# The Risk of Curtailment under the Colorado River Compact

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## INTRODUCTION

When we buy a life insurance policy, we calculate the odds that we'll need it, even if subconsciously. How's my health? What happens to my family if I'm not around? How dangerous is my job? The risk we perceive determines how big a policy we want and how much we're willing to pay. But these are uncomfortable questions we'd rather not think about, and tend to avoid.

When considering the future of the Upper Basin of the Colorado River, we need to do the same thing, even though the answers reveal unpleasant realities. If we do nothing and the water runs short, will we get the water we need? What are the risks that we won't? What can we do to mitigate the risk? An objective risk assessment is needed so we can make good decisions about the right amount of insurance to insure against catastrophic loss.

The options proposed to date range from impossible and pricey dreams of redirecting water from distant rivers to soldiering forward with little change in operation. The most realistic options include:

- A pool of water in Lake Powell that will help protect water uses in Colorado and the other Upper Basin states if river flows aren't sufficient to fulfill Lower Basin obligations.
- A "grand bargain" between the Upper and Lower Basin states with compromises on crucial unresolved legal questions that threaten their respective basin supplies in exchange for greater certainty about rights and responsibilities.
- A path to a more sustainable water balance where each basin operates within its hydrological means and manages risk in the manner it deems most appropriate.

Now is the time to think about our risks, and our insurance options. Over the next six years, negotiators for the seven Colorado River basin states will be discussing the rules for future river management, replacing the current regime that expires in 2026. This process gives us the opportunity, and the duty, to consider how to sustainably manage a finite water resource in the face of volatile supplies, aridification, and over-allocation, and figure out what kind of insurance policy we should buy.

We have dire forecasts; we have critical needs. Reconciling those competing dynamics is the primary challenge for decision-makers. The intensity of the response embodied in any new management procedures for the Colorado River should be founded on the best collective judgment about both the degree of risk of insufficient water and the magnitude of the consequences if supplies run low.

Our knowledge of the risks and consequences is growing, both in volume and in bleakness. Current forecasts project significantly lower flows in the Colorado River Basin. Respected climate scientists have conservatively estimated declines in river flows of 20% by the middle of the 21st century and 35% by the end of the century, as compared to 20th century flows. They cite support for losses of even greater, and astonishingly dismal, volumes. No one knows

precisely what the future will hold, but these and other dire projections require that water managers be armed with contingency plans for a range of possibilities.

The evaluation of the risk that use of Colorado River water will be impacted (both existing and new uses) and the magnitude of the consequences will be different for each Colorado River Basin state and major water user. The report that follows focuses on the risk that Colorado River water users within the state of Colorado will have their water use curtailed, or cut off entirely, as a result of downstream obligations under the Law of the River.[1] The goal is both to inform discussions about future operating principles for river management and to provide a basis for determining how aggressive Colorado and the other Upper Basin states should be in fending off potential curtailment. These questions are, at their core, an inquiry into whether we need an insurance policy, how big it should be, and how much we're willing to pay for it.

The 1922 Colorado River Compact – the original governing structure for the Law of the River – has been in place for almost one hundred years. While its allocation provisions continue to underpin annual operations and water deliveries to this day, the enforcement mechanisms that provide for reductions in water use in the Upper Basin states have never been triggered. As a result, no one knows exactly how enforcement would be implemented in practice. But the impacts of continued development of water within the Basin, the reduced flows experienced over the past two decades, and the substantial uncertainties surrounding the expected volume of future water supplies have combined to cause the specter of water shortage to loom much more prominently in the evaluation of reliability of Colorado River water rights.

This report wrestles with the risks of curtailment to Colorado River-sourced water rights within the state of Colorado. It outlines the major provisions of the Law of the River that contribute to the risk of curtailment. Key current measurements of water use and river flows are described, together with the most recent projections of future hydrology within the Colorado River Basin and the impact of that hydrology on vital features of the system. A description of recent developments designed to bring the system into better balance is included, together with the likely administration of water rights within the State of Colorado should it be necessary to impose curtailment in order to comply with the Law of the River.

We conclude that:

- absent action, the risk of shortage that could force curtailment to water users in Colorado and elsewhere in the Upper Colorado River Basin is real and substantial
- there are options for Law of the River compromises that could reduce this risk
- the development of a demand management program now has the potential to lessen the potentially devastating risks of forced curtailment of Colorado River water use in the future

[1] The term "Law of the River" refers to the amalgamation of statutes, treaties, court decisions, agreements, and operational documents that apportion the water and regulate the use and management of the Colorado River among the seven basin states and Mexico.

## LEGAL FRAMEWORK

### 1922 Colorado River Compact, Mexican Treaty, and Boulder Canyon Project Act

The largest risk for the Upper Basin stems from a decision made in 1922 that appears to place much of the burden of Colorado River shortages on the Upper Basin states. Presuming the river was capable of providing far more water than we now know that it has, the framers of the Colorado River Compact a century ago wrote water-sharing provisions that place a disproportionate burden on the Upper Basin during times of low flows. In the world in which they thought they lived, the River would produce a substantial surplus beyond what they were allocating - enough water to meet everyone's contemplated needs, with a surplus for future growth. They failed to see the risk posed by the bargains they made should they be wrong, made no accommodation for an equitable sharing of shortages, and wrote the rules in a way that allocated the burden of future uncertainty to the Upper Basin.[2]

The origins of this misstep date to the early 1920s, when Congress and the Department of the Interior were contemplating water projects along the lower Colorado River, including what became Hoover Dam. This activity awakened the concerns of the states in the upper part of the river system that the "additional waters made available by the storage and canal projects might be gobbled up in perpetuity by faster growing lower basin areas, particularly California, before the upper States could appropriate what they believed to be their fair share."[3] To avoid litigation and further conflict, the seven Colorado River Basin States (Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming) requested and received Congressional authorization for the negotiation of and entry into an agreement to equitably apportion the water supply. Pursuant to this authorization, representatives of the seven Basin States reached an agreement on November 24, 1922, known as the Colorado River Compact (1922 Compact).[4]

The 1922 Compact allocated the waters in the river system by apportioning 7,500,000 acre feet (7.5 million acre feet or MAF) to the Upper Basin[5] and the same amount to the Lower Basin.[6] The dividing line between the Upper and Lower Basins is Lee Ferry, a point on the river in

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[2] Eric Kuhn and John Fleck, *Science be Dammed: How Ignoring Inconvenient Science Drained the Colorado River,* University of Arizona Press, Tucson (2019).
[3] *Arizona v. California,* 373 U.S. 546, 555 (1963).
[4] *Id*. at 554-57.
[5] "The term 'Upper Basin' means those parts of the States of Arizona, Colorado, New Mexico, Utah and Wyoming within and from which waters naturally drain into the Colorado River System above Lee Ferry, and also all parts of said States located without the drainage area of the Colorado River System which are now or shall hereafter be beneficially served by waters diverted from the System above Lee Ferry." Colorado River Compact (1922) (hereinafter, "1922 Compact") Article II(f).
[6] 1922 Compact Article III(a). Article III(b) of the 1922 Compact also gives the Lower Basin the right to increase its use by another one million acre feet, a provision frequently interpreted by Arizona and the Upper Division states to refer to use of water from the Gila River. *See* Eric Kuhn and John Fleck, *The Upper Basin, Lower Basin, and Mexico: Coexisting on the Post-2026 Colorado River,* Working Paper 2019-2, p. 11, available at http://www.inkstain.net/fleck/wp-content/uploads/2019-06-09_SBDWP_2019-02.pdf.

northern Arizona, one mile below the confluence with the Paria River and approximately fifteen miles below Glen Canyon Dam and Lake Powell.[7]

Recognizing that the volatile nature of the river did not allow reliance on a predictable amount of flow from year to year, the framers of the 1922 Compact included a provision that, as commonly interpreted, allocates the risk of a shortage in flows to the Upper Division states.[8] Article III(d) of the 1922 Compact provides that "the States of the Upper Division will not cause flow of the river at Lee Ferry to be depleted below an aggregate of 75,000,000 acre feet for any period of ten consecutive years."[9] The Compact drafters, acknowledging that an obligation to deliver a portion of the flows of the river to Mexico might be negotiated in the future, further provided that any such delivery to Mexico would first be met from surplus waters and that one-half of any remaining deficiency would be delivered by the Upper Division states at Lee Ferry.[10] Such an obligation was imposed in 1944 with the ratification of a treaty with Mexico requiring delivery of 1.5 million acre feet in normal years at the border.[11] But "surplus," as used in the 1922 Compact in connection with the Mexican commitment, has never been defined, creating significant legal uncertainty about the Upper Basin's obligation under the treaty.[12]

The ten-year running average provision in Article III(d) (sometimes referred to as the "75/10" provision) is the underpinning of the risk to Upper Division state water rights from enforcement of the 1922 Compact, including those in Colorado. There is an ongoing debate as to whether the 1922 Compact imposes an affirmative obligation on the Upper Division states to <u>deliver</u> 75 MAF over any consecutive ten-year period, or rather that it requires only that the Upper Division states <u>not deplete</u> the flows of the river by human activities beyond that amount.[13] The "non-depletion" theory could mean that if climate change or normal volatility makes less than 16.5 MAF available in the system (7.5 MAF for the Upper Basin, 7.5 MAF for the Lower Basin, and 1.5 MAF for Mexico), so long as the Upper Division states are collectively depleting

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[7] 1922 Compact Article II(e), II(f), and II(g); *see also* https://www.usbr.gov/projects/index.php?id=144. Lee Ferry is frequently referred to as "Lees Ferry."

[8] The term 'States of the Upper Division' means the States of Colorado, New Mexico, Utah and Wyoming." 1922 Compact Article II(c). While the terms "Upper Basin" and "Upper Division" are frequently used interchangeably, they are defined differently in the 1922 Compact, with the Upper Basin representing the geographical extent of the river basin above Lee Ferry, which includes a part of Arizona plus areas that are served by water diverted in that part of the basin, and the Upper Division including only the four above-mentioned states. Articles II(c) and II(f). This report will use the term "Upper Division states" to refer to the states themselves, consistently with the usage in the 1922 Compact.

[9] *Id.* Article III(d).

[10] *Id.* Article III(c).

[11] Treaty Between the United States of America and Mexico, Utilization of the Waters of the Colorado and Tijuana Rivers and the Rio Grande, 1944, Article 10(a). The Treaty also provides for deliveries up to 1.7 MAF in any year that a surplus exists in excess of the amount necessary to supply uses in the U.S. Article 10(b).

[12] *See* Eric Kuhn and John Fleck, *supra* note 6.

[13] *See e.g.*, *Does the Upper Basin have a Delivery Obligation or an Obligation Not to Deplete the Flow of the Colorado River at Lee Ferry?,* Colorado River Governance Initiative (2012), available at http://www.waterpolicy.info/wp-content/uploads/2015/09/Delivery-Obligation-memo.pdf; John U. Carlson and A. E. Boles, *Contrary Views of the Law of the Colorado River: An Examination of Rivalries Between the Upper and Lower Basins,* Rocky Mountain Mineral Law Institute 32, no. 21 (1986).

less than 7.5 MAF, they are not obligated to reduce their uses to ensure that the ten-year average of 75 MAF is provided to the Lower Basin. This position is, however, at least somewhat undermined by provisions in the 1948 Upper Colorado River Basin Compact, as discussed below. If the 1922 Compact creates the obligation to "deliver" 75 MAF over ten years, then the full impact of reductions in runoff caused by climate change could fall on the Upper Division states.

The 1922 Compact provided that it would become effective after approval by the legislatures of each of the seven signatory states and by the U.S. Congress.[14] It was approved by the U.S. Congress in the Boulder Canyon Project Act on December 21, 1928. This Act also waived the requirement for ratification by seven state legislatures and provided instead that the 1922 Compact would become effective when the State of California and at least five of the other States approved it.[15] The Boulder Canyon Project Act became effective on June 25, 1929 after six states, including California, ratified the 1922 Compact.[16]

The 1922 Compact provides that "present perfected rights," meaning those that predate the Compact, are unimpaired by its provisions.[17] It is unsettled as to whether such rights are those that have priority dates earlier than the date of the execution of the 1922 Compact, November 24, 1922, or, alternatively, earlier than the date the 1922 Compact became effective based on its congressional approval, June 25, 1929.[18] The term "post-Compact" is used in this report to refer to water rights junior to the critical date, whichever it is.

