: Focus on the Facts," Vol. 11, No. 5, November/December 1993, p.8.

⁴Tucson Citizen, November 9, 1968.

to prepare its customers for possible changes in water quality resulting from the use of CAP water. Nonetheless, when deliveries of CAP water commenced in late 1992, many Tucsonans experienced changes in their water quality that they felt were undesirable. In October of 1993, the Mayor and Council voted to suspend deliveries of CAP water to areas located where CAP-related damage appeared to be most serious.

Water Quality Objectives (since 1983)

Beginning in the early 1980s, the City worked to identify appropriate ways to manage water quality given expected changes in its supply. This section addresses key decisions made about initial water quality goals for the treatment of CAP water. Most of these goals were established through the Water Quality Objectives Study conducted for the City between 1983 and 1984.

City decisions associated with this effort include:

- November 15, 1982 - Mayor and Council authorized a contract with a scientific advisor from the University of Arizona for assistance with water quality decisions (Resolution 12069).
- March 14, 1983 - Mayor and Council authorized a contract for the Preliminary Design of the Treatment Plant which included a water quality objectives study (Resolution 12188).
- May 29, 1984 - Mayor and Council adopted the Water Quality Objectives Report (WQOR) and thereby its findings and recommendations (Resolution 12680).

The purposes for retaining independent scientific resources, as identified in the Resolution, were to assist the City with technical decisions about water quality, such as:

- projecting raw water quality parameters and their changes with time
- identifying treatment process efficiencies, flexibility and reliability
- selecting appropriate chemical treatment
- identifying treatment design provisions that preserve treatment options to accommodate future changes in raw water quality

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The purposes of the 1983-1984 Water Quality Objectives Study were to:

- identify alternative treated water quality objectives
- obtain constructive feedback through the public participation process⁵.

The 1983-1984 Water Quality Objectives Study also discussed consumer costs and impacts of treatment alternatives.

The basic assumptions behind the decision to obtain independent scientific advice and to perform a Water Quality Objectives Study were:

- CAP water is a surface supply with water quality characteristics different from most of the ground water in our region.⁶
- Planning and research would be required prior to the design and construction of a Water Treatment Plant.

In addition to those listed above, some of the basic assumptions underlying the 1983-1984 Water Quality Objectives Study included:

- Ground water and CAP water would be blended on average at approximately a 50 percent ratio.⁷
- The City was committed to some amount of direct use, although when and how much versus other use options was not clear. Public input about water quality objectives

⁵Montgomery-Johnson-Brittain, "Tucson Water Treatment Plan Project Phase I Preliminary Investigations - Water Quality Objective Report" (Task 1.2), May 1984, p. 1-1.

⁶Montgomery-Johnson-Brittain, "Tucson Water Treatment Plan Project, Phase I Preliminary Investigations, Appendix A to Water Quality Objective Report, Database Memorandum (Subtasks 1.2.1 and 1.2.2)," May 1984, Chapters 2 and 4 on Historic Tucson Water Quality and Historic Colorado River Water Quality.

⁷Montgomery-Johnson-Brittain, "Tucson Water Treatment Plant Project, Phase I Preliminary Investigations, WQOR, Public Participation Program Data," May 1984, pp. 8-1 and 8-9.

appeared to be extensive, but it may have been based on assumptions about water use that have since changed.⁸

Assumptions related to the findings and recommendations of the WQOR are identified later in this section.

During the 1983-1984 Study, the consultant used information on historic and projected CAP water quality and from the public participation program to identify five constituents for the water quality objectives:⁹

- turbidity (clarity of the water)
- coliform (harmful bacteria)
- total dissolved solids (TDS)
- total hardness
- trihalomethanes (THMs or by-products of water disinfection that have been studied for the potential to cause additional human cancers)

At the time, State regulations required that "all water obtained from surface water sources shall, as a minimum, be filtered and disinfected prior to being placed into the distribution system (R18-4-232)," making disinfection of CAP water a basic objective. Additional water quality objectives were established by this study for hardness and TDS removal due to the characteristics of CAP water. The general criteria with respect to hardness and TDS removal was to reduce levels for these parameters in CAP water to the current levels in Tucson well water.¹⁰

Seven different types of treatment were suggested initially to address these constituents. These treatment methods also provided a range of water quality objectives from a minimum level of meeting federal drinking water standards to higher levels that involved improvements in aesthetic water characteristics such as hardness and taste. These seven levels were eventually reduced to three that were presented to the public for review:

⁸This study preceded the Tucson Water Resources Plan, 1990-2100 discussed in the previous chapter.

⁹Montgomery-Johnson-Brittain, "Tucson Water Treatment Plant Project, Phase I Preliminary Investigations, Appendix C-2 to the WQOR," May 1984 presentation by Dr. Carol Tate, J.M. Montgomery Consulting Engineers, Inc.

¹⁰Table 9-1 of the Water Quality Objectives Report presents the three treatment choices and water quality objective levels used in the public participation programs. Costs are summarized in Table 9-2 and in Figures 9-3 and 9-4.

