

APPENDIX D

A PRIMER ON THE COLORADO RIVER AND THE POTENTIAL FOR SHORTAGE

The Colorado River is one of the primary sources of water supply, power generation, recreation, and environmental habitat in the western United States. The river channels runoff from a drainage area of about 246,000 square miles within seven states to meet the water supply needs of over 25 million Americans. It provides a large part of the State's water-supply portfolio and by virtue of the Central Arizona Project, it is the largest renewable water source available to Tucson Water.

A shortage has yet to be declared on the Colorado River, but one will likely occur in the coming years. Depending on its magnitude, a shortage could have negligible to very significant impact on water providers who rely on this water source to meet water demand within their service areas. This appendix summarizes what a declaration of shortage means and how prepared Tucson Water is to meet such a challenge.

BACKGROUND

The Utility's access to the Colorado River relies on the State of Arizona's annual apportionment of Colorado River water, a physical delivery mechanism called the Central Arizona Project, and the City of Tucson's Municipal and Industrial (M&I) subcontract. These elements determine the means through which Tucson Water has rights to using Colorado River water and the relative priority of the City of Tucson's Central Arizona Project allocation in times of shortage.

Colorado River Water Apportionment

The waters of the Colorado River were first apportioned between the states of the upper basin division (Colorado, New Mexico, Utah, and Wyoming) and the lower basin division (Arizona, California, and Nevada) under the Colorado River Compact of 1922. Each of the basins were allocated 7.5 million acre-feet per year. The division point between the two basins was identified as Lee's Ferry which is located where Arizona State Highway 89 crosses over to the north side of the Colorado River. However, the Compact did not apportion annual rights to Colorado River water to individual states within the upper or lower basin divisions.

The specific allocation of water between the three lower basin states was set forth a number of years later in the Boulder Canyon Project Act of 1928. Under this Act, and as shown on Figure D-1, the State of Arizona obtained rights to 2.8 million acre-feet per year of Colorado River water. In 1944, a Treaty for the Utilization of Waters of the Colorado and Tijuana Rivers and the Rio Grande was established between the United States and Mexico. Under this Treaty, the Republic of Mexico was annually allotted 1.5 million acre-feet of Colorado

River water. Allocation of Colorado River water amongst the upper basin states occurred in 1948 under the Upper Colorado River Basin Compact. Review of Figure D-1 indicates that the annual apportionment among the upper basin states were specified in terms of percentages while those among the lower basin states and Mexico were specified as quantified annual volumes.

