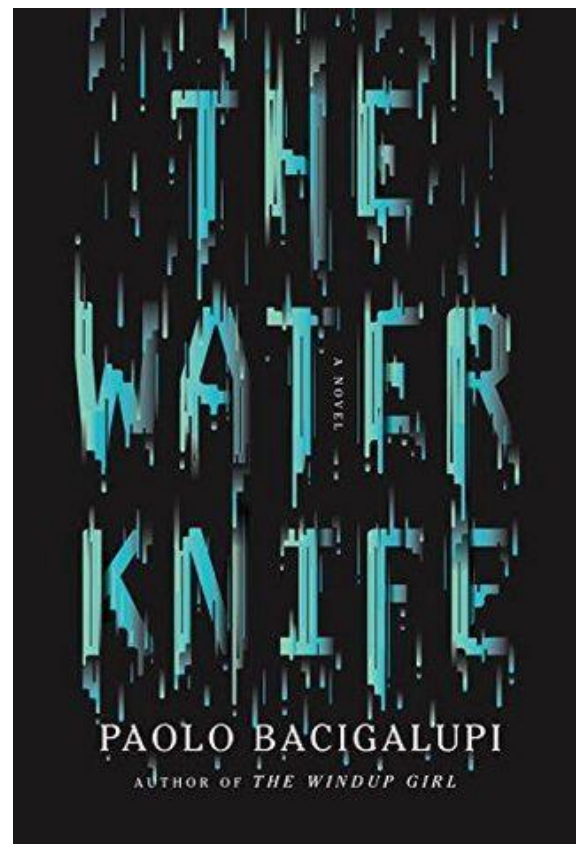
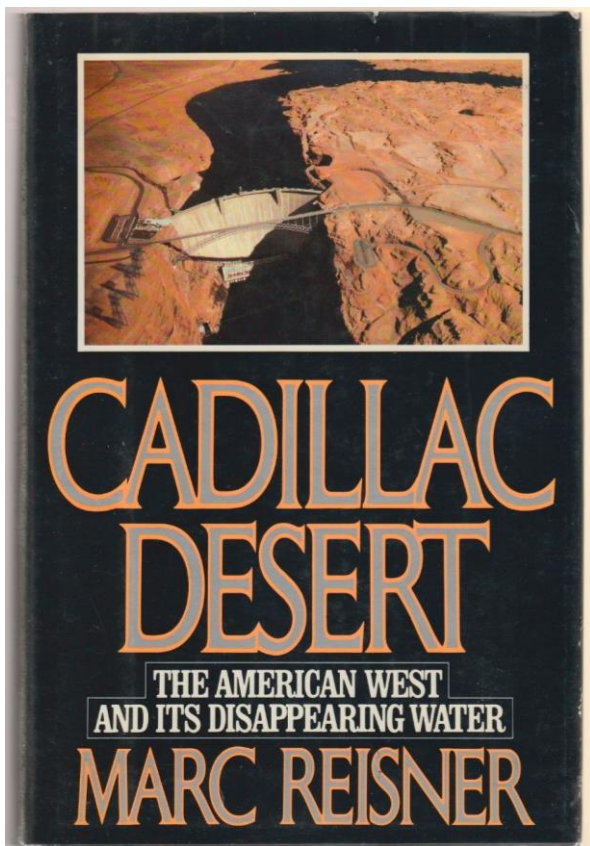


COLORADO RIVER COMPACT AND DROUGHT



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Introduction

The book, *Cadillac Desert*, by Marc Reisner is often touted as the layperson's entry to understanding water in the West (Hill, 2017). It tells the tale of the creation of infrastructure that carries water across hundreds of miles and mountain ranges but more interestingly speaks to the policies, agreements and relationships between federal agencies, farmers, states and cities that control the management and use of physical water infrastructure like canals and dams. One such agreement is the Colorado River Compact (Compact), which lays out how Colorado River water is allocated among seven western states. Negotiated in 1922, the Compact and its associated infrastructure manages the delivery of water to 40 million people (half of whom are in California) and 5.5 million acres of farmland as well as the generation of 4,200 megawatts of hydropower. The Compact encompasses 1,400 miles of river covering a 246,000-square mile basin or one-twelfth of the land area in the contiguous United States (USDOI, 2017). This paper provides an overview of the Compact, challenges implementing the Compact, the impact of drought on water deliveries to Compact states, and a look ahead at potential solutions and challenges.