- chemical disinfection
- softening
- demineralization

In comparison to decisions made in the 1960s and 1970s, public involvement was a large component of the study and formed the basis of many of the recommendations. Approximately 110,000 residents were ultimately surveyed by water bill inserts: 1,000 by workshop questionnaires: and 400 by brief phone interviews.¹¹

In addition, six meetings were held with key contact groups including:

- Citizens Water Advisory Committee (CWAC), Technical Advisory Committee
- Southern Arizona Water Resources Association (SAWARA) Steering Committee
- SAWARA Water Quality Subcommittee
- Pima Association of Governments Water Quality Committee
- Groundwater Users Advisory Council
- Business Water Users
- Environmentalists
- Homeowner Groups

A series of five project newsletters were prepared and distributed. Public meetings were held in October on water quality and treatment and on the treatment plant location in November. The public was informed about expenses related to treating CAP water in its December newsletter titled, "Water Treatment Newsletter # 3: Getting Ready for CAP: The Costs of Treatment."¹² Other newsletters covered the topics of treatment plant site selection, preliminary design, and public hearings. Some of the assumptions applied during this study differ from those currently used for CAP water in the community. For example, the study used the assumption that CAP water would be blended roughly 50 percent with ground water.¹³ In addition, the first newsletter noted that some CAP water would be used for mines and farms and that some would be recharged. The City was

¹¹Montgomery-Johnson-Brittain, "Tucson Water Treatment Plant Project, Phase I Preliminary Investigations, Appendix C to the WQOR," 1984.

¹²Montgomery-Johnson-Brittain, "Tucson Water Treatment Plan Project, Phase I Preliminary Investigations, Appendix C to WQOR, Public Participation Program Data," May 1984.

¹³Ibid.

committed to some amount of direct municipal use, although when and how much versus other use options was not clear.

In addition to newsletters, public outreach was conducted during the project using a variety of tools, including:¹⁴

- surveys through water bill insert questionnaires and workshop and meeting questionnaires
- a 20-minute slide show prepared for interested organizations with an estimated 1,050 viewers, including homemakers and environmentalists
- media coverage including project-related articles in local newspapers
- two public workshops (40 in attendance) and three special meetings with business and environmental groups
- a toll-free phone line to the consultant which resulted in a mailing list that grew from 1,400 to 2,400 interested persons

In general, Tucsonans who participated in the surveys, presentations, and meetings preferred and supported standard conventional treatment (no softening or demineralization) of CAP water at low cost to consumers.¹⁵

The report recommended basic filtration and disinfection treatment rather than softening or demineralization. This recommendation was the result of a technical analysis of alternatives overlaid with the public participation effort. The principal reasons for this decision, as cited in comments received in the surveys, were:

¹⁴Ibid.

¹⁵Ibid. In addition, Table 9-3 and Figure 9-5 of the WQOR summarizes the results of the surveys designed to obtain public input on treatment preferences. Figure 9-14 summarizes the preference of special interest groups surveyed. Table 10-1 provides a detailed list of the recommended treated water quality objectives.

- Minimize treatment cost - reducing hardness and salinity in CAP water substantially increases treatment costs. Many of those surveyed wanted their water bills to remain as low as possible.
- Avoid higher sodium concentrations - the public was informed that sodium is added to the water as a result of the softening process. A number of those surveyed expressed deep concern over increased sodium. Hardness removal (softening) was the least popular of the three alternative water quality objectives.

The technical evaluation was consistent with the results of the public participation program indicating that treatment to meet all mandatory drinking water standards, but not to reduce hardness or total salinity, was the most appropriate objective. The report also set goals for THMs at 20 parts per billion (ppb). This goal was more stringent than both current state and federal standards (100 ppb) and anticipated U.S. EPA standards (80 ppb) under the 1986 Safe Drinking Water Act Amendments.¹⁶

Shortly after the report was presented to Tucson Water, the Mayor and Council held a public hearing on May 29, 1984 to assess public opinion on the report before approving it. Following the hearing, the Mayor and Council unanimously approved and adopted the WQOR through Resolution 12680 and, consequently, the water quality objectives and treatment methodologies it recommended.

Treatment Options

In December 1985, the Preliminary Design Report for the Treatment Plant was completed and, in addition to project siting and design, some treatment options were examined.¹⁷ In this report, the assumption was that Tucson consumers would receive a blend of treated CAP water and well water, in a mixture ranging from 100 percent CAP and 0 percent well water, to 0 percent CAP and 100 percent well water.¹⁸ The three basic alternative treatment processes examined were direct

¹⁶CH₂M Hill, 1989, p. E-21. The federal limit for THMs set in 1979 by EPA was 100 ppb.

¹⁷Montgomery-Johnson-Brittain, Preliminary Design Report for the Tucson Water Treatment Plant Project, December 1985.

¹⁸Ibid, p. 3-8.

filtration,¹⁹ conventional treatment,²⁰ and high-rate conventional treatment.²¹ These processes were selected "based on their ability to achieve treated water quality objectives and for their applicability to the proposed Tucson Water Treatment Plant."²²

In this report and in a Review of the Preliminary Design Report,²³ it was found that conventional treatment offered essentially no advantages over high-rate conventional treatment (filtration) for the Water Treatment Plant, and that both direct filtration and high-rate conventional treatment were to be further evaluated after pilot studies were performed. By November 29, 1988, Carollo, Black & Veatch's "Basis for Design" Report stated that "the initial plant design is based on the direct filtration process..."²⁴ Direct filtration, as discussed in the December 1985 Preliminary Design Report, has reduced capital costs and somewhat lower operations and chemical cost than conventional treatment. At the same time, a number of disadvantages are associated with this method of treatment. They are:²⁵

- A greater degree of operator attention and expertise is required to maintain an optimized coagulant dose for meeting water quality objectives and desired filter production rates.
- Less contact time through the plant limits operational flexibility both in terms of response time by operators and the type and range of chemical doses that can be employed.

¹⁹Direct filtration is defined as coagulation, flocculation, filtration, and disinfection.

²⁰Conventional treatment is defined as coagulation, flocculation, sedimentation, filtration, and disinfection.

²¹High-rate conventional treatment contains the same basic treatment processes as the conventional treatment; however, the design criteria are less conservative than the criteria for a conventional treatment plant.