**1948 Upper Colorado River Basin Compact**

The 1948 Upper Colorado River Basin Compact[19] (Upper Basin Compact), negotiated to sort out water sharing among Wyoming, Utah, New Mexico, and Colorado, magnifies risks created by uncertainties in the 1922 Colorado River Compact in two ways. First, it appears to lock in the

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[14] 1922 Compact Article XI.
[15] Boulder Canyon Project Act, 43 U.S.C. §§ 617L(a) (1929).
[16] *Arizona v. California,* 373 U.S. at 561-62.
[17] 1922 Compact Article VIII.
[18] *See* Eric Kuhn, *Risk Management Strategies for the Upper Colorado River Basin, 2012,* pp. 7-10, available at https://www.coloradoriverdistrict.org/wp-content/uploads/2014/11/Kuhn_on_Risk_Mgt_Strategies_of_the_UCRB.pdf. The Special Master's report in *Arizona v. California*, *supra* note 3, unequivocally determines that the operative date is June 25, 1929, the effective date of the 1922 Compact. Special Master Report, Simon H. Rifkind, Arizona v. California, U.S. Supreme Court, Dec. 5, 1960, at n. 20. Rifkind's report also finds that "present perfected rights" include only the portion of a state-recognized right that was actually diverted and placed to beneficial use prior to June 25, 1929. Thus, the portion of a decreed right not yet in use as of that date would not be protected. Special Master Report at 306-09. The U.S. Supreme Court opinion implies without holding that the operative date for present perfected rights is June 25, 1929, and does not address the extent of the protection for state-recognized rights. *Arizona v. California*, 373 U.S. at 600. Both the Special Master and the U.S. Supreme Court were interpreting the 1928 Boulder Canyon Project Act and not specifically the 1922 Compact and the decisions are not binding on the Upper Division states as they were not parties to the U.S. Supreme Court action.
[19] Upper Colorado River Basin Compact (1948), *see* An Act to grant the consent of the United States to the Upper Colorado River Basin Compact, Act of April 6, 1949 (63 Stat. 31).

interpretation that the Upper Basin could be forced to bear the brunt of the impacts of climate change. Second, in an apparent effort to enforce the allocations made among the Upper Division states, it obliquely imposes a draconian curtailment punishment for completely permissible uses of water prior to curtailment.

The Upper Basin Compact apportions the Upper Basin portion of the 1922 Compact allocation as follows:

> State of Arizona 50,000 acre feet
>
> After the deduction of Arizona's use of water, not exceeding 50,000 acre feet, the remainder is split as follows:
>
> | | |
> |---|---|
> | State of Colorado | 51.75% |
> | State of New Mexico | 11.25% |
> | State of Utah | 23.00% |
> | State of Wyoming | 14.00%[20] |

The Upper Basin Compact further states that curtailment of the use of water by the States of the Upper Division may be necessary to comply with the 75/10 provision of the 1922 Compact. This required curtailment is what is often referred to as a "Compact call" or, as we will refer to it here, a "Compact curtailment."[21] In a departure from the 1922 Compact, which created no governance entity to administer its terms, the Upper Basin Compact established the Upper Colorado River Commission (UCRC), which, among other powers, has the authority to make findings about the necessity for and extent of curtailment of water use to comply with Compact obligations.[22]

The use of percentages, rather than specific volumetric amounts, to allocate the majority of the Upper Basin allocation from the 1922 Compact and the numerous references to potential "curtailment" in the Upper Division states suggest that the framers of the Upper Basin Compact viewed the 75/10 provision as something more than a non-depletion requirement, namely an obligation that the Upper Division states ensure that 75 MAF pass Lee Ferry over any consecutive ten-year period. While not conclusive as to the ultimate interpretation of the Upper Division obligation under the 1922 Compact, these provisions in the Upper Basin Compact create the risk that post-Compact water rights in the Upper Division states including Colorado could be subject to curtailment to produce flows of 75 MAF at Lee Ferry over ten years.

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[20] Upper Basin Compact Article III(a).

[21] While the term "Compact call" is in common usage in Colorado and throughout the Upper Basin, this type of "call" would be different from a call placed by a senior appropriator within the state of Colorado to curtail the diversions of an upstream junior appropriator under the prior appropriation system. *See Alamosa-La Jara Water Protective Ass'n v. Gould*, 674 P.2d 914, 922-24 (Colo. 1984). Accordingly, the term "Compact curtailment" is used in this report.

[22] Upper Basin Compact, Articles IV and VIII(d)(8).

The Upper Basin Compact also contains a provision that has earned the disparaging nickname "penalty box," addressing the comparative use of the Upper Basin water allocation among the Upper Division states. Article IV(b) provides:

> If any State or States of the Upper Division, in the ten years immediately preceding the water year in which curtailment is necessary, shall have consumptively used more water than it was or they were, as the case may be, entitled to use under the apportionment made by Article III of this Compact [containing the percentage allocations to the Upper Division states], such State or States shall be required to supply at Lee Ferry a quantity of water equal to its, or the aggregate of their, overdraft or the proportionate part of such overdraft, as may be necessary to assure compliance with Article III of the Colorado River Compact, before demand is made on any other State of the Upper Division.[23]

While not a model of clarity, the penalty box provision could be construed to mean that if, for example, Colorado has used more than 51.75% of the overall consumptive use of Colorado River water by the Upper Division states and the other Upper Division states are within their percentage allocations, Colorado water users could be subject to curtailment to the full extent of the overage from the previous ten years before water uses in any other Upper Division state are affected. This provision has the potential to impose an extremely severe *post hoc* burden on an affected state for use of water that was perfectly legal and proper in the preceding years.[24]

Neither the general curtailment nor the penalty box provisions of the Upper Basin Compact has been triggered to date.

**Colorado River Storage Project Act of 1956**

Recognizing that the volatility of Colorado River flows could make the Lee Ferry obligation of the Upper Division states difficult to meet while at the same time allowing those states to serve their anticipated growth, Congress authorized a series of dams and reservoirs on the upper river. The purposes of the 1956 Colorado River Storage Project Act (CRSPA) included "regulating the flow of the Colorado River, storing water for beneficial consumptive use, making it possible for the States of the Upper Basin to utilize, consistently with the provisions of the Colorado River Compact, the apportionments made to and among them in the Colorado River Compact and the Upper Colorado River Basin Compact."[25] The primary authorized projects are Curecanti (now Aspinall), Glen Canyon, Navajo, and Flaming Gorge.[26] The reservoirs created would allow storage of Upper Basin flows in wetter years that could then be used to satisfy the 1922 Compact obligation when flows were low. All of the primary projects have been

[23] *Id.* Article IV(b).
[24] *See* information on 2009-2018 use by Colorado, *infra* notes 73 and 74 and accompanying text.
[25] Colorado River Storage Project Act, 1956, 43 U.S. Code 620, § 1.
[26] *Id.*

constructed and Lake Powell, created by Glen Canyon Dam, serves as the primary water savings account for the Upper Basin.

**Arizona v. California - The Supreme Court Weighs In**

Instigated in 1952 by a complaint filed by Arizona under the US Supreme Court's original jurisdiction to hear disputes between states, a decision was finally rendered in 1963 that provided additional detail on the elements of the Law of the River. The Court's decision determined the division of the 7.5 MAF allocated to the Lower Division states (2.8 MAF to Arizona; 4.4 MAF to California; and 0.3 MAF to Nevada).[27] It also found that the use of the tributaries to the mainstem of the Colorado River does not count against those allocations.[28] The decisions reached in *Arizona v. California* were based solely on the Boulder Canyon Project Act, not the 1922 Compact,[29] so the meaning of the various Compact provisions have not been interpreted. Also, interestingly, because the Upper Division states were not parties to the Supreme Court proceeding, they are not bound by the decision.

**Colorado River Basin Project Act of 1968 and the Long-Range Operating Criteria**

The 1968 Colorado River Basin Project Act[30] (1968 Act), the final major piece of Colorado River development legislation, added two elements to Colorado River water management that are important to understanding risks in Colorado and the rest of the Upper Basin going forward. First, it authorized the infrastructure to support a substantial increase in Lower Basin use by enabling the construction of the Central Arizona Project to bring Colorado River water to the Phoenix and Tucson valleys and the farming areas around them, facilitating the diversion of water allotted to Arizona by the Supreme Court in *Arizona v. California*.[31] Second, it created a new operational framework for the river by directing the Secretary of the Interior to propose criteria for the operation of the federal reservoirs, and specifically for the releases from the Upper Basin reservoirs including Lake Powell. The order of priority of such releases was specified, which included balancing the amount of water stored in Lake Mead and Lake Powell.[32]

Originally adopted in 1970 and updated in 2005, the Long-Range Operating Criteria, or LROC, fulfill this directive.[33] The LROC describe how releases from Lake Powell and other Upper Basin reservoirs will be determined, listing the various factors that will be considered. The LROC address the balancing of the contents of Lake Powell and Lake Mead and the manner in which Lake Mead will be operated, including the declaration of a shortage in the Lower Basin when insufficient mainstream water is available to satisfy annual consumptive use requirements of

[27] *Arizona v. California,* 373 U.S. 546, 567-71 (1963). *See also, Arizona v. California,* Decree, 376 U.S. 340 (1964).
[28] 373 U.S. at 572-75.
[29] *Id.* at 565-67.
[30] Colorado River Basin Project Act, 1968, P.L. 90-537, § 102(a).
[31] 1968 Act Title III.
[32] 1968 Act § 602(a).
[33] Long-Range Operating Criteria, 70 Fed. Reg. 15873.

7,500,000 acre feet. The LROC state an objective of maintaining a minimum annual release of 8.23 MAF from Lake Powell.[34] This number derives from the apportionment of water to the Lower Basin of 7.5 MAF, plus one-half of the 1.5 MAF obligation to Mexico, or 0.75 MAF, minus 20,000 acre feet assumed to be provided on an average annual basis by the Paria River, which is within the Upper Basin but below Glen Canyon Dam and above Lee Ferry.

**Interim Surplus Guidelines and the Quantification Settlement Agreement**

From 1964 to 2001, California diverted an average of 5.1 MAF per year from the Colorado River.[35] It was able to do so because Arizona and Nevada were not utilizing the full amount of their allocations. But that landscape began to change at the beginning of the 21st century. Uses in Arizona and Nevada were ramping up, and concerns were growing that California needed to be put on a water diet, whether voluntarily or through intervention, and its uses limited to 4.4 MAF as required by the Boulder Canyon Project Act.[36] The first step along this path took the form of the Interim Surplus Guidelines, issued by the Secretary of the Interior in 2001. These guidelines describe how the Secretary of the Interior will allocate water that is unused by any Lower Division state, and "linked determinations of surplus availability to specific elevations of Lake Mead and also to California's progress in developing and implementing a plan to reduce its annual consumptive use to 4.4 MAF."[37] The guidelines provided penalties for California if agreement limiting that state's use to 4.4 MAF had not been reached by the end of 2001.[38]

The California agreement contemplated in the Interim Surplus Guidelines was the Quantification Settlement Agreement (QSA). Although it was not executed before the deadline established in the Interim Surplus Guidelines, the QSA establishes water budgets for the various California water contractors and incorporates agreements that quantify the rights of California water users and provide for water transfers to facilitate reaching the 4.4 MAF limit.[39]

The results were soon felt. After rising steadily through the 1990s, annual Lower Basin main stem consumptive use peaked at 8.6 million acre feet in 2002 before dropping to 7.5 million acre feet in 2003 and generally staying at or below that level ever since.[40]

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[34] *Id.* § II.
[35] Reclamation, Lower Colorado River Water Accounting Reports, https://www.usbr.gov/lc/region/g4000/wtracct.html.
[36] *See supra* notes 27-29 and accompanying text.
[37] Reclamation, The Colorado River Documents, at 2-3 (2008).
[38] Record of Decision, Colorado River Interim Surplus Guidelines, Final Environmental Impact Statement, January 2001, at 26-27.
[39] Quantification Settlement Agreement among Imperial Irrigation District (IID), the Metropolitan Water District of Southern California (MWD), and Coachella Valley Water District (CVWD), Oct. 10, 2003; Colorado River Water Delivery Agreement among the United States, IID, MWD, CVWD, and San Diego County Water Authority, Oct. 10, 2003.
[40] Reclamation, Lower Colorado River Water Accounting Reports, https://www.usbr.gov/lc/region/g4000/wtracct.html.

**2007 Guidelines**

While an important step in reducing Colorado River water use, the 2001 Interim Surplus Guidelines and related steps proved insufficient. In 2005, after six years of significantly below average flows in the Colorado River system and with Lake Powell having dropped to its lowest levels since it was filled in the 1960s, the basin management community recognized the need for further action. The Department of the Interior together with the seven Basin States initiated a process to develop operational tools that would improve their collective ability to respond to drought conditions and coordinate the operation of the large Colorado River reservoirs.

This process ultimately resulted in the adoption by the Secretary of the Interior of a Record of Decision in December 2007 concerning Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead.[41] The 2007 Guidelines were adopted by that Record of Decision.[42] For the "interim period" of 2007 to 2025 during which the 2007 Guidelines are in effect, they implement the LROC. After this interim period, operations will revert to the LROC unless other agreements are reached. A formal review of the 2007 Guidelines must begin no later than December 31, 2020 that will include consultation with the Basin States.[43]

The 2007 Guidelines were adopted by the Secretary of the Interior "to provide a greater degree of certainty to United States Colorado River water users and managers of the Basin by providing detailed, and objective guidelines for the operations of Lake Powell and Lake Mead, thereby allowing water users in the Lower Basin to know when, and by how much, water deliveries will be reduced in drought and other low reservoir conditions."[44] They address a wide variety of Colorado River operations, including storage of surplus water in Lake Mead, flood control procedures, reduced deliveries to the Lower Division states when Lake Mead levels reach specified critical elevations, and reduction of California's agricultural use. The principal provisions of the 2007 Guidelines that are relevant to this report on risk to Colorado water rights concern the reduction of deliveries in the Lower Basin at low levels in Lake Mead and the coordinated operations of Lake Powell and Lake Mead. Both of these areas are described below.

*Reduction of Deliveries to Lower Basin States during Shortage Conditions*

The 2007 Guidelines provide for reduction of deliveries of water to Arizona and Nevada in the Lower Basin when Lake Mead elevations reach certain critically low levels. The amounts in acre feet of the prescribed reductions based on Lake Mead elevations above sea level are shown in Figure 1.