The Colorado River Compact

The Compact was developed in response to the gold rush in the western United States during the late 19th and early 20th century. Miners and panners used water to extract gold from rocks and rivers. At the time, water use was ruled by the prior-appropriation water rights doctrine, also known as "first in time, first in right." This means that the first person to take a quantity of water from a water source and apply it to "beneficial use," typically defined as agricultural, industrial or household use, has first right to its continued use. As the gold market became more robust, the demand for water also grew, creating competition between states and regions that relied on the same water source, in this case the Colorado River. Less developed states were concerned that faster growing states like Arizona and California would take more than their "fair share" of available water based on the prior-appropriation doctrine. Adding to this scarcity mentality, infrastructure projects like the Hoover Dam were being planned by downstream states to store water for later use (implying that water would be taken away from upstream users) (USBR, 2017). As a result, there was a "call to action" to protect water rights for all states and regions. The action culminated in the development of the Compact.

The Compact was signed (although not ratified) in Santa Fe, New Mexico on November 24, 1922 during the Herbert Hoover Administration. Although the Compact was initiated to respond to water issues stemming from the gold rush, the Compact document expanded to include several purposes including:

- "to provide for the equitable division and apportionment of the use of the waters of the Colorado River System
- to establish the relative importance of different beneficial uses of water
- to promote interstate comity
- to remove causes of present and future controversies
- and to secure the expeditious agricultural and industrial development of the Colorado River Basin, the storage of its waters, and the protection of life and property from floods" (USBR, 1922)

As part of the Compact, the seven western states were split into two groups: Upper Division (Wyoming, Colorado, Utah and New Mexico) and Lower Division (California, Nevada and Arizona) (Figure 1).

Figure 1: The Colorado River Basin
 Source: Colorado Foundation for Water Education, 2016.



Each division has an associated basin or area of land within the respective division states that naturally drains into the Colorado River System (System) and all other parts within the respective division states that are “beneficially served by waters diverted from the System.” Each Basin is allocated 7.5 million acre feet (MAF) or 2.4 trillion gallons of water each year. However, 90% of the total water (allocated for both basins) is sourced from the Upper Basin (USDOL, 2017). The Lower Division has a right to increase water use by 1 MAF a year to account for growth and development. The Upper Division cannot hold back water allocated for the Lower Division. States can negotiate for more water than allocated through the Compact should “extra” or not allocated water become available but the decision would involve all the other Compact states and the United States Congress for approval. Water use was defined by sector with domestic, agricultural and power generation uses prioritized over navigation uses, and domestic and agricultural uses prioritized over power generation. The full Compact document provides additional provisions and details (USBR, 1922).

Selected Issues Involving the Colorado River Compact

Although the Compact seems relatively straightforward, with allocated amounts for each Basin and general rules to govern the relationship between the Basins, there are several issues that complicate the agreement. For example, in addition to the seven states, Mexico is allocated 1.5 MAF a year in a separate 1944 Treaty between the United States and Mexico. The Colorado River flows into the Sea of Cortez (Gulf of California) in northwestern Mexico making a case for Mexico to have rights to a portion of the Colorado River flow. However, Mexico is at the “end of the line” for water deliveries, meaning the water is used many times by other entities before reaching Mexico and therefore has experienced water quality issues that are not as prevalent further upstream. The 1944 Treaty only dictates water quantity not water quality. By the 1960’s, the salinity levels rose (due to human activities) in water deliveries to Mexico to a point that they were unusable for drinking, livestock or irrigation. To address this issue (and subsequent issues), Mexico and the United States developed a series of “minutes” or proposed decisions that are “related to the Treaty’s execution and interpretation.” Minutes are considered “binding” and are handled through the United States’ Executive Branch. Minute 242 successfully addressed the water quality issue in 1973 by committing the United States to build additional drainage channels, fund cleanup of damaged lands and maintain salinity at a certain level in deliveries to Mexico (Carter, 2017).