²²Montgomery-Johnson-Brittain, Preliminary Design Report for the Tucson Water Treatment Plant Project, December 1985, p. 5-1.

²³Carollo, Black & Veatch, Preliminary Draft Design Report, August 1987.

²⁴Carollo, Black & Veatch, Basis of Design, November 29, 1988, p. 21.

²⁵Montgomery-Johnson-Brittain, Preliminary Design Report for the Tucson Water Treatment Plant Project, December 1985, p. 5-4.

- Short contact time through the plant makes the use of certain oxidants such as potassium permanganate and adsorbents such as powdered activated carbon more difficult.
- Without sedimentation, the removal of high turbidity, algae, taste and odors is limited.
- Shorter filter runs between backwashes are experienced during high turbidity episodes.
- Filter production efficiency is lower than conventional treatment.
- Increased monitoring of the raw water source and plant performance may be required by the Arizona Department of Health Services (later Arizona Department of Environmental Quality).

In addition to the conventional and direct filtration treatment methods, recharge was seriously considered in 1987 as a treatment method for CAP water after it had been previously rejected by the USBR in the mid-1980s during the planning for the Phase B Aqueduct.

A recharge proposal was presented by Dr. C. Brent Cluff. The proposal involved conveyance of CAP water from the canal west of the Tucson Mountains "to the upstream portions of the three main stream systems in the Tucson Basin (Santa Cruz, Rillito, Canada del Oro). It would be discharged into the stream bed where, through infiltration it would move downward to the water table and then laterally toward existing city wells. Proponents claimed that in the process of moving through the subsurface most if not all of the organic compounds that would lead to the formation of carcinogenic substances THMs when the water was treated with chlorine would be removed."²⁶ In addition, the impact of salts in CAP water would be minimal due to mixing with ground water. The resulting treatment by recharge would produce about the same quality of ground water that Tucsonans are accustomed to drinking and using without disinfection. Costs were estimated to be low because the only anticipated expense would be the construction of a \$50 million pipeline from the CAP canal to the areas of recharge.

²⁶SAWARA, Waterwords, "Special Issue on Artificial Recharge - SAWARA Board Opposes the Water Supply Security Through Recharge Initiative," Vol. 5, No. 4, May/June 1987.

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Petitions were circulated and a citizens' initiative for the all-recharge alternative began. The initiative amended Chapter 25 of the Charter of the City of Tucson. "Section 14. Water Supply Security Through Recharge" and noted that all CAP water placed in the potable domestic water system would first be recharged into any appropriate aquifer in the Tucson AMA. No additional funds would be spent to construct or operate a chemical treatment facility for CAP water. No chemical treatment facility could be used by the City to treat CAP water that causes "a net increase in the total concentration of suspected or proven human carcinogens in the treated water, as measured in parts per billion."²⁷ These treatment restrictions would not apply to CAP water already recharged and comingled with ground water in the Tucson AMA. (This is the exception to the above restrictions.)

SAWARA and the CAP Association both opposed the initiative on the basis of unacceptable costs, concerns about the recovery of the water, and the potential for unknown health risks and effects on the existing ground-water supply.²⁸ The CAP Association estimated the costs of safely implementing the all-recharge proposal at \$400 million (including removal of existing landfills). The Association also claimed that the construction and annual operating costs of the proposed treatment plant was less than half the amount estimated for the same activities on the recharge initiative.

In the October 1987 CAP Water Treatment Plant and Clearwell Reservoir Final Environmental Assessment,²⁹ the USBR evaluated Tucson's all-recharge alternative proposal in relation to cost effectiveness, health considerations, water yield, and reliability and concluded:

- An all-recharge program would cost significantly more than the proposed City treatment plant.
- While the soils can remove some contaminants from water, there is ample evidence that all organics are not removed from water by travel through soil. Data from Orange County, California indicate that 66 percent of the organic precursors are removed in recharged Colorado River water. Assuming a similar removal rate in Tucson and assuming that the Environmental Protection Agency does require

²⁷Ibid.

²⁸See also CAP Association, CAP Watergram, "Tucson's All Recharge Assessment - September 1987," Vol. 19, No. 5, 1987.

²⁹U.S. Bureau of Reclamation, October 1987, pp. 11-15.

disinfection, the use of chlorine at the wellheads when the recharged water is pumped would produce THMs in excess of 20 ppb. Because an all-recharge program would have numerous recovery wells rather than one water treatment plant, the use of disinfectants other than chlorine to reduce the formation of THMs would not be economically feasible.

- With an all-recharge program, a portion of the recharged CAP water would not be recoverable for use. Losses would occur from evaporation, soils binding of water, evapotranspiration by plants adjacent to the stream channels, and the inability of the aquifer system to accept the amount of water required to recharge 148,420 AF annually.
- Recharge cannot be relied upon to assure that Colorado River water will always meet the increasingly more stringent State and Federal health standards.

Proposition 100, as the citizen's initiative was called, was brought before Tucson City voters in 1987. The election was held in November of 1987 and 65 percent of City voters participating in the election voted against the initiative. Although the initiative was defeated, the proposition helped to increase public awareness of recharge as a water resources management tool. At the same time, the initiative may have slandered the term "recharge."

In October 1987, the USBR issued a Finding of No Significant Impact (FONSI) for the CAP Water Treatment Plan Environmental Assessment. This meant that an EIS would not be necessary prior to the Secretary's decision on the preferred alternative for the treatment plant site.³⁰ Construction of the CAP Treatment Plant began in 1987. In November 1991, the USBR dedicated the completed Tucson Water Treatment Plant.

The community's interest in recharge alternatives has not waned, however. A proposal similar in concept to the 1987 initiative was presented by Dr. C. Brent Cluff in 1993. The proposal involves performing pilot recharge tests with treated CAP water. Tucson Water and Pima County Wastewater Management may jointly evaluate this proposal.