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[41] Record of Decision, December 13, 2007, Secretary of the Interior Dirk Kempthorne (hereinafter, "ROD"), available at https://www.usbr.gov/lc/region/programs/strategies/RecordofDecision.pdf.
[42] *Id.* at Section XI.G. Section XI.G of the ROD constitutes the "2007 Guidelines."
[43] 2007 Guidelines, Sections 7.D and 8.
[44] ROD, p. 6.

| Lake Mead Elevation (Feet) | Arizona Reduction (AF) | Nevada Reduction (AF) |
|---|---|---|
| 1075 – 1050 **Tier 1** | 320,000 | 13,000 |
| 1050 – 1025 **Tier 2** | 400,000 | 17,000 |
| Below 1025 **Tier 3** | 480,000 | 20,000 |

Figure 1 Lake Mead Delivery Reductions, 2007 Guidelines

These reductions become applicable when Lake Mead content is projected to be at or below the specified elevations on January 1. The projection made in August of one year for January 1 of the following year is determinative.[45]

*Coordinated Operations of Lake Powell and Lake Mead*

The objective of the coordinated operation provisions in the 2007 Guidelines is "to avoid curtailment of uses in the Upper Basin, minimize shortages in the Lower Basin and not adversely affect the yield for development available in the Upper Basin."[46] The provisions are complex, but in essence provide that when the contents of Lake Mead and Lake Powell are relatively equal – not substantially out of balance – the minimum objective annual release of 8.23 MAF called for by the LROC will be made from Lake Powell to Lake Mead. Releases greater than 8.23 MAF will be made to balance the content in the two reservoirs if Lake Powell's content exceeds Lake Mead's. Releases smaller than 8.23 MAF, but not less than 7.0 MAF, may be made if Lake Powell levels are low and Lake Mead levels are not critical.[47]

Over the past ten years, releases from Lake Powell to Lake Mead have been 8.23 MAF for two years, 7.48 MAF for one year, and 9.0 MAF or greater for seven years.[48] A release of 8.23 MAF is projected for water year 2020.[49]

The minimum objective release from Lake Powell of 8.23 MAF established by the LROC and 2007 Guidelines has raised a question as to whether the Upper Basin's obligation will be deemed to be 82.5 MAF over ten years (82.5/10) to account for the Upper Basin half of the

[45] 2007 Guidelines § 2.
[46] *Id.* § 6.
[47] *Id.*
[48] Reclamation, Annual Operating Plans, 2010-2019, available at https://www.usbr.gov/uc/water/rsvrs/ops/aop/index.html.
[49] *Id.*; Reclamation, August 2019 24-Month Study, available at https://www.usbr.gov/lc/region/g4000/24mo/index.html.

Mexican delivery, as opposed to 75 MAF over ten years as described in the 1922 Compact.[50] Although subject to continuing objection by the Upper Division states, the use of the 8.23 MAF objective in the LROC and 2007 guidelines creates the risk that the Upper Basin's obligation will be judged by reference to a cumulative total of 82.5 MAF passing Lee Ferry over any consecutive ten-year period, or at least some amount greater than 75 MAF.

## RECENT DEVELOPMENTS TO ADDRESS RISK AND DEFICITS

The risk of shortage in the Colorado River system is well known and has been the subject of considerable discussion over the past two decades. This period has been marked by a series of policy discussions, negotiations, and agreements, driven in part by a recognition of the problems caused by the river's historic over-allocation, and in part by a shift in the hydrologic baseline toward drier conditions.

The 2001 Interim Surplus Guidelines and the subsequent QSA were the first steps in responding to this risk. In combination, they forced California's Colorado River water use to drop from more than 5 MAF per year to 4.4 MAF. The 2007 Guidelines were the second significant response to this risk, mandating reductions in deliveries to the Lower Division states when Lake Mead levels drop to critical elevations. Because, however, dry conditions within the Colorado River Basin have continued, and are predicted to deepen, further efforts have been made to address the reduced supplies and increased demands and to bring the system into better balance.

Two consecutive agreements with Mexico have been reached since 2012 that have, among other things, enlisted Mexico's participation in the sharing of risk of dry hydrology. In addition, since 2013, the Basin States have been engaged in a process of contingency planning aimed at reducing the likelihood of reaching critical elevations in Lake Mead and Lake Powell during the interim period of the 2007 Guidelines. A set of agreements executed and approved in early 2019 set forth the commitments of the seven Basin States and the Secretary of the Interior to a series of measures that will contribute to a better balance between supply and demand in the Colorado River Basin. Taken together, these agreements are known as the Drought Contingency Plan, or DCP. Separate plans have been put in place for the Upper and Lower Basins, as described below. The required federal legislation authorizing and approving these agreements was signed in April 2019,[51] and final execution of the related agreements occurred the following month.[52]

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[50] *See, e.g.,* Eric Kuhn, *supra* note 18, at 13-14. The amount of 82.5 MAF represents 10 years of release of 8.23 MAF from Lake Powell plus 10 years of 20,000 acre feet of assumed additional inflow from the Paria River.
[51] P.L. 116-14.
[52] *See*, *Interior and states sign historic drought agreements to protect Colorado River,* https://www.usbr.gov/newsroom/newsrelease/detail.cfm?RecordID=66103.

**Upper Basin Drought Contingency Plan**

The Upper Basin Drought Contingency Plan (UB DCP) consists of three components: weather modification (cloud seeding) and removal of invasive species; drought response operation of Upper Basin federal reservoirs; and investigation of demand management. Cloud seeding and removal of phreatophytes to augment Upper Basin snowpack have been taking place for many years and will continue and possibly be expanded. Drought response operation of the federal reservoirs involves releasing extra quantities of water from the federal reservoirs upstream of Lake Powell in order to maintain a "target elevation" of 3,525 feet to minimize the risk of declines below the minimum power pool of 3,490 feet in Lake Powell. An agreement addressing the details of drought operations was executed by the Upper Division states and the Department of the Interior as part of the DCP package on May 20, 2019.[53]

A second agreement concerning demand management has also been executed and included in the DCP package.[54] This agreement authorizes the Upper Division states to store voluntarily conserved water in unused capacity in certain federal reservoirs in the Upper Basin without charge, up to a limit of 500,000 acre feet. Importantly, water stored pursuant to this agreement will not be subject to release pursuant to the coordinated operations provisions of the 2007 Guidelines to balance the contents of Lakes Mead and Powell. The agreement makes clear that it does not establish an Upper Basin demand management program, but merely creates the authorization for storage capacity that would be needed in order to develop such a program.[55] More specifics on demand management are discussed below.

**Lower Basin Drought Contingency Plan**

The Lower Basin Drought Contingency Plan (LB DCP) is intended as an add-on to the 2007 Guidelines and provides for "contributions" of water to Lake Mead by the Lower Division states, created through non-use of legally available Colorado River water or through conservation or other methods. These required contributions are triggered by elevations in Lake Mead, similar to the 2007 Guidelines, but begin at a higher elevation (1,090 feet) and include a number of intermediate sub-tiers between elevation 1,050 and 1,025 feet, with the goal of slowing the pace of decline and preventing Lake Mead levels from falling below 1,020 feet.[56] All existing tier levels have bumped up amounts of delivery reductions.

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[53] Agreement for Drought Response Operations at the Initial Units of the Colorado River Storage Project Act, available at https://www.usbr.gov/dcp/docs/final/Attachment-A1-Drought-Response%20Operations-Agreement-Final.pdf.

[54] Agreement regarding Storage at Colorado River Storage Project Act Reservoirs under an Upper Basin Demand Management Program, available at https://www.usbr.gov/dcp/docs/final/Attachment-A2-Drought-Managment-Storage-Agreement-Final.pdf.

[55] *Id.*

[56] Lower Basin Drought Contingency Plan Agreement, Exhibit 1-Lower Basin Drought Contingency Operations, §§ III.B and V.B.2, available at https://www.usbr.gov/dcp/docs/final/Attachment-B-Exhibit-1-LB-Drought-Operations.pdf.

In addition, the Secretary of the Interior has committed to take affirmative actions to implement Lower Basin programs designed to create or conserve 100,000 acre feet or more of Colorado River System water each year to contribute to conservation of water supplies in Lake Mead and other Colorado River reservoirs in the Lower Basin.[57]

**Minutes 319 and 323**

In addition to the reductions in deliveries required by the 2007 Guidelines and the Lower Basin DCP when Lake Mead levels reach critically low elevations, two agreements implementing the 1944 Treaty with Mexico provide for reductions to that country's deliveries as well. Minute 319 describes the Mexican government's commitment to take reductions from the normal 1.5 MAF delivery ranging from 50,000 to 125,000 acre feet when Lake Mead levels reach the same elevations described in 2007 Guidelines and in Figure 1 above.[58] Minute 319 was in effect from 2012 through 2017 and has now terminated, but the shortage and delivery reduction provisions described above have been extended and enhanced by Minute 323.

Minute 323 between the U.S. and Mexico, effective from 2018 through 2026, restated and continued the shortage reduction provisions set forth in Minute 319. Minute 323 also established a Binational Water Scarcity Contingency Plan that provides for deeper cuts to deliveries to Mexico under specified low reservoir elevations in Lake Mead.[59] With the finalization of the Lower Basin DCP agreement, Mexico's commitment to additional reductions has become effective.[60]

**New Schedule of Delivery Reductions in the Lower Basin**

The total reduction of deliveries and Lake Mead contributions from the 2007 Guidelines, the Lower Basin Drought Contingency Plan, and Minute 323 are shown in Figure 2 below.

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[57] Lower Basin Drought Contingency Plan Agreement, § 3.b., available at https://www.usbr.gov/dcp/docs/final/Attachment-B-LB-DCP-Agreement-Final.pdf.

[58] Minute 319, Interim Cooperative Measures in the Colorado River Basin through 2017, November 12, 2012, § III.3, available at https://www.ibwc.gov/Files/Minutes/Minute_319.pdf.

[59] Minute 323, Extension of Cooperative Measures and Adoption of a Binational Water Scarcity Contingency Plan in the Colorado River Basin, September 21, 2017, §§ III and IV, available at https://www.ibwc.gov/Files/Minutes/Min323.pdf.

[60] *Id.,* § IV; *Commission Signs Colorado River Binational Water Scarcity Contingency Plan Report,* July 11, 2019, https://www.ibwc.gov/Files/Press_Release_071119.pdf.

| Lake Mead Elevation (Feet) | California | Arizona | Nevada | Interior | Mexico | Total |
|---|---|---|---|---|---|---|
| 1090 – 1075 **Tier 0** | 0 | 192,000 | 8,000 | 100,000 | 41,000 | 341,000 |
| 1075 – 1050 **Tier 1** | 0 | 512,000 | 21,000 | 100,000 | 80,000 | 713,000 |
| 1050 – 1045 **Tier 2** | 0 | 592,000 | 25,000 | 100,000 | 104,000 | 821,000 |
| 1045 – 1040 **Tier 2** | 200,000 | 640,000 | 27,000 | 100,000 | 146,000 | 1,113,000 |
| 1040 – 1035 **Tier 2** | 250,000 | 640,000 | 27,000 | 100,000 | 154,000 | 1,171,000 |
| 1035 – 1030 **Tier 2** | 300,000 | 640,000 | 27,000 | 100,000 | 162,000 | 1,229,000 |
| 1030 – 1025 **Tier 2** | 350,000 | 640,000 | 27,000 | 100,000 | 171,000 | 1,288,000 |
| Below 1025 **Tier 3** | 350,000 | 720,000 | 30,000 | 100,000 | 275,000 | 1,475,000 |

Figure 2 Total Reductions from 2007 Guidelines, DCP Contributions, and Minute 323 (in acre feet)

**Expiration of 2007 Guidelines, DCP agreements, and Minute 323**

The 2007 Guidelines expire on December 31, 2025, after the preparation of the 2026 Annual Operating Plan that will govern operations of the Colorado River through water year 2026.[61] The DCP agreements and Minute 323 have the same expiration date as the 2007 Guidelines.[62] The required review of the 2007 Guidelines is anticipated to be initiated by U.S. Bureau of Reclamation (Reclamation) in 2020.[63] Various parties around the Colorado River Basin are gearing up for the anticipated discussions about the next version of operating agreements that will govern management of the Colorado River into the future.

[61] 2007 Guidelines, § 8.A.
[62] Agreement Concerning Colorado River Drought Contingency Management and Operations, paragraph M, available at https://www.usbr.gov/dcp/docs/final/Companion-Agreement-Final.pdf; Minute 323, *supra* note 58, Resolution 12.
[63] 2007 Guidelines, Sections 7.D and 8.

## CURRENT STATUS OF KEY PARAMETERS

### Lake Mead Levels

Lake Mead is the largest reservoir in the United States and constitutes the water savings account for the Lower Basin. As a result of unfavorable hydrology and withdrawals in excess of inflows by the Lower Division states, Lake Mead elevations have decreased substantially from 2000 to the present and have been hovering for several years around the first shortage level from the 2007 Guidelines, as shown in the figure below.