There were also internal issues between signatory states in the Compact. For example, California and Arizona debated over volumetric limits for each state in the Lower Division, which was partially resolved with the Boulder Canyon Project Act of 1928. This act limited the Lower Division states to the following annual allocations of water: Arizona (2.8 MAF), California (4.4 MAF) and Nevada (0.3 MAF). However, Arizona and California continued to debate over which water sources counted towards their allocation limits and how to calculate and allocate surplus water supplies. This dispute made it all the way to the Supreme Court, where it was finally resolved in a 1967 court decision in favor of Arizona regarding tributary waters and in favor of California regarding the surplus interpretation. Further complicating matters, Arizona didn’t sign the Colorado River Compact until 1944, 21 years after the six other states. Due to this delay, there was also a delay in developing infrastructure to carry water allocated by the Compact to Arizona. Arizona introduced the Central Arizona Project (CAP) in partnership with United States Bureau of Reclamation to the United States Legislature for support. At the same time, California was leading an effort to block support of CAP. In return for support for the CAP, Arizona agreed to “guarantee California’s 4.4 million acre feet a year as a priority over the CAP entitlement.” The CAP was finally authorized by Congress in 1968 (CRWUA, 2017). Lastly, there were also disputes within individual Compact states on how to appropriate internal state allocations to water districts. For example, California resolved internal disputes with the California Seven Party Agreement of 1931 (USBR, 1931).

Record of Decision

While the Compact and subsequent court and legal decisions dealt with normal water supply and surplus allocations, they didn't do much to tackle allocations during drought or other decreased water supply conditions. As the Colorado River Basin experienced prolonged drought in the late 1990's and early 2000's, there was conflict within the Basin about allocations due to declining reservoir levels. Between 2000 and 2005, both Lake Powell and Lake Mead were at 46% capacity and there were no rules in place on how to handle allocations to states under these conditions (Jerla, 2009). Adding to the severity of the situation, the Compact state allocations were established based on the assumption of 15 MAF mean annual flow in the Colorado River. However more recent calculations of mean annual flow have been closer to 13.7 MAF (USBR, 2017). States are now dealing with not only drought conditions but a reduced base flow. In response, the Department of the Interior held a 2-year public process to "develop additional operational guidelines and tools to meet the challenges of the drought in the Basin (USDOI, 2007)." As a result, by December 2007, the Record of Decision (Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead) was complete and released.

The Record of Decision document reached consensus on several items in addition to a plan for water shortages including mandates to "encourage conservation, implement closer coordination of operations of Lake Powell and Lake Mead, preserve flexibility to deal with further challenges such as climate change and deepening drought, implement operational rules for a long – but not permanent – period in order to gain valuable operating experience, and continue to have the federal government facilitate – but not dictate – informed decision-making in the Basin." Regarding water shortages, the Record of Decision outlines a series of operational guidelines (conditions and associated actions) partially based on varying reservoir levels as a metric for evaluating the varying degree of shortage and associated reductions in allocations to the Lower Division states. While at the time of the Record of Decision completion no shortages (delivery of less than 7.5 MAF to Lower Division states) had ever been declared, the purpose of the Record of Decision was to provide a "greater degree of certainty" to Lower and Upper Division States, water manager and users of how Lake Powell and Lake Mead will be managed in times of drought and other low reservoir conditions (USDOI, 2007). This document provides water managers and users with information on when and by how much water deliveries will be reduced (cutbacks) and in turn how to prepare for such conditions at the local level (alternative supplies, conservation, etc.). Table 1 shows cutbacks to each Lower Division state based on declining reservoir levels of Lake Mead, the main Lower Division reservoir, according to the Record of Decision. The Record of Decision guidelines use a 24-month projection for the following January 1st system storage and reservoir water surface elevations to determine if a shortage will exist for the following calendar year. The operational guidelines in Table 1 for shortages are in effect regarding water supply through 2025 and regarding reservoir operating through 2026.