In addition to the evaluation of various inorganic treatment methods, various disinfection techniques that met the water quality objectives identified in 1984 were examined. There are several

³⁰City of Tucson, Tucson Water, "Chronology of Public Participation Process, CAP Water Treatment Plant," 1994.

means of disinfecting drinking water, including the use of chlorine, ozone, chloramine (a combination of ammonia and chlorine) and recharge of water supplies.³¹ In order to work well, disinfectants must remain at a suitable concentration in the water supply for a sufficient period of time. Each disinfection method has a different effectiveness and potential to create hazardous by-products that can affect human health. Chemical disinfectants, by their very nature, present some health risk since their role is to kill pathogens. These risks are not well defined and by-products of these chemical disinfectants, which may also have some health effects, are not all characterized.³² At the same time, disinfection of drinking water is widely viewed by the national scientific community as necessary to avoid what has been estimated as a 100 percent risk of infection by waterborne disease.

Disinfection studies were performed by both the cities of Phoenix and Tucson at the Union Hills Pilot Treatment Plant. The studies began at about the time CAP water was available in the Phoenix area in 1986.³³ Ultimately, the City of Tucson selected ozone as its primary water disinfectant and chloramine as its residual disinfectant, considered state-of-the-art at the time.³⁴ By contrast, the City of Phoenix selected chlorine in keeping with its historic treatment method for its surface water supplies. The method chosen by the City of Tucson - the combination of ozone and chloramines - was expected to produce fewer disinfectant by-products of concern than chlorine while providing for a highly reliable disinfection in the plant and in the City's distribution system.^{35 36}

In September 1992, prior to the start of CAP deliveries in Tucson, the CAWCD prepared an open memorandum to discuss concerns about CAP water quality. One of the issues it addressed was

³¹Ibid.

³²SAWARA, Water Quality Subcommittee, presentation by Dr. Cornelius Steelink, Professor Emeritus of the University of Arizona, August 1992. References noted include R.J. Bull and F.C. Kopfler, "Health Effects of Disinfectants and Disinfectant Byproducts," AWWA Research Foundation and American Water Works Association, 1991; and Bette Hileman, Chemical and Engineering News, July 13, 1992, p. 7.

³³Carollo, Black, & Veatch, Basis of Design Report, November 29, 1988.

³⁴CAP Select Water Quality Panel, "Response to CAP Technical Paper Distributed by Supervisor Ed Moore," 1992 referencing Nieminski and Sheppard, 1989, on findings of the pilot studies.

³⁵SAWARA, Waterwords, "CAP: Focus on the Facts," Vol. 11, No. 5, November/December 1993, p. 8.

³⁶In a special meeting hosted by the SAWARA Water Quality Subcommittee on April 28, 1993, Dr. Sierka, the City's scientific advisor on water treatment matters, stated that Tucson Water's choice of disinfectants is highly effective in eliminating pathogens at a low cost and its engineering choices provide flexibility for future needs.

the use of chloramines and ozone as disinfectants.³⁷ The memorandum explained that water characteristics vary greatly with location and that the source, whether ground water or surface water, does not guarantee a specific quality of water. Over 100 cities around the country have used chloramine as a disinfectant, including Los Angeles, San Diego, Denver, St. Paul and Milwaukee. CAWCD noted that a summary of the toxicity of chloramines presented at the American Water Works Association (AWWA) Annual Conference and Exposition in Philadelphia, Pennsylvania on June 23-27, 1991 showed no links of chloramine to a cancer risk or birth defects. With respect to ozone, the memorandum noted that a possible carcinogen called bromate could be formed if bromide compounds were present in the CAP water and combined with ozone. The typical concentration of bromides in the Colorado River are below those considered significant in the formation of bromate. Southern California also uses Colorado River water and has not found bromides at significant concentrations.³⁸ Other information reviewed for this report suggests that some of these findings are still under debate and that studies are continuing to ascertain the health effects of these disinfectants and their by-products.³⁹

The issue of CAP water quality and disinfection has been raised in a number of ways since the mid-1980s. For example, a 1986 lawsuit filed by the Animal Defense Council alleged that the USBR's EIS for the Phase B Aqueduct was inadequate due to the absence of a worst-case analysis to ascertain the effects of these disinfectants.⁴⁰ Federal precedent relies on such analyses when the impacts of an action are unknown or uncertain. The District Court judge ruled against the plaintiffs. In 1989, the "Tucson Water Resources Plan, 1990-2100" framed the CAP water quality issue more generally:⁴¹

On the whole, both the consultant and citizens [ADCOM] were satisfied with the present ground-water quality but were concerned

³⁷CAWCD, Memorandum to Interested Parties on "CAP Water Quality," September 10, 1992.

³⁸The CAP Select Water Quality Panel provided information to confirm this statement in their 1992 "Response to CAP Technical Paper Distributed by Supervisor Ed Moore."

³⁹Other materials that can be reviewed on this subject include: National Research Council, Board on Environmental Studies and Toxicology, Commission on Life Sciences, Drinking Water and Health, Vol. 7, Subcommittee on Disinfectants and Disinfectant By-Products, Safe Drinking Water Committee, National Academy Press, Washington, D.C., 1987; the Federal Register, Vol. 57, no. 138, July, 1992; and Regli, Stig, P.E., "Trihalomethane Standard" in Water Review, A Publication of the Water Quality Research Council, Vol. 9, No. 3, 1991.

⁴⁰SAWARA, Waterwords, "Status Report on Tucson Phase B Litigation," vol. 4, No. 5, August 1986.