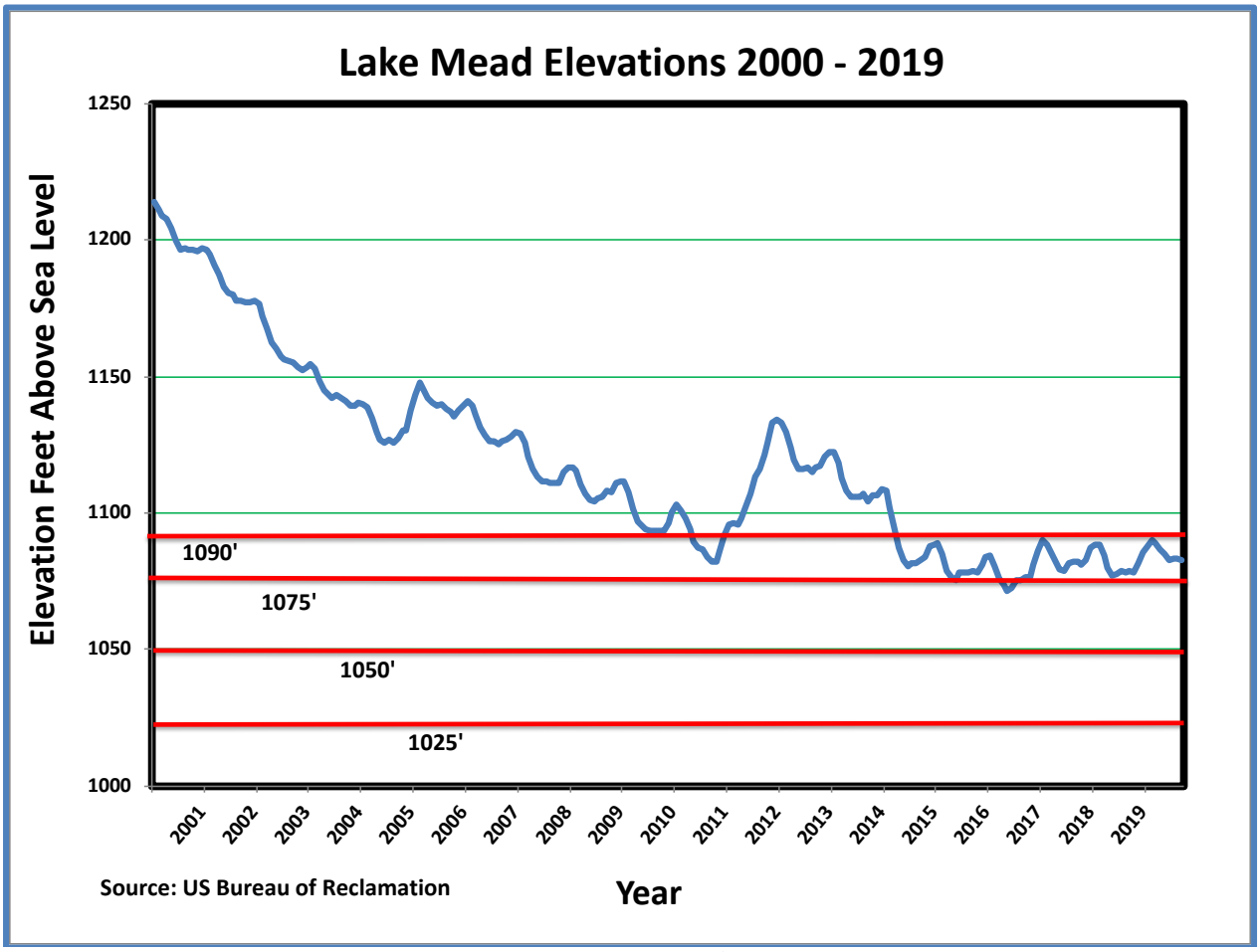


Figure 3 Lake Mead Elevations[64]

### Lake Powell Levels

Lake Powell is the second largest reservoir in the country and provides capacity for water storage to ensure the Upper Division states' continued ability to comply with the 1922 Compact. The period of 2000 to 2019 constitutes the lowest 20-year period for inflows to Lake

[64] Data source, Reclamation, Lake Mead at Hoover Dam, End of Month Elevation (Feet), available at https://www.usbr.gov/lc/region/g4000/hourly/mead-elv.html, last accessed Nov. 7, 2019.

Powell since the closure of Glen Canyon Dam in 1963, with an average unregulated inflow of approximately 81% of the 30-year average from 1981 to 2010.[65] "Unregulated inflow" is the measured flow after upstream consumptive use and human activities but is adjusted for changes in upstream reservoir storage.[66] The 2018 water year was particularly dry in the Upper Basin, with total unregulated inflow to Lake Powell for water year 2018 of 4.6 MAF, only 43% of average.[67] For water year 2019, unregulated inflow was 120% of average.[68] Lake Powell levels are highly sensitive to annual hydrology[69] and are influenced over time by the requirements of balancing contents to approximate Lake Mead (see discussion below).

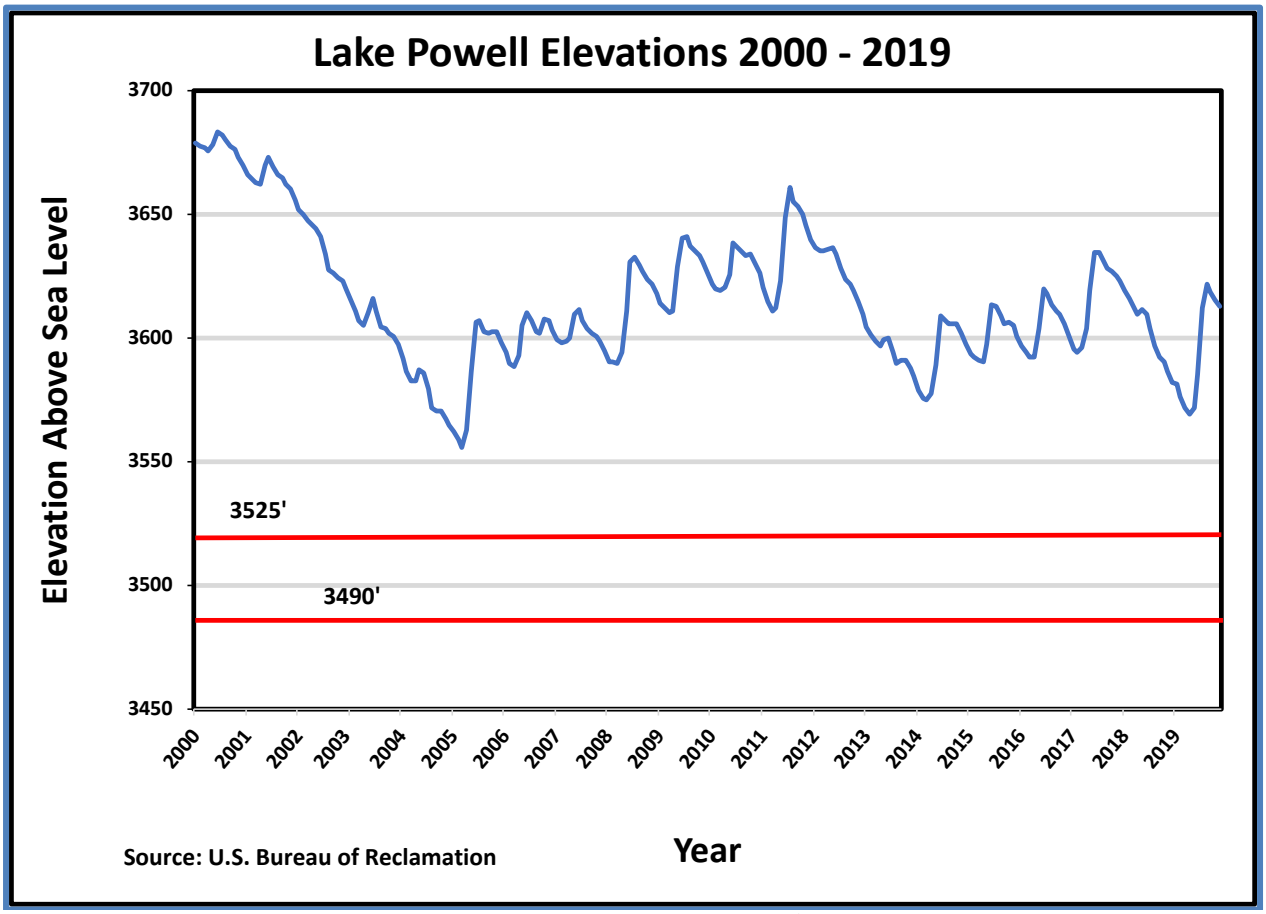


Figure 4 Lake Powell Elevations[70]

[65] Reclamation, Glen Canyon Dam, https://www.usbr.gov/uc/water/crsp/cs/gcd.html, last accessed Nov. 7, 2019.
[66] Reclamation, Upper Colorado Region, Water Operations, Historic Data, https://www.usbr.gov/rsvrWater/HistoricalApp.html
[67] Reclamation, Glen Canyon Dam, *supra* note 65. The water year for Lake Powell is October 1 to September 30.
[68] *Id.*, Inflow Forecast.
[69] *See, e.g.,* on Figure 4, sharp increases in water elevations in wet years 2011 and 2019 and sharp decreases in elevations in dry years 2013, 2014, and 2018.
[70] Data source, Reclamation, Lake Powell Water Operations, Historic Data, available at https://www.usbr.gov/rsvrWater/HistoricalApp.html, last accessed Nov. 7, 2019.

Lake Mead was 39% full and Lake Powell 54% full as of November 4, 2019.[71]

**Consumptive Use in Upper Basin and State of Colorado**

The discussion thus far has related to supplies of water in the Colorado River. The other half of the water balance equation is demand for or use of water. While it is a relatively easy proposition to measure demand and usage in the Lower Basin since most usage derives from deliveries from Lake Mead or measured diversions from the mainstem, it is much more difficult in the Upper Basin where it must be estimated based on available data on thousands of diversions and estimates of the associated consumptive use.

Reclamation annually estimates the amount of beneficial consumptive use of water from the Colorado River and its tributaries in the Upper Basin. Beneficial consumptive use is normally construed to mean the consumption of water brought about by human endeavors including the use of water for municipal, industrial, agricultural, power generation, export, recreation, fish and wildlife, and other purposes, along with the associated losses incidental to these uses.[72] Over the ten-year period from 2009 to 2018, these uses and losses in the Upper Division states were estimated to average 3.86 MAF per year.[73] During this same period, consumptive uses and losses within the State of Colorado from the Colorado River or its tributaries were estimated at an average of 2.17 MAF per year,[74] representing approximately 56% of the total use by the Upper Division states.

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[71] Reclamation, Lower Colorado Water Supply Report, November 4, 2019.

[72] Reclamation, *Provisional, Upper Colorado River Basin, Consumptive Uses and Losses Report, 2016-2020*, July 2019 (2020 CUL Report), at p. 4, available at https://www.usbr.gov/uc/envdocs/reports/ColoradoRiverSystemConsumptiveUsesandLossesReports/20190800-ProvisionalUpperColoradoRiverBasin2016-2020-CULReport-508-UCRO.pdf, last accessed Oct. 25, 2019.

[73] *Id.* at p. vii; Reclamation, *Provisional, Upper Colorado River Basin, Consumptive Uses and Losses Report, 2011-2015* (2015 CUL Report), p. v, available at https://www.usbr.gov/uc/envdocs/reports/ColoradoRiverSystemConsumptiveUsesandLossesReports/20170200-ProvisionalUpperColoradoRiverBasin2011-2015-CULReport-UCRO.pdf, last accessed Oct. 25, 2019; Reclamation, *Provisional, Upper Colorado River Basin, Consumptive Uses and Losses Report, 2006-2010* (2010 CUL Report), p. v, available at https://www.usbr.gov/uc/envdocs/reports/ColoradoRiverSystemConsumptiveUsesandLossesReports/Provisional-UpperColoradoRiverBasinConsumptiveUsesandLossesReport-2006-2010prov.pdf, last accessed Oct. 25, 2019. Evaporation from Upper Basin reservoirs is not included in this figure. 2018 is the latest year for which this data is available, and all reports are designated "Provisional." Note that there are some inconsistencies with respect to the manner in which consumptive uses and losses are calculated within the different Upper Basin states. *See Comparison of U.S. Geological Survey and Bureau of Reclamation Water-Use Reporting in the Colorado River Basin*, Scientific Investigations Report 2018-5021, U.S. Geological Survey.

[74] 2010 CUL Report, p. v; 2015 CUL Report, p. v; 2020 CUL report, p. vii.

**Ten-Year Flow at Lee Ferry**

Reclamation reports that the cumulative ten-year flow at Lee Ferry as of the end of water year 2019 (September 30, 2019) is 92.5 MAF.[75] Whether the Upper Basin responsibility is 75 MAF over ten years or 82.5 MAF over ten years, it has been satisfied to date.

**Lower Basin Structural Deficit**

The Lower Division states are using more Colorado River mainstem water on average than the 7.5 MAF allocated under the 1922 Compact, approximately 1.2 million acre feet more each year than they receive from Lake Powell and from tributary inflows.[76] This is what is known as the "Structural Deficit." It results from the fact that the allocations to and usage by the Lower Division states do not account for evaporation from Lake Mead, system losses in the Lower Basin, or the Lower Basin's portion of the obligation to Mexico. This deficit has the potential to increase if overall flows in the River continue to decline.