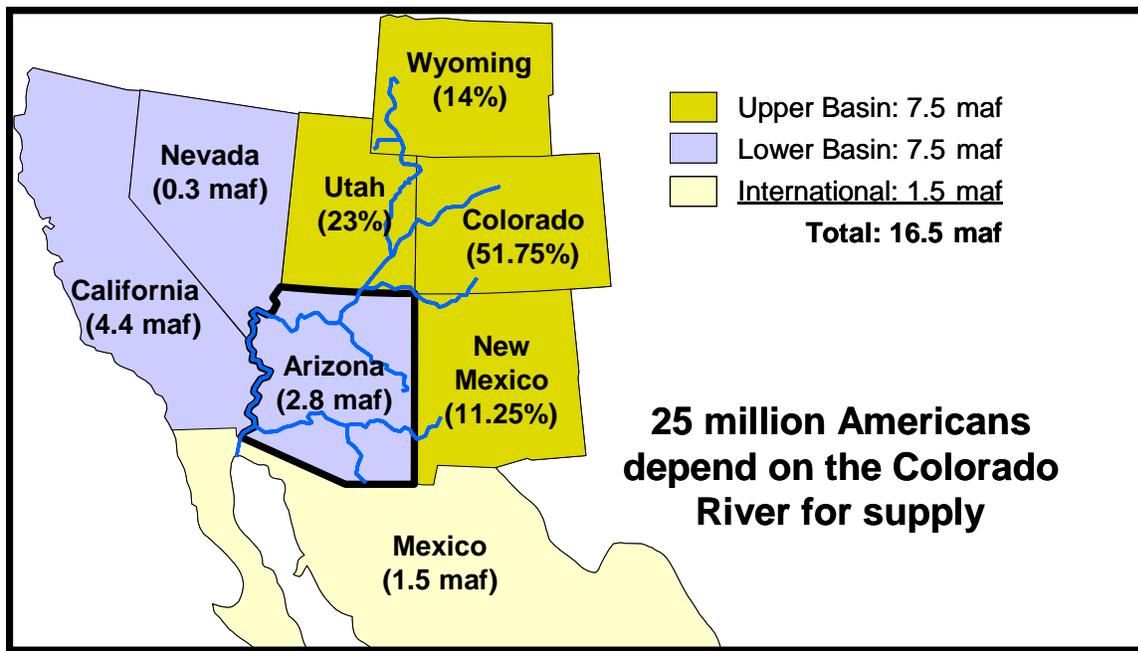


Figure D-1: Annual Allocations of Colorado River Water by State and Mexico

It took many decades before Arizona was able to fully utilize its allocation, and the State had to withstand a series of attempts to take its unused portion away. Over time, these inter-state issues were resolved, and many Arizona communities, Native American tribes, and agricultural interests have obtained their own rights to a portion of Arizona’s annual allocation. These allocations were obtained pursuant to the master repayment contract between the U.S. Bureau of Reclamation and the Central Arizona Water Conservation District (CAWCD) related to the Central Arizona Project (Contract No. 14-06-W-245). In the case of the City of Tucson, an allocation of Colorado River water was acquired through its subcontract with the CAWCD and the U.S. Bureau of Reclamation (Contract No. 9-07-30-W0199). Tucson’s allocation has changed over time due to various re-allocations, water system acquisitions, and legal settlements. As discussed in Section Four, the City’s current allocation is 135,966 acre-feet per year with two pending reallocations that will bring the total to 144,191 acre-feet per year in the near future.

Central Arizona Project

The Central Arizona Project is a 336-mile long system of aqueducts, pipelines, and pumping plants that extends from Lake Havasu to the southwestern edge of Tucson. The project is designed to deliver about 1.5 million acre-feet of Colorado River water per year to Pima,

Pinal, and Maricopa counties, and it is the largest single source of renewable water supplies in Arizona.

Efforts to develop the Central Arizona Project began in earnest in 1946 when the Central Arizona Project Association was formed to educate Arizonans and lobby the United States Congress to authorize its construction. Construction was finally authorized in 1968 under the Colorado River Basin Project Act which enabled the U.S. Department of the Interior (and the Bureau of Reclamation) to fund and construct the Central Arizona Project and established a repayment mechanism to recover costs. In 1971, the Central Arizona Water Conservation District (CAWCD) was created to provide a means for Arizona to repay the federal government for project construction and to manage and operate the Central Arizona Project. Construction took twenty years and the entire project cost over \$4 billion (Central Arizona Project, 2007a).

Pursuant to the City of Tucson’s subcontract with CAWCD, the City’s allocation of Central Arizona Project water is designated for Municipal and Industrial (M&I) use. An M&I allocation has the highest priority within the Central Arizona Project allocation hierarchy along with Native American allocations.

Colorado River Water Availability

In-stream flows at Lee’s Ferry can vary widely from year-to-year. Review of Figure D-2 indicates that the magnitude of the annual flows at Lee’s Ferry have on average been trending downward. In recent years, the annual flows have continued to decline overall due to the ongoing multi-year drought in the Colorado River basin (United States Geological Survey, 2004).

The time period used to estimate water flows for apportionment under the Colorado River Compact in 1922 was from 1905 to 1922. Unknown at the time, this time period had the highest long-term annual flow volume of the past century averaging 16.1 million acre-feet per year at Lee’s Ferry (USGS, 2004). Further review of Figure D-2 indicates that annual flows of the Colorado River have generally been below 16.1 million acre-feet since 1920. This in turn means that the time will come when some Colorado River water users will experience periods of shortage despite the presence of significant storage reservoirs on the system. Projections based on current on-river conditions strongly suggest that the first shortage may be close at hand.