⁴¹CH₂M Hill, Tucson Water Resources Plan, 1990-2100, 1989, p. 23.

with the quality of future supplies. Many citizens believe that CAP water will be lower in quality than the ground-water they are currently served.

Plans to use the Tucson area aquifer for storage of CAP or reclaimed water [through recharge] must assure adequate protection of ground-water quality. Because CAP water is relatively high in dissolved solids (salts) and because use of reclaimed effluent will tend to further concentrate salts in the system, some form of salt removal will most likely have to be included in the reclamation process.

During the summer of 1991 the City began its efforts to prepare the public for conversion from ground water to CAP water with a community assessment survey.⁴² The Mayor and Council appointed Tucson's CAP Select Water Quality Panel⁴³ in September to assist on technical issues.

In 1992, local public concerns about the health risks from drinking water treated with these methods was raised again, in part by County Supervisor Ed Moore, just as CAP water deliveries were arriving in Tucson area homes. The CAP Select Water Quality Panel prepared a response to Supervisor Moore's questions and presentation of the health risks, stating that the treatment methods were designed to maintain appropriate levels of disinfection with the lowest known risk.

Tucson Water also utilized a variety of outreach tools to provide information to the public on the conversion to CAP water between 1991 and 1994, including:⁴⁴

- Public service announcements, press conferences, and media events
- 12 bill inserts mailed to 183,000 addresses
- 72 presentations to a range of professional organizations, church groups, clubs, and neighborhood associations

⁴²City of Tucson, Tucson Water, "Tucson Water Public Information Chronology: Conversion to Central Arizona Project Water," 1991 through 1994.

⁴³This was a panel of local physicians and engineers, which was chaired by Ron Sparks, M.D.

⁴⁴City of Tucson, Tucson Water, Chronology of Public Participation Process, 1994.

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- 15 press releases including information about zinc orthophosphate, colored water, hard water, and flushing programs
- Over 30 direct mailings on topics like the effect of chloramines on fish, CAP water treatment and kidney dialysis, and CAP water and swimming pools
- Expanded customer phone service coincided with the start of CAP deliveries

CAP Water Quality Concerns and the Curtailment of Deliveries

Water service to Tucson area residents using treated CAP water began in November 1992. By the next year, about 80,000 connections were being served CAP water and residents began reporting problems. Colored water appeared to be the most prevalent problem. In response to the colored water problem, the City retained consultant services⁴⁵ in May 1993. Two months later, the first consultant report on colored water suggested pipe corrosion from CAP water as the primary cause. Zinc orthophosphate, a corrosion inhibitor, was suggested as the means to correct the problem. In August, a neighborhood flushing program began and zinc orthophosphate was introduced into the system. In September of 1993, the City set up its Neighborhood Service Center to address the growing frustration and anger in the community about CAP water problems.⁴⁶ A Customer Assistance Program was established to reimburse Tucson Water customers for some of their costs and to provide relief on water bills. In October 1993, the Mayor and Council voted to return 50 percent of the CAP service area to ground-water service and in November, the CAP Oversight Committee was appointed to facilitate an evaluation of CAP water uses.

In March of 1994, the CAP Water Quality Expert Panel evaluated the performance of the consultant retained in May 1993, and the corrosion control activities to date.⁴⁷ They found that the consultant "rendered valuable advice" and recommended that he become a member of the Water

⁴⁵Dr. Edward Singley

⁴⁶"While colored water was the catalyst for community action, various individuals, homeowner associations, and businesses have indicated their overall dissatisfaction with CAP water because of its mineral content, corrosiveness, and negative effect on plumbing and appliances," Tucson Water, "CAP/Groundwater Blending Study - Pre--Submittal Information" December 9, 1994.

⁴⁷Letter to Mr. Thomas McLean from McGuire Environmental Consultants, Inc., March 24, 1994, Re: Dr. Edward Singley.

Quality Expert Panel.⁴⁸ With a five-member panel, they examined the progress of a September 30, 1993 Action Plan to measure the quality of Tucson Water's overall corrosion control activities. The panel found Tucson Water's corrosion control activities to be adequate. However, the panel noted some problems at the treatment plant relating to lack of staffing and the dramatically reduced demand for treated water, both of which could lead to maintenance problems and additional expenses.⁴⁹

Once the colored water problem became widespread in 1993, both Tucson Water and at least one City Council member searched for information in past studies that may have warned the City about this consequence of converting to CAP water. Some of the findings of this review are noted below:

From the 1984 Water Quality Objectives Report⁵⁰ -

The report stated its preferred method of corrosion control was pH adjustment or, alternatively, the use of inhibitors like zinc orthophosphate. Also suggested was the implementation of a corrosion monitoring program or a survey of customer plumbing prior to the use of CAP water. The report identified problems experienced with corrosion of galvanized pipes in southern California due to poor quality pipe and due to algae control chemicals used there. Despite this finding, the report did not conclude that corrosion protection was a major issue for the Tucson area.

From Carollo, Black & Veatch's Review of the Preliminary Design Report dated August 1987⁵¹ -

This report suggested that chemical addition for corrosion protection should be considered in Tucson contrary to the 1984 report.

⁴⁸Ibid.

⁴⁹Ibid.

⁵⁰Montgomery-Johnson-Brittain, "Tucson Water Treatment Plant Project Phase I Preliminary Investigations - Water Quality Objective Report" (Task 1.2), May 1984; as quoted by Michael Tubbs, Tucson Water in his memorandum to Mayor and Council, September 30, 1993.

⁵¹As quoted by Michael Tubbs, Tucson Water, Memorandum to Mayor and Council on "Change of Expert Consultant on the Water Treatment Plant Project," September 30, 1993.