The existence of the Structural Deficit and its interplay with the balancing provisions of the LROC and 2007 Guidelines ensure that, without future modifications to the operating procedures and reduction in use by the Lower Division states, Lake Powell will continue to be drained and the benefits associated with its water storage eroded.[77] This occurs because continued declines in Lake Mead are "balanced" by higher than target releases from Lake Powell. The Lower Basin Drought Contingency Plan discussed above addresses the Structural Deficit at times when Lake Mead is at low elevation levels. It does not solve the systemic problem of overuse. As a result, the Structural Deficit is not merely a Lower Basin problem. It represents an existential problem for the entire Colorado River Basin.

## PROJECTIONS OF FUTURE HYDROLOGY, DEMAND, AND IMPACT ON RISK

As stated initially, the enforcement provisions of the 1922 Compact have not been triggered since its inception. Colorado and the other Upper Division states are and always have been in full compliance with both the 1922 Compact and the Upper Basin Compact. But past performance is not a good indicator of future results, both in investments and more particularly

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[75] Reclamation, Draft Annual Operating Plan for Colorado River Reservoirs 2020, draft of Aug. 30, 2019 p. 18. https://www.usbr.gov/lc/region/g4000/AOP2020/2020AOP_2019-08-30_Consultation-3.pdf, accessed November 8, 2019

[76] *See e.g.,* The State of the Colorado River, Central Arizona Project Briefing to Arizona Delegation, April 2014, available at http://www.cap-az.com/documents/meetings/05-01-2014/9.%20Colorado%20River%20Report%20May%201%20Board.pdf; Colorado River Structural Deficit, Arizona Municipal Water Users Association, available at http://www.amwua.org/where-we-stand/issues/colorado-river-structural-deficit.

[77] *See It's Hard to Fill a Bathtub When the Drain is Wide Open: The Case of Lake Powell,* Colorado River Research Group, August 2018, available at https://www.coloradoriverresearchgroup.org/uploads/4/2/3/6/42362959/crrg_the_case_of_lake_powell.pdf.

in the Colorado River water balance. Increased water demand and the current and anticipated impacts of warming temperatures on overall supplies have caused a paradigm shift in the approach of water managers to forecasting and planning. This section summarizes recent projections of future streamflows and demand for water in the Colorado River system and the impact of those projections on Colorado water rights and the potential for curtailment.

**Long-Term Basin Flow Projections**

Scientists first suggested in 1983 that rising greenhouse gases posed a risk to the Colorado River. Their finding was based on the expectation that increasing greenhouse gases would raise temperatures, and that "for any given annual precipitation, runoff diminishes rapidly with increased temperature."[78] While such a pattern was expected generally as a result of rising temperatures, it was anticipated to be especially significant in the Colorado River Basin and other similar river systems in relatively arid western North America.[79]

Subsequent research focused mostly on future projections, but by the second decade of the 21st century, decreasing flows in the Colorado River demonstrated that climate change had shifted from a future projection to a present problem. The Colorado River Basin has experienced significantly lower than average flows over the past two decades, with river flows less than would be expected given the amount of precipitation falling in the basin.[80] Flows are projected to decrease even more significantly in the future with recent scientific research indicating that future climate change impacts on the Colorado River flows will be much more serious than previously assumed. One such study conservatively estimates that warming temperatures in the Colorado Basin will cause declines in overall river flow of approximately 20% by mid-century and 35% by the end of the century, with support for losses exceeding 30% at mid-century and 55% by 2100.[81] These types of decreases in flows are well beyond the capacity of existing operational regimes to manage.

The Fourth National Climate Assessment released in November 2018 supports the conclusion that the southwestern part of the United States will experience reduced flows, more frequent and severe droughts, and increased year-to-year variability. Focusing particularly on the Colorado River Basin, the Assessment provides the temperature and flow data shown below

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[78] Roger Revelle and Paul E. Waggoner, *Effects of a Carbon Dioxide- Induced Climatic Change on Water Supplies in the Western United States*, Changing Climate: Report of the Carbon Dioxide Assessment Committee, Washington, D.C., National Academy Press (1983).
[79] *Id.*
[80] C.A. Woodhouse, G.T. Pederson, K. Morino, S.A. McAfee, & G.J. McCabe, *Increasing influence of air temperature on upper Colorado River streamflow*, Geophysical Research Letters, 43(5), 2174-2181 (2016).
[81] Brad Udall and Jonathan Overpeck, *The Twenty-first Century Colorado River Hot Drought and Implications for the Future,* Water Resources Research, Volume 53, Issue 3, pp. 2404-2418 (2017); *see also* Testimony of Brad Udall, House of Representatives Committee on Natural Resources, Subcommittee on Water, Oceans, and Wildlife, February 26, 2019.

and notes that the trends for temperature (upward) and river flow (downward) are statistically significant.[82]

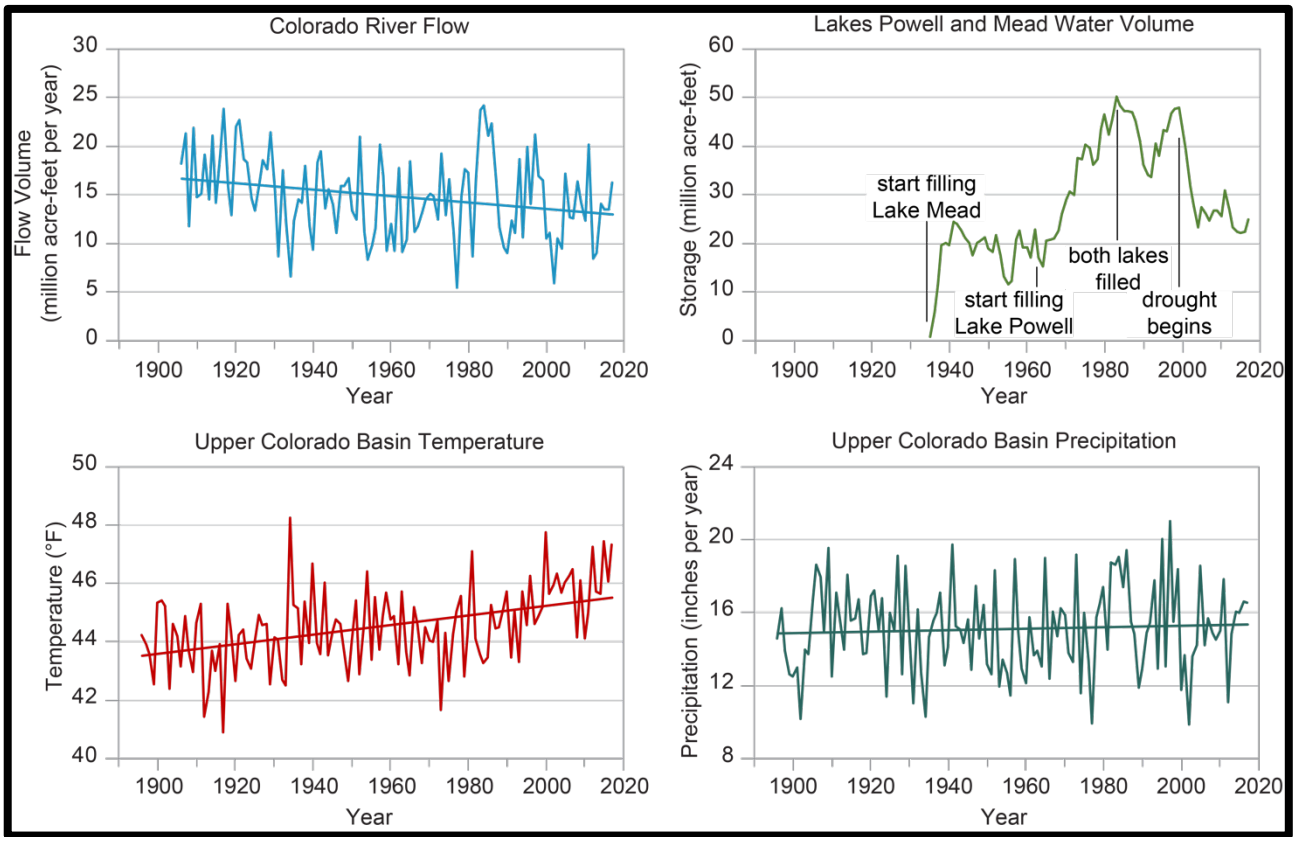


Figure 5 (from Fourth National Climate Assessment, Figure 25-3)

A group of Colorado River scientists warns against the use of the word "drought" to describe conditions in the Basin, as the term implies a short-term, aberrational occurrence. Because the Colorado River system is experiencing a transition to an increasingly water scarce environment and is unlikely to return to previously "normal" conditions, the term "aridification" is more appropriate.[83] These projections and warnings point to trouble ahead.

**Shorter-Term Flow Projections**

Reclamation continually updates forecasts of probable Colorado River flows and the impact of such flows at the major federal reservoirs in the Basin. Every month, Reclamation publishes a new forecast for the operation of Lake Powell and Lake Mead for the upcoming 24 months (24-

[82] USGCRP, *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II,* U.S. Global Change Research Program, Washington, DC, Ch. 25: Southwest (2018), available at https://nca2018.globalchange.gov/chapter/25/.

[83] Colorado River Research Group, *When is Drought Not a Drought? Drought, Aridification, and the "New Normal"* (2018), available at https://www.coloradoriverresearchgroup.org/uploads/4/2/3/6/42362959/crrg_aridity_report.pdf.

Month Studies).[84] The projection for January 1 elevations made in the previous August 24-Month Study is used to determine whether a shortage condition exists that would trigger the reductions of deliveries from Lake Mead described above and for the applicable methodology for coordinated operations of the two reservoirs.[85]

Reclamation's August 2019 24-Month Study projects that Lake Mead elevation will exceed 1,075 feet but will be less than 1,090 feet as of January 1, 2020.[86] This means that the Tier 0 reductions shown in Figure 2 above will be in effect for 2020. The above average snowpack in the Upper Colorado River Basin in the winter of 2018-19 dodged what was widely expected to be the first Tier 1 shortage declaration under the 2007 Guidelines. As of August 2019, Reclamation estimated a 43% chance of Lake Mead dropping below elevation 1,075, which would trigger a Tier 1 shortage declaration under the 2007 guidelines and DCP, by 2024. The risk of Lake Powell dropping below elevation 3,525 between now and 2024, a level identified as a trigger for increased Upper Basin risk, was estimated at 2% based on the August 2019 model runs.[87] Both of these probabilities are very substantially less than what was estimated as recently as January 2019.[88] These changes suggest significant sensitivity in the short term risk assessment to single-year weather conditions. While the risk profile looks substantially better as a result of the above-average 2019 snowpack, this short-term sensitivity also means that one or two dry years can substantially degrade the outlook.

Projections of future flows and reservoir conditions have typically been made using information from past hydrology. The probabilities cited above for Lake Mead and Lake Powell are based on "full hydrology," meaning the complete historical record from 1906 to 2017. But the drier hydrology in the Colorado River Basin over the past two decades compared to the full period of record[89] has made such "stationary" predictions less reliable.[90] Accordingly, Reclamation now augments its forecasts using what it calls "stress test" hydrology, looking at the more current and drier period of 1988 to 2015.

Using the stress test hydrology, the projections for Lake Powell levels through 2026 predict a 13% chance that the reservoir will fall below 3,525 feet. The stress test projections for Lake Mead reveal a 67% chance of dropping below 1,075 feet and a 10% chance of dropping below 1,025 feet by 2026.[91]

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[84] *See e.g.,* October 2019 24-Month Study, available at https://www.usbr.gov/lc/region/g4000/24mo/2019/OCT19.pdf.
[85] 2007 Guidelines, *supra* note 42, §§ 2 and 6.
[86] Reclamation, August 2019 24-Month Study, p. 1, available at https://www.usbr.gov/lc/region/g4000/24mo/2019/AUG19.pdf.
[87] Reclamation, Colorado River System 5-Year Projected Future Conditions, August 2019, available at https://www.usbr.gov/lc/region/g4000/riverops/crss-5year-projections.html, last accessed Nov. 7, 2019.
[88] Reclamation, Colorado River System 5-Year Projected Future Conditions, January 2019, available at https://www.usbr.gov/lc/region/g4000/crss/January2019-5Year.pdf.
[89] Brad Udall and Jonathan Overpeck, *supra* note 81, pp. 2407-2408; Glen Canyon Dam, *supra* note 65.
[90] Paul C.D. Milly, et al., *Stationarity is Dead: Whither Water Management?,* Science, Vol. 319, Feb. 1, 2008.
[91] Reclamation, August 2019 Colorado River System Projections through 2026, distributed Sept. 5, 2019, Slides 17, 19, available from authors.

Reclamation's forecast for Lake Mead elevations using both the full hydrologic record from 1906 to 2017 and the stress test hydrology are presented in Figure 6 below.