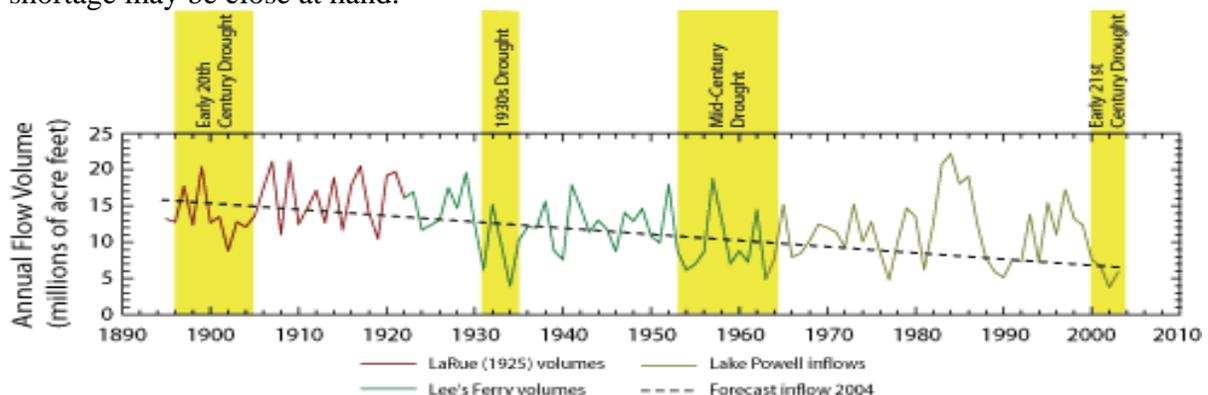


Figure D-2: Annual Colorado River Flow at Lee’s Ferry (modified from USGS, 2004)

LAW OF THE RIVER AND THE CENTRAL ARIZONA PROJECT

The Colorado River is managed and operated subject to a long litany of laws, treaties, and court decisions dating back to the Colorado River Compact of 1922. Collectively referred to as the “Law of the River,” a broad legal framework has evolved which addresses most issues. However, the Law of the River only provides limited guidance to the Secretary of Interior for times of shortage. Selected elements of the Law of the River that relate to a potential Central Arizona Project shortage are summarized in the following sections.

Mexican Water Treaty of 1944 (Treaty Series 994)

In 1944, a Treaty for the Utilization of Waters of the Colorado and Tijuana Rivers and the Rio Grande was established between the United States and Mexico. Amongst other things, this treaty allocated waters between the United States and Mexico for each of the three rivers included in the agreement and authorized the construction of dams, the study of flood control works, and the evaluation of the potential to produce hydro-electric power.

Colorado River shortage issues are indirectly addressed in this treaty. Article 10 indicates that in the event of extraordinary drought or serious accident which would make it difficult for the United States to make required deliveries to Mexico, the water allotted to Mexico would be reduced in the same proportion as consumptive uses in the United States. Beyond this statement in the 1944 Treaty, however, no agreement is in place which specifies how Colorado River shortages would be shared between the United States and Mexico. This apparent legal ambiguity may have significant effect on water users on both sides of the border when the Secretary of Interior eventually declares a shortage.

Arizona v. California IV (376 U.S. 340)

The 1964 U.S. Supreme Court decision in *Arizona v. California IV* resolved a long-standing dispute between the two states. Among various other issues, the Supreme Court decided the case in favor of Arizona by confirming that Arizona will have access to its full allocation of Colorado River water (2.8 million acre-feet per year) at such time as it is needed (United States Supreme Court, 1964).

In Section II(B)(3) of the 1964 decision, it was confirmed that in times of shortage, California could not use more than its allotted 4.4 million acre-feet per year just by putting a greater volume to consumptive use before Arizona could fully utilize its annual allocation. In effect, the Supreme Court upheld that agreements associated with the Law of the River had precedence over the doctrine of prior appropriation. This decree essentially laid the groundwork for the construction of the Central Arizona Project. However, the political fallout from this decision led California to apply significant pressure in Congress to work language into the Colorado River Basin Project Act of 1968 which specified a lower priority for Central Arizona Project water in times of shortage.

Colorado River Basin Project Act (U.S. Public Law 90-537)

The Colorado River Basin Project Act was signed into law in 1968 to authorize the construction, operation, and maintenance of the Colorado River Basin Project and for other purposes. Under this Act, the Secretary of Interior was directed to conduct a “full and complete” investigation in support of developing a general plan to meet the future water needs of the Western United States. The Act also included guidance on the potential to augment flows in the Colorado River in order to offset delivery obligations to Mexico under the Mexican Water Treaty of 1944. Finally, the construction, operation, and maintenance of the Central Arizona Project were authorized.

The Act contains two sections pertinent to shortage issues. Section 201(b) discusses the administration of the Supreme Court decree in *Arizona v. California IV* (376 U.S. 340) noting that during times of shortage, deliveries to the Central Arizona Project will be curtailed. Such a reduction would ensure that sufficient water is available to first satisfy the demands of other Lower Basin rights including the full 4.4 million acre-feet per year to California and right holders of similar standing in Arizona and Nevada. Section 304(e) establishes a protection for any Central Arizona Project user who legally relinquished water from other sources in exchange for Colorado River water deliveries via the project. Such users will have the first priority to receive Central Arizona Project deliveries.