From the Tucson Water Pilot Plant Report dated December 1987⁵²

The consultant studied various indicators to classify the corrosivity of CAP water such as resistivity, bicarbonate ions, and the saturation index. It found that "these conflicting evaluations demonstrate the difficulty in classifying a particular water as corrosive or non-corrosive. Actual conditions at plants treating CAP water indicate that the water is somewhat corrosive and that corrosion control must be addressed in the plant design." A 1993 memorandum by M. Tubbs, former Director of Tucson Water, explained that by November 1988, the consultant concluded in the Basis of Design Report that the design consideration for corrosion control incorporated the ability to feed zinc orthophosphate as a treatment process element. When the plant operation began in 1991, "it included this process element."⁵³

From "Review of Central Arizona Project Documents Applicable to the City of Tucson, Arizona"⁵⁴ -

Seven City reports, memoranda or meeting minutes dating from September 1983 to March 1984 discussed concerns about water hardness and corrosivity. Some of these documents suggest that corrosion was a problem prior to the delivery of CAP water. Tucson Water meeting minutes from March 27, 1984 indicates that the utility planned to monitor corrosion in the future. The priority given to this issue with respect to other water quality concerns was not included. Nevertheless, the quotes in this Review suggest that Tucson Water and the Mayor and Council were aware of potential problems in 1984, prior to final treatment plant design. As M. Tubbs noted previously, the ability to feed corrosion control chemicals to the system was added to the plant.

In September of 1993 the Water Resources Research Center of the University of Arizona released its preliminary analysis of "Impacts of Changes in Water Quality and Consumer Responses in Tucson, Arizona." Using a sample of 1,500 randomly selected addresses for homeowners in the Tucson metropolitan area, the study asked about water sources, perceived water quality, impacts on fixtures, occurrence of rashes (resulting from bathing in hard water), and expenditures to improve water quality. The study found that the introduction of CAP water in Tucson resulted in "widespread dissatisfaction with the aesthetics of the water and water-related expenditures. The additional costs

⁵²Ibid.

⁵³Both pH adjustment and inhibitor feed capabilities were included in design of plant.

⁵⁴Richards, Don, in attachment to memorandum from Councilman Saggau to Mayor and Council, September 30, 1993.

per responding household are approximately \$169 in one-time expenditures and \$43 in annual expenses. These costs are not uniformly distributed, with most households bearing lower costs, but some bearing much higher costs. Many categories of costs were not investigated or quantified, some of which may be substantial. A conservative estimate of total additional costs for areas currently receiving CAP water is \$15 million in one-time expenditures and increased annual expenses estimated at \$3.5 million."⁵⁵

The question of colored water and corrosion has not abated since the decision to reduce the CAP water delivery area. At a May 1994 SAWARA committee meeting, a member of the Water Quality Expert Panel raised the potential role of chloramine in the corrosion problem. This disinfectant is an oxidizer that lasts 10 to 14 days in the distribution system and can react with conveyance materials and valves. Concern was raised that lead and copper may be leached from pipes by this disinfectant; however, Tucson Water indicated that none of their data supported this concern. Other issues raised included the possibility that chloramines can cause a problem known as nitrification due to the presence of ammonia in this compound. The zinc orthophosphate used to combat corrosion may be contributing to odor problems due to the presence of phosphates. At many public meetings, residents still receiving CAP water brought samples of red and turbid water taken from taps or evaporative coolers in their neighborhoods.

This chapter concludes the Historical Review of Tucson's CAP-related decisions since 1965. The story continues to be written as metropolitan area water users participate in or observe the progress of the CAP Use Study for Quality Water.

Appendices following this chapter provide additional information:

- A - Acronym List
- B - The 1976 Water Rate Increase and Subsequent City Council Recall
- C - Selected Bibliography
- D - General Comments on the Draft Historical Review

⁵⁵Woodard, Gary C., Susanna Eden, and Ken Seasholes, "Impacts of Changes in Water Quality and Consumer Responses in Tucson, Arizona - Preliminary Analysis," Water Resources Research Center, University of Arizona and with support from The Arizona Daily Star, September 1993, p. 18.

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Appendix A

Acronym List

AF	Acre-Feet
ADCOM	Advisory Committee (Long-Range Planning Process, 1989)
ADEQ	Arizona Department of Environmental Quality
ADWR	Arizona Department of Water Resources
AMA	Active Management Area
AVID	Avra Valley Irrigation District
AWWA	American Water Works Association
CAGRD	Central Arizona Groundwater Replenishment District
CAP	Central Arizona Project
CAPA	Central Arizona Project Association
CATS	Central Arizona Project Alignment and Terminus Storage Committee
CAWCD	Central Arizona Water Conservation District
CWAC	Citizens Water Advisory Committee
EIS	Environmental Impact Statement
FICO	Farmers Investment Company
FONSI	Finding of No Significant Impact
GAC	Granular Activated Carbon
GPCD	Gallons Per Capita Daily
GUAC	Groundwater Users Advisory Council
GWMA	Groundwater Management Act
MAF	Million Acre-feet
M&I	Municipal and Industrial
MGD	Million Gallons per Day
MUM	Metropolitan Utilities Management Board
NATION	Tohono O'odham Nation
OM&R	Operation, Maintenance, and Repair Costs
PAG	Pima Association of Governments
PPB	Parts Per Billion
SAFE-CAP	Southern Arizonans for the Central Arizona Project
SAWARA	Southern Arizona Water Resources Association
SAWRSA	Southern Arizona Water Rights Settlement Act
SES	Southwest Environmental Services
TAMA	Tucson Active Management Area
TDS	Total Dissolved Solids

THMs
TOC
USBR
USDOI
WQOR

Trihalomethanes
Total Organic Carbon
U.S. Bureau of Reclamation
U.S. Department of Interior
Water Quality Objectives Report