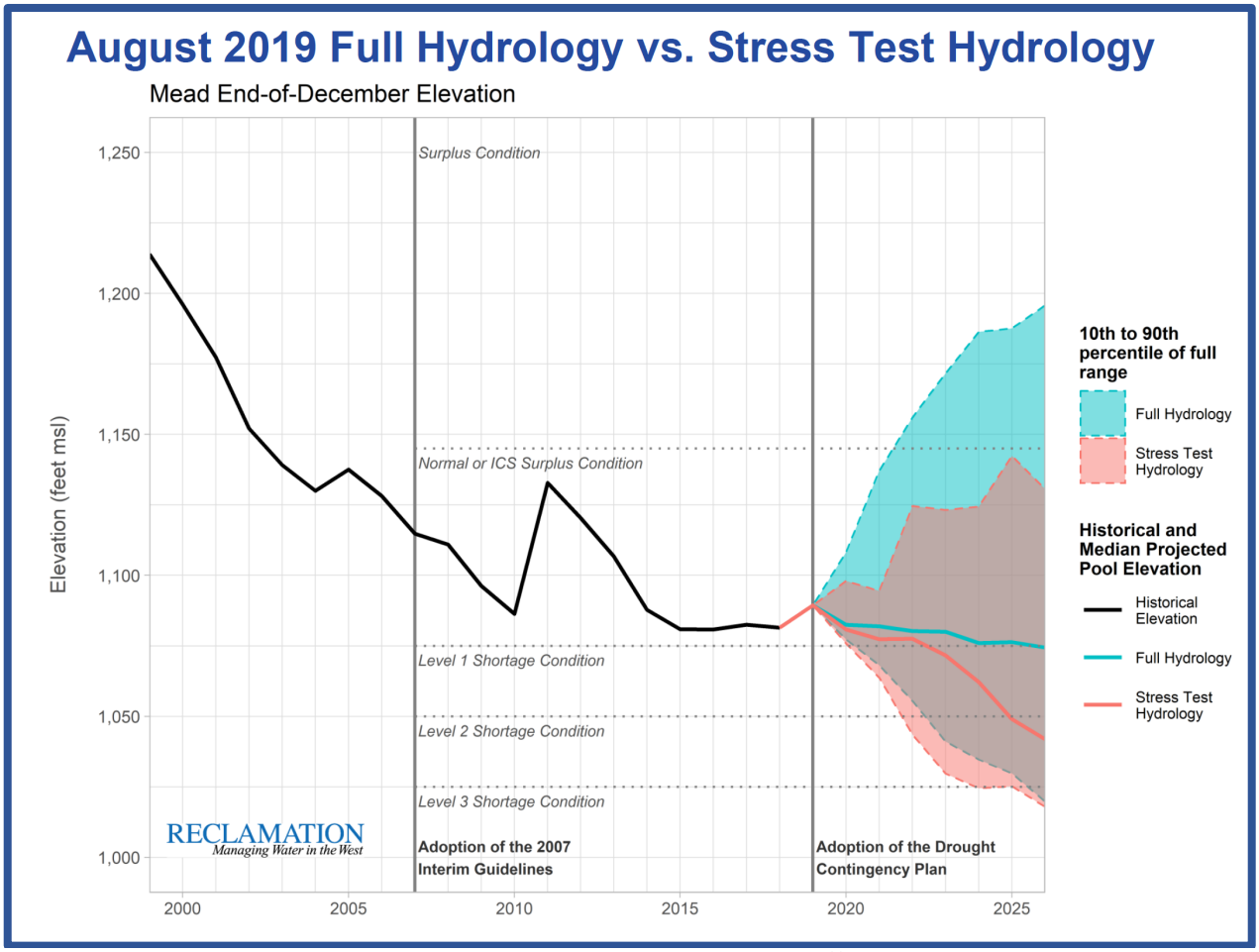


Figure 6 Projected Lake Mead Elevations[92]

While complex, this figure indicates that the median projection based on the stress test hydrology and including the DCP reductions (solid orange line) has Lake Mead levels falling dangerously low, below elevation 1,050, by around 2025.

Some technical analyses have also suggested that even the stress test hydrology may be overly optimistic and inappropriately stationary because the 1988 to 2017 period was wetter than the most recent experience in the Basin (2000 to 2018) and because it does not attempt to project

[92] *Id.*, Slide 18.

future, deeper climate change impacts.[93] Use of even drier hydrology to forecast the future would increase and accelerate the risk of reaching very low levels in Lake Mead.

Because of the coordinated reservoir operations provisions of the 2007 Guidelines, falling levels in Lake Mead usually require greater releases from Lake Powell in order to balance the contents of the two reservoirs.[94] The Lake Powell elevation commonly viewed as most critical is 3,490 feet. This is the lowest level at which water can be safely taken through the intakes to the hydropower turbines within Glen Canyon Dam.[95] Below this elevation, no hydropower can be produced. At this level, the only outlets available for releasing water out of Lake Powell are the "river outlets" at the bottom of the dam. The amount of water that can be released through the river outlets is dependent upon the elevation of the reservoir, which provides the pressure that forces water out. Below 3,490 feet, the maximum rate of discharge quickly drops and the reservoir is unable to pass 8.23 MAF minimum objective release required by the 2007 Guidelines.[96] In addition, less than 4 MAF remains in active storage in Lake Powell at this level, all of which could be used up in a matter of months at normal release rates.[97]

Reclamation has analyzed the probability of Lake Powell descending below 3,490 feet over the next seven years under various scenarios. Figure 7 below shows the results of one of these analyses. Similar to Figure 6 above, this chart shows projected Lake Powell elevations based on different hydrological and operating assumptions. The dark green line toward the bottom shows what Reclamation terms "plausible future elevation" projections that are based on actual hydrology from 2001 to 2007. This chart demonstrates the very real possibility of Lake Powell dipping to 3,490 feet as soon as 2023 if the same conditions that were experienced at the beginning of the century repeat, even with the Drought Contingency Plans in place.

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[93] Eric Kuhn, Memo to Board of Directors, Colorado River Water Conservation District, September 13, 2016, p. 12, available at https://www.coloradoriverdistrict.org/wp-content/uploads/2016/09/20160913-Joint-west-slope-risk-study-update.pdf.
[94] 2007 Guidelines, *supra* note 42, § 2.D, pp. 50-53.
[95] John C. Schmidt, *Fill Mead First: A Technical Assessment,* 2016, at 11, available at https://qcnr.usu.edu/wats/colorado_river_studies/files/documents/Fill_Mead_First_Analysis.pdf.
[96] *Id.* at 10-11.
[97] Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lakes Powell and Mead, Final Environmental Impact Statement, November 2007, Appendix A, Attachment B, available at https://www.usbr.gov/lc/region/programs/strategies/FEIS/AppA.pdf.

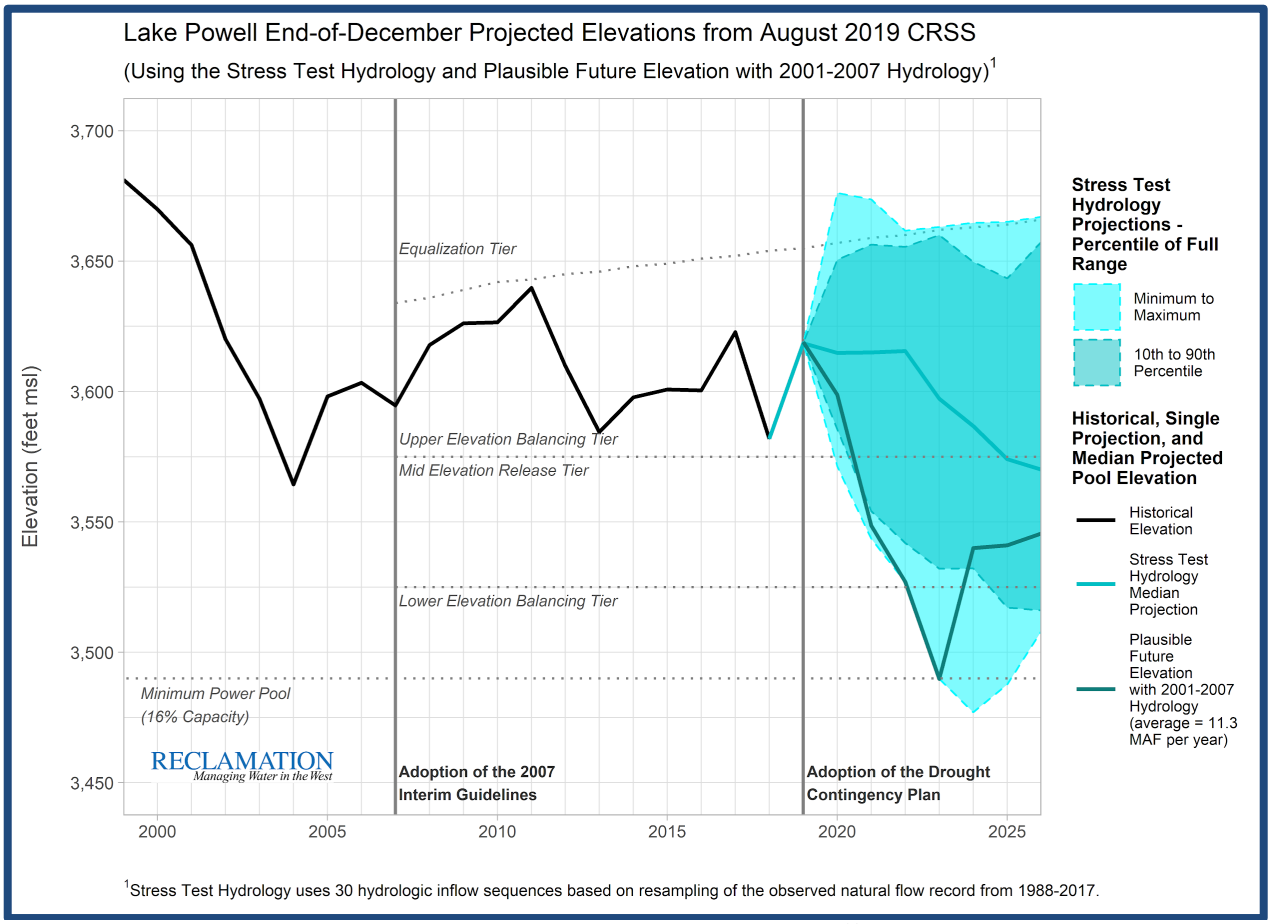


Figure 7 Projected Lake Powell Elevations[98]

**Risk Study on Lake Powell**

The perils of a dwindling Lake Powell and impacts on Colorado water rights are particularly troubling to Colorado's west slope water users and transmountain diverters. Since 2014, various entities in Colorado have been examining the risk that the contents of Lake Powell will fall below certain critical elevations. The four Basin Roundtables for the river basins of the western slope of Colorado commissioned Phase 1 of a Risk Study to advance discussions about Colorado River development and the risk of curtailment should Lake Powell reach critically low levels.[99] Subsequent phases of the Risk Study have been funded by the Colorado River Water Conservation District and Southwestern Water Conservation District.

The most pressing concerns motivating this Risk Study was that if Lake Powell falls too low, generation of hydropower will be lost and the Upper Division states will be unable to provide water to the Lower Basin in the amounts called for by the 2007 Guidelines. If the latter situation occurs, curtailment of post-Compact water rights could be required in order to comply

[98] Reclamation, 2019, Research and Modeling Group.
[99] The Risk Study described in this section is not an official analysis of the State of Colorado.

with the 1922 Compact and the Upper Basin Compact. The Risk Study seeks to quantify the risk of this type of "crash" of Lake Powell and to assess the efficacy of different strategies to avoid curtailment and make the system more sustainable.

The Risk Study analyzed the likelihood of Lake Powell falling below 3,490 feet of elevation under various scenarios.[100] In order to provide a safe buffer above 3,490 feet, the Risk Study also analyzed the potential of Lake Powell levels falling below 3,525 feet.[101] At this level, less than 2 million acre feet of storage remains before the minimum power level of 3,490 feet is reached. Phase 1 of the Risk Study concluded that, without corrective action, shortages at Lake Powell (water levels below 3,525 feet) are likely to occur over the next twenty years.[102]

Focusing on the "stress test" period of 1988 - 2015, the Risk Study indicates that the likelihood of Lake Powell dropping below 3,525 feet at some point in the next 25 years is approximately 39%.[103] The likelihood of the 10-year running average Lee Ferry volume dropping below 82.5 MAF was found to be approximately 46%.[104] While the likelihood of the 10-year running average at Lee Ferry dropping below 75 MAF was found to be zero, the Risk Study points out that previous simulations in earlier phases of the study and by Reclamation have found that there is a risk that a 10-year running average could decline below 75 MAF.[105]

The most recent work of the Risk Study builds on the previous analyses and examines the impact of additional water development in the Upper Division states on the risk of curtailment. It also projects the likely priority dates of water rights in the State of Colorado that would be affected by curtailment at different volumetric levels.[106] Both of these analyses are discussed in further detail below.

**Impact of the Drought Contingency Plans**

The Lower Basin components of the DCP constitute significant voluntary reductions in demand on the Colorado River system when Lake Mead is low. The discussions that have led to these potential agreements are a testament to the collaboration of water managers in the Colorado

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[100] Colorado River Risk Study: Phase I Summary Report, Oct. 18, 2016, updated August 1, 2018, Hydros Consulting (hereinafter "Risk Study Phase 1 Report"). Note that the Risk Study report consists of the summary report, plus three webinars and various presentations and memos. Risk Study Phase 1 Report, at 12.
[101] *Id.* The elevation of 3,525 feet is also the "target level" utilized in the Drought Response Operations Agreement of the Upper Basin DCP. *See* Drought Response Operations Agreement, *supra* note 53 and accompanying text.
[102] Risk Study Phase 1 Report, pp. 10-11 ("CRSS modeling indicates that shortages at Lake Powell (defined here as pool elevation less than 3525') and Lake Mead (<1020) are likely to occur in the future, absent the implementation of drought contingency plans. With DCPs in place for both basins, the likelihood of these critical events is significantly reduced, but not eliminated."); Joint West Slope Basin Roundtable Risk Study Webinar #1, May 2016, Slides 22-24.
[103] Risk Study Phase III Update, June 20, 2019, available at https://www.coloradobasinroundtable.org/wp-content/uploads/2019/07/Risk-Study-Phase-III-for-the-4BRT-meeting-6.20.19.pdf, Slide 7.
[104] *Id*.
[105] *Id.*
[106] *Id.*

River Basin that has been occurring over the past decades. In addition, Minutes 319 and 323 embody commitments by Mexico to reduce its demand on the river in coordination with reductions in the United States. The complexity of the negotiations leading to these agreements and the difficulty in obtaining the necessary buy-in and approvals cannot be overestimated.