Standing of the Central Arizona Project during Shortage

Based on the guidance provided to date by the Law of the River, the 1.5 MAF associated with the Central Arizona Project has the lowest priority during times of shortage. It is probable that Mexico would be co-equal with the Central Arizona Project pursuant to language in the Mexican Water Treaty of 1944; however, the specifics of this relationship have yet to be formalized. Rights to Colorado River water along the main stem in Arizona and Nevada that post-date 1968 would also be co-equal with the Central Arizona Project; however, this does not represent a large volume when compared to the 1.5 million acre-feet per year conveyed via the project. At the present time, California’s entire Colorado River allocation of 4.4 million acre-feet per year would be protected during times of shortage until such time as the entire Central Arizona Project allocation and other post-1968 rights are curtailed.

SHORTAGE PROPOSAL UNDER CONSIDERATION

In order to establish guidelines for river operations during shortage conditions, the Secretary of Interior initiated a process to establish operating criteria. In 2005, the Secretary solicited recommendations for shortage guidelines and two main proposals were submitted – one crafted by the seven basin states and a second developed by a group of non-governmental environmental organizations. The Secretary also brought forward two additional potential options (a “Water Supply” alternative and a “Reservoir Storage” alternative) as well as a “No Action” alternative. The Secretary of Interior issued a draft Environmental Impact Statement (EIS) in February 2007 and a final EIS in November 2007. Detailed information on the EIS, each of the five initial alternatives, and the eventual Preferred Alternative is available

through the U.S. Bureau of Reclamation’s website for the Lower Colorado River Region at www.usbr.gov/lc/region/programs/strategies/documents.html.

The “Preferred Alternative” was developed by the U.S. Bureau of Reclamation based on the concepts and criteria presented in the five original options. The Preferred Alternative is closely aligned with the alternative proposed by the seven basin states.

The primary goals of the Preferred Alternative are to minimize the extent and duration of shortages in the Lower Basin and to reduce the risk of a “Call on the River” where Upper Basin water usage could be curtailed to satisfy deliveries to the Lower Basin. This alternative includes the use of small-scale, proactive (stepped) shortages of 400,000 acre-feet, 500,000 acre-feet, and 600,000 acre-feet to maintain reservoir storage as long as possible; coordinated operation of Lakes Powell and Mead; and creating a mechanism to store and deliver conserved system water (through infrastructure improvements that reduce system losses) and non-system water (generally land fallowing in tributary watersheds that results in increased flows in the Colorado River). The primary purpose of the stepped shortages is to accept small-scale shortages sooner in time to forestall a major shortage later in time.

An important innovation that was proposed is the potential to accrue a new class of water credits in the Colorado River system referred to as Intentionally Created Surplus (ICS). Under this proposal, users of Colorado River water would obtain ICS credits through “extraordinary conservation” projects, tributary conservation projects, introduction and/or exchange of non-Colorado River system water, and system efficiency improvements (Basin States, 2006).

It is assumed in the Preferred Alternative that Mexico shares the reduced delivery volumes on a pro-rata basis. It is proposed that Mexico’s shortage share be set at 17 percent which represents Mexico’s percentage share of the total volume of Colorado River water entitled to Mexico and the Lower Basin states. Negotiations to finalize Mexico’s proposed sharing level are ongoing. The proposed Lake Mead elevation triggers and stepped shortage volumes under the Preferred Alternative are summarized on Table D-1.

Lake Mead Level (Feet amsl ¹)	Shortage Volume (Acre-Feet)	United States Share (Acre-Feet)	Mexico Share (Acre-Feet)
1075	400,000	333,000	67,000
1050	500,000	417,000	83,000
1025	600,000	500,000	100,000
<1025	Re-consultation	Re-consultation	Re-consultation

Table D-1- Elevation Triggers at Lake Mead and Shortage Volumes.

The Secretary of Interior issued a draft set of Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lakes Powell and Mead on December 10, 2007. The current planning assumption is that the Secretary of Interior's final Record of Decision will reflect most, if not all, of the concepts of the Preferred Alternative. The concepts included in this Alternative have already been endorsed by the contract users of Colorado River water. It is also assumed that Mexico will share in Colorado River water shortages at the 17% level although this is not yet certain.