Future Cutbacks

To date elevation levels in Lead Mead have stayed above 1,075 feet, and therefore, the shortage guidelines outlined in the Record of Decision (Table 1) have not been triggered. However, it is likely cutbacks will be needed in the future, if not near future. For example, in November 2016, Lake Mead was one foot away from triggering the cutbacks outlined in the Record of Decision. Lake Mead was at 37% of capacity. Depending on 2017's precipitation in the Basin and other factors, the Lower Division states could be facing cuts as soon as January 2018. If this happens, Arizona and Nevada would have to cut 320,000 AF (11%) and 13,000 AF (4%) respectively from their typical annual allotment. However, no cuts are required for California under these circumstances. The University of Colorado and the United

State Bureau of Reclamation’s modeling shows that there was essentially a 50/50 chance that the Lower Division states would face shortages in 2018, without implementing any cutbacks in use (as of November 2016) (Finley, 2016).

Table 1: Allocations by State by Lake Mead Elevations

Source: Record of Decision, Colorado River interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead, December 2007.

Lake Mead Elevation (feet)	Lower Basin Allocation	Arizona Allocation	Nevada Allocation	California Allocation
NORMAL >1,075 projected	7.500 MAF	2.80 MAF	300,000 AF	4.4 MAF
≤1,075 projected or 1,050 on Jan. 1st	7.167 MAF	2.48 MAF	287,000 AF	4.4 MAF
≤1,050 projected or 1,025 on Jan. 1st	7.083 MAF	2.40 MAF	283,000 AF	4.4 MAF
≤1,025 projected on Jan. 1 st	7.000 MAF	2.32 MAF	280,000 AF	4.4 MAF

Another factor that impacts the level of Lead Mead is how Mexico decides to use it’s 1.5 MAF annual allocation. Mexico and the United States enacted Minute 319 in 2012, which among other joint cooperative actions, allowed Mexico to bank or hold a portion of its allocation in Lake Mead for future use (USBR, 2012). This provision of Minute 319 benefits both Mexico by increasing storage options and the United States by contributing to maintaining Lake Mead levels above storage triggers (described above in Table 1). However, the Minute term is only five years and is set to expire on December 31, 2017 around the same time Lake Mead is projected to drop below the 1,075 level. Both countries have been meeting to discuss an extension or replacement for Minute 319, currently known as “Minute 32X” that would continue some of the efforts set forth in Minute 319 (USDOL, 2017). To date, no new or extended Minute 319 has been approved, and there is uncertainty on how future agreements may be implemented under the Trump administration (Richards, 2017).

As of February 2017, conditions have improved in the Colorado River Basin due to winter snowfall. The United States Bureau of Reclamation revised their projections of a shortage in January 2018 down from about a 50% chance to 34% chance. By the end of 2017, Lake Mead could be at least 3 feet above the storage threshold of 1,075. This is quite different than the projection several months ago, which goes to show how reliant the Colorado River System is on weather (Yardley, 2017).

Even if the immediate threat of shortage may be averted for 2018, longer term planning for shortages is still taking place. For example, the Lower Division states have developed a draft Lower Basin Drought Contingency Plan (LBDCP) to reduce the risk of Lake Mead falling below the critical level of 1,020 feet, a threshold not specifically accounted for in the Record of Decision Interim Guidelines. The LBDCP would

be in place through 2026, in line with the Record of Decision. According to the draft LBDCP, Arizona and Nevada would take additional reductions but California would also be expected to reduce use as well (note that California does not have cutbacks in the Record of Decision). As of January 2017, completion of the LBDCP remains uncertain (CAP, 2017). A local advantage to plans like LBDCP is that they attempt to mitigate shortages amongst themselves rather than having the federal government step in with requirements like those in the Record of Decision.