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Appendix B

The 1976 Water Rate Increase and Subsequent City Council Recall

At the same time questions were raised about CAP and the need to address limited ground-water supplies, another resources planning and growth management issue faced Tucson in the years 1976 and 1977- a marked water rate increase during the summer and the subsequent recall of the City Council. While this issue is not directly related to CAP decisions, it represents a water resources controversy of a magnitude similar to the one experienced by Tucson in the summer and fall of 1993 when CAP water was first delivered. The 1976/1977 controversy was also generated through water management decisions of Tucson Water and the Mayor and Council acting in what they believed to be the best interests of the community. The decisions provoked a swift, angry response by Tucsonans, in effect an early message of concern about managed growth. The water rate increase and resulting Council recall vote provide some lessons in the broader historical context of CAP decisions made by Tucson.

Early in 1976 the need for an increase in water rates was first presented to Tucson Water and the Mayor and Council through consultant findings that the costly expansion of the City's water distribution system was exceeding revenues available to accommodate that growth.¹ The rate increase comprised one financing mechanism for an ambitious 6-year capital improvement program. It was based, for the first time, on the cost of providing service and, therefore, could also present a rational means of encouraging conservation. Recognizing this departure from past rate structures, Tucson Water staff and the Mayor and Council negotiated the rate change with the criteria that the pricing be equitable and involve sound water resources management. Several separate moves were made by the Mayor and Council to confront high water use through "water alerts" and other peak season restrictions. Although Martin, et al. notes that publicity such as newspaper coverage was associated with these deliberations, this source also states that "it was far from a topic of major public concern." Martin, et al. reports that by the time the final revised rate structure was presented, the Mayor and Council majority "understood that the proposed rates would affect customers in different locations and with varying patterns of water consumption quite differently."² They did not appear

¹Martin, William E., Helen M. Ingram, Nancy K. Laney and Adrian H. Griffin, Saving Water in A Desert City. Resources for the Future, Inc. Washington, D.C., 1984. This source reported a 42 percent proposed rate increase (p. 15). This reference provides a detailed description of events, public concerns, and Council activities.

²Martin, et al., 1984, p. 19.

to understand that the level of impacts would be as severe as they ultimately were. Four newly elected Democratic City Council members who had campaigned primarily on the platform of planning for controlled growth voted to adopt the new rates in June of 1976.

The rates were adopted on the basis that they were equitable and that wasteful use of scarce water supplies due to exceptionally low prices was no longer acceptable. At the same time, however, the rates, in addition to improving the system to meet existing demands, had the somewhat contradictory effect of financing a delivery system that would meet growing water demands. By July 1976, the new rates were in effect and the community response was intense in the wake of a hot and dry summer with higher than normal water use. The effort to recall the four Democrats began the same month. By September, twice the number of signatures needed to recall these council members had been collected, despite moves to cancel lift charges or ameliorate the effects of some of the rate provisions. Editorials in the Arizona Daily Star supported the soundness of the rate structure but agreed that the charges were too high. Other news coverage rallied with the community against the Mayor and Council and the rate increase. The Citizen's Recall Committee was formed and placed its weight behind three potential candidates who promised to reduce the water rates as soon as possible after election. Water workshops held by the four Democrats who voted to adopt the increase received little attention from the community. When water use fell in the winter, so did the cost to water users as a result of the new rate structure. However, according to Martin, et al., the public confidence was so low that one Council member reported that constituents believed that the basic rates had been reduced.³ A successful recall election was held on January 8, 1977.

A number of critical actions were taken by the City to respond to this loss of public faith. First, the City Manager appointed a Blue Ribbon Citizen's Committee that evolved into a Citizen's Water Advisory Committee (CWAC) in November 1977. Members of CWAC were selected to represent a broad base of the community; none were particularly active or involved in the summer's controversy. Their job was to provide independent evaluations for and recommendations to the City on sound water management practices and policies. Martin, et al. reports that the "appointment of the CWAC task force marked the beginning of a gradual decline in the emotional debate over water."⁴ Second, the consultant who recommended the rate increase was replaced by an internationally known firm who was asked to reassess the former firm's recommendations about the need for capital improvements and a steep increase in water rates.

Ironically, the Mayor and Council members elected in the wake of the recall decided against a roll back of Tucson water rates despite earlier promises to do so. Reportedly, these members were

³Ibid., p. 21.

⁴Ibid.

educated on the deleterious effects of lower rates on local water service and the need for conservation. By February of 1977, CWAC issued a report that supported a rate structure based on the cost of service to customers and mirrored the rate components developed through the previous Mayor and City Council. The CWAC report urged that an effective conservation and public education program was needed to reduce the impact of such a rate structure on summer water bills. The CWAC report was presented at a well-attended and lengthy public meeting. By this point, groups like the Chamber of Commerce, which had opposed the previous Mayor and Council, expressed hearty support for the new rates. Following the hearing, the Mayor and Council voted 6 to 1 in favor of a water rate ordinance based on cost of service and the assumption that water use could be cut by 25 percent to ameliorate the cost to users. Martin, et al. reports that only one provision from the previous structure, the establishment of fees for various lift zones, was effectively eliminated. In addition to the new rate structure, the City inaugurated the highly successful "Beat the Peak" public education program in April 1977. Reductions in per capita water use have been correlated to the price.