SHORTAGE IMPACTS AND TUCSON WATER'S PREPAREDNESS

The Colorado River is the largest renewable water resource available to Tucson Water. The Utility is currently in the process of bringing its full allocation into use to help offset ground-water mining and to comply with the State of Arizona's Assured Water Supply regulations. The City's current allocation is 135,966 acre-feet per year; two pending reallocations will bring the total to 144,191 acre-feet per year in the near future. While use of Colorado River water is a key step toward maintaining a more sustainable water supply, the Utility will also be prepared to deal with the uncertainties and impacts related to shortages of its Colorado River water supply.

Probable Shortage Impacts

To assess Tucson Water's preparedness for eventual Colorado River water shortages be they caused by extended drought and/or climate change, it is important to first evaluate what shortage conditions will mean for the Utility. Once a shortage is declared, the Central Arizona Project will be curtailed to a significant degree – presumably in accordance with the Preferred Alternative. Discounting the minor shortage contributions of other late-priority water, it is assumed that the Central Arizona Project will be curtailed at 83% of the appropriate volume for each shortage tier which assumes 17% of the shortage will be borne by Mexico.

Once shortages occur, the relative priority of different water uses will determine which Central Arizona Project water users will be impacted. Not all water uses are of equal priority. In the Record of Decision for the allocation of waters and contracting under the CAP, major categories of water allocation included Native American use (309,828 acre-feet per year), M&I (640,000 acre-feet per year), and the remaining supply for "non-Indian" agriculture (Secretary of Interior, 1983). The Record of Decision also set shortage criteria including a condition that 25 percent of the 173,100 acre-feet annually allocated to the Gila River Indian Community would be curtailed while the remaining allocation would share the same priority as 510,000 acre-feet per year of the M&I allocation. The Record of Decision goes on to state the following:

“...During years of water supply shortages, Indian users and non-Indian M&I users would share a first priority on project water supplies...water delivery for miscellaneous uses would be reduced pro-rata until exhausted; next, non-Indian agricultural uses would be reduced the same way until exhausted; next, the Gila Tribe allocation would be reduced by 25 percent and other Indian agricultural uses would be reduced by 10 percent on a pro rata basis until exhausted.

Thereafter, the remaining water contracted for by 11 Indian entities under existing contracts and 75 percent of the Gila River Tribe allocation would share a priority with 510,000 acre-feet of non-Indian M&I uses...and would be reduced on a proportional basis, and within each class on a pro-rata basis, ***based on the amount of water actually delivered to each entity in the latest non-shortage year.***”

(Emphasis added; from Secretary of Interior, 1983).

Based on the above language, Tucson Water does benefit from the relative priority of M&I uses within the Central Arizona Project’s hierarchical scheme. The Central Arizona Project allocation totals 1.5 million acre-feet per year. Of the total, M&I subcontracts currently account for 555,031 acre-feet per year, Native American contracts total 555,086 acre-feet per year, and the remainder is allocated to “non-Indian” agriculture and miscellaneous uses (Central Arizona Project, 2007a). Therefore, it is highly likely that M&I allocations would not be curtailed until a shortage of 600,000 acre-feet per year or more is declared.

M&I allocations will only retain this relative priority based on the amount that was used in the most recent non-shortage year (i.e. last normal year). An M&I allocation is only as valuable as the demonstrated use of it prior to entering a shortage. The actual subcontracts held by individual entities may also have additional language that can affect the distribution of water between M&I users.

SUMMARY

Eventual shortages on the Colorado River will have a significant impact on the water providers such as Tucson Water which have come to rely on this renewable water supply. The Law of the River has evolved over time and provides limited guidance for shortage impacts. Under this framework, the Central Arizona Project has the lowest priority for water deliveries. With an ongoing drought and the increasing possibility of a shortage occurring in the near term, the Secretary of Interior is in the process of evaluating operational shortage guidelines proposed in the Preferred Alternative. Tucson Water will remain active in ongoing planning activities to ensure the Utility is adequately prepared to deal with supply impacts caused by shortage.

Tucson Water is well positioned for eventual shortages on the Colorado River. Nonetheless, there are additional steps that will be taken to further augment the Utility’s protections. Of primary importance, Tucson Water plans to bring its full allocation of Central Arizona Project water into use as soon as practicable to ensure that it has access to the greatest potential volume of water during the first and second tiers (steps) of Central Arizona Project shortages. The Utility will also continue working with the AWBA to maximize the amount of firmed water that is in storage at its own facilities while working toward finalizing recovery plans for the majority of the water that currently lacks a clear recovery mechanism. Finally, Tucson Water will continue to engage in state-wide and basin-wide planning efforts related to the Colorado River.