The Upper Basin also has a part to play in shortages. As part of the Compact, the Upper Basin is required to deliver 7.5 MAF of water to the Lower Basin. The assumption is that the Upper Basin would have to deliver 7.5 MAF of water even if faced with their own shortages and the inability to provide themselves with their own 7.5 MAF allocation (Fleck, 2001). It is uncertain what would actually happen under this circumstance as these conditions have not yet occurred.

Potential Management Solutions

Realizing that water shortages are a likely part of the Colorado River Basin's future, several different approaches to managing the decreased supply have been offered up as potential solutions (Jacobs, 2011). The first is to renegotiate the Compact and allow for inter-basin exchanges between the Upper and Lower Basins (Grant, 2008). A second idea is to use market forces to reallocate available water between users, such as agriculture and urban users. For example, if a shortage occurs, the available water is valued and sold to the highest bidder, a proxy for the highest beneficial use. This could result in traditionally allocated agricultural water being sold to urban centers at a higher price (WRA, 2014). Third is the modification of dams within the Colorado River System. Some proponents call for more dams to store more water in times of shortage, while others call for the less dams, specifically the decommissioning of Lake Powell to reduce evaporative loss and consolidate operations (Lustgarten, 2016). Fourth is the increase in water recycling within the Colorado Basin. Even with a decrease in overall water availability, increased recycling efforts mean that the water that is available would be used multiple times, extending supply (WRA, 2014). Fifth is the idea of better utilizing a component of the Record of Decision called Intentionally Created Surplus (ICS), which are collective actions taken by a state(s) to intentionally conserve water to leave in Lake Mead for later use. Actions can include fallowing of agricultural land, canal lining programs, desalination programs and other conservation programs (USBR, 2007). Lastly is conservation efforts by both municipal and agricultural users to decrease demand on the Colorado River Basin itself, thus more closely matching the decrease in supply to a decrease in demand (Grant, 2008).

Conclusion

In reality, in complex systems like the Colorado River Basin, there is not one "magic bullet" solution to comprehensively "solving" the Basin's water supply issues. Water management in the Colorado River Basin in a sense is an unsolvable or "wicked problem," in which, at best, managers attempt to balance the variety of demands between Basins, states, and water users (municipal, agriculture and the environment) against an uncertain water supply (Horst, 1973). Management going forward will likely involve a mix of all the above proposed solutions as well as others that have not even been developed yet. One thing that is certain is that the solutions will need to be more collaborative than those originally designed in the Compact, which propagated an illusion of two separate but equal (in terms of demand and supply) basins (Dineen, 2016). Additionally, the changing supply profile of the Colorado River Basin and potential impacts of climate change will require a fresh look at the baseline assumptions that the Compact allocations are built on (Christensen, 2004). Bradley Udall, a senior fellow at the University of

Colorado Law School summarized the situation as “Nineteenth-century water law is meeting 20th-century infrastructure and 21st century climate change (Hiltzik, 2014).”

How the Colorado River Basin is managed and ultimately what allocations are available to each state will have impacts beyond the immediate states and water users. For example, California receives about 10% of its total water supply from the Colorado River and in some years, exceeds its allocation (CDWR, 2013). In the event the allocation is decreased, California will need to make up that difference either through demand management or supply augmentation, which could put pressure on other supplies in the state like northern California. However complex, policy makers and managers need to continue to work towards solutions to this “wicked problem,” even in the face of these challenges to avoid a future like the one described in the dystopian novel, *The Water Knife*, by Paolo Bacigalupi, in which the West has succumbed to drought and there is a monopoly over water and with it a constant highstakes battle over who gets water, how much and when.

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