The Risk Study indicates, however, that even with all of the measures that are part of the Drought Contingency Planning process (Lower Basin DCP reductions, drought operations of Upper Basin reservoirs, demand management in the Upper Basin), a substantial risk, 25 to 35%, remains that Lake Powell will drop below elevation 3,490 feet by 2036.[107] Reclamation's modeling confirms that even with the DCP, the risk of reaching critical levels in Lake Powell continues.[108]

If future flows in the Colorado River are further reduced as predicted under climate change scenarios,[109] then the DCP falls short of its goal of providing additional security and certainty in the water supply of the Colorado River System. The Risk Study does not project impacts after 2036, which could be even more ominous based on the climate change predictions.

The storage pool of 500,000 acre feet in Lake Powell contemplated by the Upper Basin Demand Management Agreement is a good start, but likely insufficient to allow for the magnitude of demand management water savings required to reduce the risk of Compact curtailment to acceptable levels.[110] The Risk Study modeled a Lake Powell water bank of 1 MAF in size and concluded that, in some scenarios, as much as 2 MAF could be required in a single year to maintain a safe level in Lake Powell.[111] The 2012 Colorado River Basin Water Demand and Supply Study modeled a water bank in Lake Powell of 5 MAF.[112]

It should be noted that the reductions in use in the Lower Basin required by the 2007 Guidelines and the DCP are implemented only at significantly diminished storage levels in Lake Mead.[113] The Structural Deficit is fully offset only when Lake Mead is at 1,025 feet or below. While always supportive of the Lower Basin DCP, representatives of the Upper Division states

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[107] Risk Study Phase 1 Report, *supra* note 100, p. 10; Risk Study Webinar #1, May 10-13, 2016, Slides 22-24; Risk Study Phase III, *supra* note 103, Slide 7. *See also,* Udall Testimony, *supra* note 81, at 3-4; Buschatzke, *The DCP Makes CO River Delivery Shortfalls Less Painful, But It Doesn't Make Them Go Away* (Sept. 5, 2018), https://new.azwater.gov/news/articles/2018-05-09.

[108] *See* Figure 7 above and accompanying text.

[109] *See* Udall and Overpeck, *supra* note 81.

[110] Colorado River Risk Study: Phase II Task 1 Report, May 17, 2018, updated August 1, 2018 (Risk Study Phase II Task 1 Report), pp. 7-10; comments of Jim Lochhead, CEO of Denver Water, Colorado Water Congress, February 1, 2019.

[111] Risk Study Phase II Task 1 Report, pp. 7-10; Risk Study Phase I Report, pp. 10-11.

[112] Reclamation, Colorado River Basin Water Demand and Supply Study, Appendix G2, CRSS Modeling Assumptions, p. G2-14.

[113] At elevation 1,075, Lake Mead holds approximately 35% of its total capacity; at elevation 1,025, the stored water is less than 22% of the full amount. Reclamation, Lake Mead Area and Capacity Tables, 2011, available at https://www.usbr.gov/lc/region/g4000/LM_AreaCapacityTables2009.pdf.

have expressed the concern that the reduction and contribution measures put in place to date and contemplated by the Lower Basin DCP have the effect of ensuring that Lake Mead will remain at very low elevations, possibly averting catastrophe but continuing the overallocation of and resulting risk to the Colorado River system.

The renegotiation of the 2007 Guidelines, which will begin in 2020, will likely incorporate some version of the reduction and contribution schedule in the Lower Basin DCP. Because it is difficult, if not unachievable, to maintain Lake Powell at safe levels under the current volumes of Lower Basin water usage and the balancing regime required by the coordinated operations in the 2007 Guidelines,[114] new operational rules will also likely result from these discussions. While water managers and stakeholders in the Colorado River Basin are well aware that additional measures are needed to address the likely impacts of climate change, such measures translate to challenging economic and political collisions. As a result, it is quite difficult to predict at this time exactly what those new rules will look like and the impact on Lake Powell.

**Anticipated New Demand**

The preceding sections describe the historical and forecast supplies in the Colorado River Basin. As pointed out previously, the demand for water is the other half of the equation that rules the River. The Lower Basin's demand on the mainstem of the River is relatively fixed, as its contracts for water are limited to 7.5 MAF unless a surplus exists. Because use of water from Lower Basin tributaries is not counted against the 7.5 MAF allocation, however, tributary uses can intensify, leaving less water in the mainstem, and increasing pressure on Lake Mead and on the supply of water to Mexico.[115] The Bureau of Reclamation has not maintained data on water use in the tributaries since 2005, making it difficult to draw a bead on current usage or evaluate trends.

In the Upper Basin, demand can hypothetically continue to increase as the Upper Division states have not yet utilized the theoretical 7.5 MAF allocated to them by the 1922 Compact. While anticipated increases in population in the Upper Basin do not necessarily translate to proportionate increases in water demand,[116] growth in demand is anticipated.

The Upper Colorado River Commission and the Upper Division states periodically attempt to make reasonable estimates of future depletions in the Upper Colorado River Basin.[117] These

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[114] *See It's Hard to Fill a Bathtub When the Drain is Wide Open: The Case of Lake Powell*, *supra* note 77.
[115] *See* Eric Kuhn and John Fleck, *The Upper Basin, Lower Basin, and Mexico: Coexisting on the Post-2026 Colorado River, supra* n. 6.
[116] *See, e.g.,* Michael Cohen, *Municipal Deliveries of Colorado River Basin Water*, Pacific Institute, 2011, available at http://pacinst.org/publication/municipal-deliveries-of-colorado-river-basin-water-new-report-examines-100-cities-and-agencies/.
[117] *See* Resolution of the Upper Colorado River Commission, June 6, 2017, available at http://www.ucrcommission.com/RepDoc/UCRCAnnualReports/69_UCRC_Annual_Report.pdf pp. 130-35. The Resolution emphasizes that these estimates are not predictions of what future water use will be but are projections for use in planning and modeling.

estimates do not incorporate either the highest or lowest projections of future water demand, but include "existing uses, future uses that will occur in systems already built but not yet at capacity and projected additional future uses for which specific plans exist."[118] Against a baseline of current depletions in the Upper Basin of approximately 4.536 MAF annually, the UCRC estimated in 2017 that demand will reach approximately 5.428 MAF by 2060 and 5.442 MAF by 2070, an increase of approximately 20%.[119] Within Colorado, the UCRC estimates that demand will reach 2.955 MAF by 2060 and stay the same for 2070, an increase of 360,000 acre feet from the current demand of 2.595 MAF, or approximately 14%.[120]

The Risk Study indicates that an increase in demand in the Upper Basin of approximately 500,000 acre feet or 11.5% roughly doubles the risk of Lake Powell declining below elevation 3,525 feet and the risk that the 10-year running average flow at Lee Ferry will drop below 82.5 MAF.[121] That means that, with such an increase in demand, the risk of Lake Powell dropping below elevation 3,525 feet in the next 25 years would be roughly 78% and the risk of the 10-year running average at Lee Ferry dropping below 82.5 MAF would be roughly 92%.[122] A smaller increase in demand would obviously reduce these risk probabilities, but the risks would still be substantial.

There are several concrete proposals for additional uses of Colorado River water in the Upper Basin that could constitute the types of "future uses for which specific plans exist," that would likely have been included in the UCRC estimates. These include Utah's proposed Lake Powell pipeline,[123] Wyoming's expansion of Fontenelle Reservoir's active capacity,[124] and, within Colorado, the Windy Gap Firming Project,[125] Gross Reservoir Enlargement,[126] and, possibly,

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[118] *Id.*

[119] Upper Colorado River Division States, Current and Future Depletion Demand Schedule, December 31, 2016, available at http://www.ucrcommission.com/RepDoc/DepSchedules/CurFutDemandSchedule.pdf. These estimates do not include evaporation from Upper Basin reservoirs, which would add 520,000 acre feet to each figure.

[120] *Id.* Note that the current demand (2017) specified by the UCRC for Colorado of 2.595 MAF is greater than the Reclamation estimate in its Consumptive Uses and Losses reports, which indicate that Colorado has averaged 2.17 MAF of consumptive use over the last ten years, *supra* note 74 and accompanying text.

[121] Risk Study Phase III, *supra* note103, Slide 7 (based on approximately 2.5 MAF of current consumptive use, Slide 10).

[122] *Id.*

[123] *See generally* http://lpputah.org/. A lawsuit filed on March 21, 2019 challenging the adequacy of the Bureau of Reclamation's environmental compliance in connection with the "Green River Block Exchange" could, if successful, impact the viability of the Lake Powell pipeline. *See Center for Biological Diversity, et al. v. U. S. Dept. of the Interior,* Case No. 19CV0789, U.S. District Court, District of Columbia.

[124] *See* H.R. 646, https://www.congress.gov/bill/115th-congress/house-bill/648; https://www.usbr.gov/newsroom/newsrelease/detail.cfm?RecordID=62296.

[125] *See generally* https://www.northernwater.org/sf/wgfp/home. A lawsuit seeking to halt the construction of Chimney Hollow Reservoir, a component of the Windy Gap Firming Project, is pending in the U.S. District Court for the District of Colorado. *See Save the Colorado et al. v. U.S. Bureau of Reclamation et al.,* Civil Action No. 17-CV-2563, available at https://www.courthousenews.com/wp-content/uploads/2017/10/Colorado-River-Firming-Project-COMPLAINT.pdf.

[126] *See generally* https://grossreservoir.org/. A lawsuit seeking to halt the construction of the Moffat Collection System Project, of which the enlargement of Gross Reservoir is one component, is pending in the U.S. District

Whitney Reservoir.[127] The total amount of additional diversions that could result from these projects is approximately 350,000 acre feet, suggesting substantial increases in the risks described above.

Another potential category of new uses stems from the development of currently unused tribal reserved rights. The recent Colorado River Basin Ten Tribes Partnership Tribal Water Study assessed current water entitlements and use by ten Native American tribes in the Colorado River Basin, including five in the Upper Basin. The Study concludes that there is a very substantial amount of unused tribal water in the Upper Basin, over 1.0 MAF.[128] This includes a significant portion of as yet unresolved tribal reserved right claims. The Study projects development of currently unused tribal rights and looks at the impacts on certain metrics, including Lake Powell inflows and elevations.[129] It does not address the effect of tribal water development on the risk of curtailment in the Upper Basin.

As shown by the Risk Study, increases in demand from present levels exacerbate and further increase the risk that shortages will occur in Lake Powell.[130] Such shortages increase the risk that curtailment of Colorado water rights will be required.

## ADMINISTRATION OF COMPACT CURTAILMENT IN COLORADO

At present, it is not clear exactly how curtailment of water rights in Colorado to comply with the 10-year running average requirement from the 1922 Compact would be implemented. In other words, it is not yet known how the Colorado State Engineer would administer the curtailment of water rights to comply with the Compacts. The State Engineer's Office has been working internally to examine options for administration of Compact curtailment and analyzing the impact on various priorities and types of water rights, but no analysis or further information has yet been made public.

If the Lower Basin made a claim that Compact curtailment was required, it is quite possible that litigation between the Upper and Lower Division states would result. The pendency of litigation might suspend any curtailment to Colorado River water rights within the State of Colorado, but it is likely that the question of whether immediate curtailment is required or should be stayed would also be litigated.

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Court for the District of Colorado. *See Save the Colorado et al. v. Semonite et al.,* Civil Action No. 18-CV-3258, available at https://www.courthousenews.com/wp-content/uploads/2018/12/WildEarth-over-Big-Dam.pdf 5.

[127] *See* https://www.aspentimes.com/news/aurora-colo-springs-seek-to-drill-on-lower-homestake-creek-dam-sites/.

[128] Colorado River Basin Ten Tribes Partnership Tribal Water Study Report, December 2018, Ch. 5.11, available at https://www.usbr.gov/lc/region/programs/crbstudy/tws/finalreport.html.

[129] *Id.*

[130] Eric Kuhn Memo, *supra* note 93, at p.5; Risk Study Phase I Report, West Slope Basin Roundtables Presentation, July 13, 2016, Slide 10, *supra* note 100; Risk Study Phase III, *supra* note 103, Slide 7.

If curtailment is necessary for Compact compliance, an obvious means of administration would be based on the prior appropriation system, the mechanism through which all Colorado water rights are administered.[131] Water rights diverting from streams and rivers on the western slope would be curtailed - prohibited from diverting - in reverse order of priority until the required amount of water was delivered. It is not currently known whether the restoration of Lee Ferry flows to meet the 75/10 or 82.5/10 requirement would need to occur within one year or could be spread out over time. The manner in which various tributaries (Yampa, Gunnison, San Juan, etc.) would be administered, *vis-à-vis* the Colorado River mainstem and each other is also unknown. The penalty box provision of the Upper Basin Compact could mean that Colorado water rights would be curtailed in an amount sufficient to offset Colorado's use in excess of its proportionate amount in the past before curtailments occur in the other Upper Division states.[132] All of these issues may be raised in litigation.