Martin et al. point to some lessons learned from their analysis of this Tucson case study on the political feasibility of instituting economically sound water management practices. First, they note that the public relations efforts associated with "Beat the Peak" should have begun at the time of the price increase, not in response to it. A similar comment was made regarding the timing of CWAC's appointment and report on the soundness and fairness of the new rate structure. Other conclusions which may illuminate the current dilemma over CAP use include:⁵

- Noncoercive public information campaigns are advantageous but should be combined with other effective mechanisms, like marginal price increases that truly reflect the cost of service, to achieve a desired response, like water conservation for specific and beneficial purposes. Demand for water is almost always inelastic, but it is not totally inelastic. Therefore, a higher water price will achieve a lower use.
- Conflict over water policy is not always a sign of failure of that policy. The controversy over water rates brought the issue of conservation and management to the attention of a broad number of Tucsonans. The debate that followed demonstrated that most of the decisions made were essentially sound and the policy was subsequently endorsed by the public as well as a newly elected Council. The policy implemented as a result of this crisis of public confidence endured for a substantial time period.

⁵Martin et al., 1984, pp. 98-102.

- Conclusions were presented for broad groups of stakeholders that are also represented in the current dilemma. Economists must learn to provide concrete examples of how water policies based on economic theory can be applied. Environmental quality goals are more likely to be achieved when considered in a cost-benefit framework. Finally, "water utility managers will be more successful in implementing innovative water policies when they recognize the risks their proposals present to elected politicians."⁶
- The most profound lesson learned through this case study was that "the policy system is more flexible than it appears, policy leadership can become available, and change is possible."⁷

⁶Ibid.

⁷Ibid.

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Appendix D

General Comments on the Draft Historical Review

Oral comments obtained as a result of the November 3, 1994 Oversight Committee meeting at which the Historical Review was discussed are summarized below.

1. General Comment:

Certain historical events are missing and should be added.

Response:

Some events have been added in response where key CAP-related decisions were involved. In some cases, the events mentioned during the meeting were already part of the document. It was not feasible to prepare an unabridged history, but a dedicated effort was made to include as much as possible in the time allowed.

2. General Comment:

The document is too long, too Reive, and biased in favor of the official position on CAP.

Response:

The document is lengthy due to the span of time and complexity of history covered. It was not intended to present a biased view. The final report does identify official documents and events. The authors intend no specific support or disclaimer for any historic event described. Questions about the CAP have been raised and strengthened, for example, in Chapter 2 with respect to economic assumptions about agricultural use of the CAP and in Chapter 5, with respect to the City's planning for possible CAP water corrosion problems as the system was being designed. The historical review now references Dames & Moore's "Findings and Recommendations for Convening a Consensus-Building Process" dated August 12, 1994. This report indicates a range of opinions on CAP that includes severe concern as well as support.

3. General Comment:

There are no data in support of the "conclusions" about public participation in the preface.

Response:

"Conclusions" about public participation have been removed in the final document. Information about public participation present in the historical documents reviewed has been summarized in the text and referenced in the Selected Bibliography (Attachment C).

4. General Comment:

The document contains no analysis of history. (One Oversight Committee member disclaimed the basis and accuracy of the entire document and recommended that it be tabled).

Response:

The report was not intended to provide an analysis of past decisions. Rather, the decisions themselves are presented to allow readers to reach their own conclusions. This effort was made to avoid bias as much as possible. The document does not intend to justify or rationalize the City's CAP-related actions. Once again, the 'Convening Report' noted in comment 3 should be reviewed for the range of perceptions about the CAP in Tucson.

5. General Comment:

This is an impossible task that may require a year of academic work to complete. There are not enough resources in this project to prepare the kind of history we are discussing. The difficulty of preparing even the level of information contained in the draft was acknowledged.

Response:

No response.

6. General Comment:

The document contains official information that has not been compiled anywhere else and is useful for this purpose. The document does not have to be labeled as an unabridged history of Tucson and CAP water.

Response:

As noted above, the report was not intended to be an unabridged history of Tucson's use of CAP water. An effort was made to identify and include the most critical events.

7. General Comment:

The document is not useful unless it contains the political context of the history. The context would identify who the players were and why they took certain positions, e.g. who is SAWARA, who is Brent Cluff, etc. It should present what "really happened" in the historic public meetings and not what was published in newspapers. The "sense" of these meetings would also be important to include. One commentor acknowledged that documentation of

this information is probably not available and only those present could really tell that part of the story. Some felt strongly that this part of the story needs to be told.

Response:

This report was limited to documented information. The authors reference the Dames & Moore Report titled " Findings and Recommendations for Convening a Consensus-Building Process," August 12, 1994, in which perceptions and attitudes related to CAP use are reported.

8. General Comment:

The process by which this document was generated did not include enough opportunity for review by the Oversight Committee. There was too much input by Tucson Water.

Response:

The consultant acknowledges the problems associated with this review process. Several efforts were made to provide materials to and obtain input from the Oversight Committee. The consultant was also concerned about balancing input from Tucson Water with input from other sources. Review processes during the Water Use Study have improved, in part, as a result of this document.

9. General Comment:

There should be an acknowledgement that current residents of Tucson who are experiencing CAP water problems may not have been present at the time treatment and direct use decisions were made. They are living with the results of other's decisions.

Response:

This statement is acknowledged in the Preface.

Dames & Moore received written comments that were reviewed and incorporated, as appropriate, from:

- Marybeth Carlile and Lois Kulakowski, Executive and Assistant Directors, Southern Arizona Water Resources Association
- Dr. Helen Ingram, Professor of Political Science and Director, Udall Policy Center, University of Arizona (former Oversight Committee member)
- Kathy Jacobs, Director, Tucson Active Management Area, Arizona Department of Water Resources (former Oversight Committee member)

- Dr. William Martin, Professor of Agricultural Economics, University of Arizona
- Karen Dotson, Principal Planner, Tucson Water
- Ann Audrey, formerly employed by Office of Water Conservation, Tucson Water