It should be emphasized that only post-Compact water rights, those that were not "perfected by use" prior to the operative Compact date, are subject to curtailment should reductions in consumptive use be necessary to comply with the 1922 Compact.[133] It has been estimated that of approximately 2.5 MAF of Colorado River depletions in Colorado on an average annual basis, approximately 1.6 to 1.75 MAF is attributable to pre-Compact water rights.[134] But there are ongoing questions about the operative date for determining pre- and post-Compact rights, the particular date associated with a water right that is determinative,[135] and the meaning of "perfected by use."[136]

Regardless of the precise definition, it is apparent that significant amounts of Colorado's West Slope-sourced water rights can be considered pre-Compact and not subject to curtailment. That's the good news. The corollary bad news is that the burden of curtailment will fall on the much smaller quantum of post-Compact rights. Significant curtailment reaching far into the seniority ranking may be necessary to achieve the amounts of reduced usage required for Compact compliance.

The Risk Study has evaluated the effect of potential curtailment in Colorado to produce differing volumes of water. As an example, producing 300,000 acre feet of water to respond to Compact curtailment would require curtailment of water rights with priority dates junior to 1940. This means that water rights junior to that date would not be allowed to divert at all.

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[131] *See* Colo. Const. Art. XVI, Sec. 6; *Coffin v. Left Hand Ditch Co.,* 6 Colo. 443 (1882).
[132] Upper Basin Compact, Art. IV.b; *see* information on 2009-2018 use by Colorado, *supra* notes 72 to 74 and accompanying text.
[133] *See supra* notes 17 to 18 and accompanying text.
[134] Risk Study Phase III Update, *supra* note 103, Slides 11-13.
[135] *Id.,* Slide 12.
[136] For example, it is unknown as to whether an adjudicated municipal water right for 10 cubic feet per second (cfs), of which only 2 cfs was in use in 1922 (or 1929) would be considered "perfected by use" to the full extent of the 10 cfs decreed right.

Producing 600,000 acre feet would require curtailment of post-1935 water rights. Curtailment of all post-Compact water rights would be necessary in order to produce 932,000 acre feet.[137]

In order to avoid disproportionate economic and social impact on any one sub-basin, consideration may be given to distributing the mandatory reductions based on each sub-basin's percentage of post-Compact water use relative to the State as a whole. Another variation would distribute the mandatory reductions between West Slope uses (mostly agricultural) and trans-mountain diversions (mostly municipal) based on each sector's percentage of post-Compact water. Both of these possibilities have been preliminarily analyzed in the Risk Study.[138] As with any alternative schemes, some sub-basins and sectors are helped and others are hurt by potential changes in administration in this zero-sum game. It will be difficult to determine which of the many possible curtailment methods would be the "fairest" and it is certainly not clear at this time exactly what process would be used for Compact administration in Colorado.

## RISKS INHERENT IN INTERSTATE LITIGATION

Given the aforementioned legal uncertainties and ambiguities about the various parties' water entitlements under the Law of the River, one frequently discussed course of action is litigation. Each of the basin's factions has lawyers with well-rehearsed arguments designed to protect their share of the water. Lawyers for Upper Division states stand ready with arguments that would reduce their clients' Lee Ferry delivery obligation in the face of climate change. Lawyers for Lower Division states are equally prepared with arguments that could end future Upper Basin development and even roll back current uses to meet their interpretation of the 1922 Compact. In any such litigated dispute, the winner's position could require the loser to suffer catastrophic results. Even without considering climate change impacts on the river, there is not enough water for all the lawyers to be right, creating substantial risk and uncertainty for all parties if this path is chosen.

The apparent attractiveness of litigation is clear. A number of the risks described above, particularly those associated with the legal framework of the Law of the River and the continued existence of the Structural Deficit, could at least theoretically be resolved through a legal challenge. Within any of the Basin states, individuals or groups may lobby for litigation to resolve what they see as unforgivable infractions of the Law of the River by other states. This has made the threat of litigation and the confrontational approach that goes with it a tempting talking point for elected officials and candidates for elective office.[139]

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[137] *See* Risk Study Phase III Update, *supra* note 103, Slides 13-16. For context, the federal Fryingpan-Arkansas Project has a priority date of 1957, Denver Water's Dillon Reservoir has a priority date of 1946, and the federal Colorado-Big Thompson project has a priority date of 1935.
[138] *Id.,* Slides 18-27.
[139] *See, e.g.,* Lawmakers question efforts to fill new Lake Powell drought pool, Water Education Colorado, Sept. 25, 2019, https://www.watereducationcolorado.org/fresh-water-news/lawmakers-question-efforts-to-create-colorado-river-drought-plan/ (Colo. state senator Jerry Sonnenberg invokes protection by US Supreme Court).

As just one example, a declaratory judgment could be sought to settle once and for all the question of whether the 1922 Compact establishes a delivery obligation on the part of the Upper Basin or whether, on the contrary, it is merely a non-depletion obligation. If a state is a party to this type of case, the U.S. Supreme Court has "original jurisdiction" to hear it.[140] The allocations within the Colorado River Basin have been the subject of numerous original jurisdiction disputes in the U.S. Supreme Court over the years, the most well-known being the *Arizona v. California* lawsuit decided in 1963.[141]

Litigating a favored legal position would appear to have the advantage of securing a definitive answer, binding on the parties and valid into the future, but there are plentiful disadvantages. The most obvious is the risk of losing - no individual party can be sure of the ultimate result. What seems like an inescapable conclusion to one state will, without a scintilla of a doubt, be met with an equally firm conviction to the contrary by another state, or its lawyers. The sitting Justices of the U.S. Supreme Court are not knowledgeable about western water issues and have been known to reach conclusions that are inexplicable to experienced water managers.[142]

As strikingly illustrated by *Arizona v. California*, interstate litigation can be seemingly endless in duration, cost buckets of money, and freeze participants in the status quo for fear of jeopardizing a legal position. It also may not solve the underlying problem. The 1963 decision in *Arizona v. California* was instigated by a complaint filed eleven years earlier and has been estimated to have cost the parties $5 million at the time[143] (approximately $42 million in 2019 currency). The trial itself lasted more than two years, featured 106 witnesses, and produced thousands of exhibits.[144] The case has been reopened five times subsequent to 1963[145] and followed on the heels of three previous trips to the Supreme Court.[146] Clearly, none of the individual decisions made the problems go away.

Other interstate water disputes are similarly long-lived. *Florida v. Georgia*, a dispute over the waters of the Apalachicola-Chattahoochee-Flint river system in the southeastern United States, originated in 1990 and is still going strong.[147] *Texas v. New Mexico and Colorado*, a case involving the Rio Grande Compact, is a baby in the original jurisdiction family, with its birth in 2014. After five years, the court has only recently decided who the proper parties are and has

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[140] U.S. Constitution, Art. III, Sec. 2.
[141] *Arizona v. California,* 373 U.S. 546 (1963).
[142] *See, e.g., Arkansas Game & Fish Commission v. United States*, 568 U.S. 23 (2012) (holding that periodic flooding of a wildlife management area located in a floodplain resulting from releases from a flood control dam upstream, made in accordance with the recommendations of a publicly constituted advisory committee, constitutes a "taking" for which compensation is required.)
[143] Bonnie G. Colby and Katharine L. Jacobs, editors, *Arizona Water Policy: Management Innovations in an Urbanizing, Arid Region*, at 18.
[144] Simon H. Rifkind, *supra* note 18, p. 3.
[145] *Arizona v. California*, 547 U.S. 150, 150-52 (2006).
[146] *Arizona v. California,* 373 U.S. at 550-51 n. 1.
[147] *Florida v. Georgia,* 585 U.S. ___, 138 S. Ct. 2502; 201 L. Ed. 2d 871 (2018); Wikipedia, Florida v. Georgia (2018), https://en.wikipedia.org/wiki/Florida_v._Georgia_(2018).

not resolved any of the substantive claims.[148] Those who would use the courts to resolve an interstate water dispute must clearly be long-term investors.

While litigation purports to provide definitive answers, the courts' ultimate determinations may differ markedly from the original questions asked. Again, *Arizona v. California* provides a spot-on example. Arizona's original complaint, filed in 1952, requested resolution of three questions: (1) the interpretation of Article III(b) of the 1922 Compact; (2) the manner in which "beneficial consumptive use" is measured; and (3) how evaporation losses from Lake Mead will be charged.[149] The 1963 decision resolved exactly none of those claims. As the Special Master's report acknowledges, the original pleadings "were of little use in formulating the issues to be tried."[150] Even with supplemental filings, "many of the issues for decision did not emerge until final briefs were submitted."[151] In other words, the controversies, legal theories, and strategies all evolved during the process of litigation, which took on a life of its own.[152] The rationale for the original filing of the complaint might easily get lost along the way.

While litigation is pending, the already arduous business of collaboration becomes exponentially tougher. Representatives of litigating parties must carefully police what they say so as not to undermine nuanced legal positions or have their words turned against them in the next oppositional paper filed with the special master or the court. This is doubly true for governmental litigants. Interstate litigation is a public matter and political capital will have been expended in instigating the claim, meaning that any proposed compromise will meet with at least some outraged public horror that the state's future is being flushed down the drain by incompetent overseers. This maneuver can be used strategically against the political party in control of the state executive branch. All manner of internal and external politics can take settlement discussions off track.[153] The individuals working on the litigation within the state will be hard pressed to both keep on top of the case and its deadlines and engage in meaningful settlement discussions while simultaneously carrying out the active day-to-day management of the river system they must share with their litigation opponents. All of these pressures work against sensible settlements.

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[148] Texas v. New Mexico and Colorado, 583 U.S. ___ (March 5, 2018).
[149] *Arizona v. California*, Motion for Leave to File Bill of Complaint and Bill of Complaint, No. 10 Original, 1952 Term, U.S. Supreme Court, pp. 25-27.
[150] Simon H. Rifkind, *supra* note 18, p. 3.
[151] *Id.*
[152] Jack L. August, *Dividing Western Waters: Mark Wilmer and Arizona V. California*, Texas A&M University Press, 2007.
[153] *See, e.g., Maui Mayor Rejects Clean Water Act Settlement, Aims for Supreme Court Hearing: Internal politics in Maui County muddle a closely watched groundwater case,* Circle of Blue, Oct. 22, 2019, https://www.circleofblue.org/2019/world/maui-mayor-rejects-clean-water-act-settlement-aims-for-supreme-court-hearing/?mc_cid=61c69ae5b7&mc_eid=65f04a5c03.

Interstate water litigation may be a sensible strategy when other, less fraught, efforts have utterly failed. But it should never be thought of as the best way of resolving a disputed issue. The risks are massive in terms of time, resources, uncertainty of outcome, and depletion of political capital. It is wildly impractical to believe that the many legal uncertainties surrounding the 1922 Compact and subsequent statutes can easily be resolved through litigation.

## RECAP OF THE RISKS OF CURTAILMENT

An evaluation of the overall risk of curtailment of water rights in Colorado to comply with the 1922 Compact must consider the aggregation of the various individual risks discussed above, and a projection of those risks into the future. The various risks described in this paper are summarized below.

### Legal Risks

1. The obligation of the Upper Basin is held to be a delivery obligation as opposed to a non-depletion obligation. This would mean that the Upper Basin must absorb any climate change reductions to the flows in the Colorado River to deliver 75 MAF over ten years at Lee Ferry, even if that requires curtailment of existing uses to do so.
2. Because of the obligation to Mexico, the Upper Basin's obligation at Lee Ferry is held to be 82.5 MAF over ten years. This obviously increases the obligation of the Upper Basin states and the risk that curtailment of existing uses will be required.
3. Water rights junior to November 24, 1922 are deemed to be post-Compact water rights. This simply means that more water rights in the Upper Division states are vulnerable to curtailment.
4. The State of Colorado is determined to have exceeded its proportionate share of Upper Basin water and to be responsible for repaying the overage under the penalty box provision of the Upper Basin Compact. This could be very difficult for Colorado as the state might need to produce 1.5 and 2.0 MAF through curtailment to fulfill the obligation to the Lower Basin at Lee Ferry before any of the other Upper Division states are required to contribute. The Risk Study tells us that producing approximately 900,000 acre feet of water would require curtailment of <u>all</u> post-Compact water rights.

### Hydrological Risks

5. A repeat of hydrology experienced in the past causes Lake Powell to fall below the critical level of 3,490 feet. No hydropower generation would occur, resulting in loss of funding for federal water projects in the Upper Basin, as well as endangered species and adaptive management programs that provide security

for Upper Basin uses. The ability of Lake Powell to produce the required delivery to the Lower Basin would be in severe jeopardy.

6. The hydrology gets worse and approximates the climate change projections of reduction of flows in the Colorado River system by an additional 20-30% by 2050 and 35-55% by 2100, causing even steeper and earlier declines in Lake Powell, with the same consequences as described above.

**New Depletions or Demands**

7. New depletions occur through new projects in the Upper Basin and increase the risk of Compact curtailment. The risk that required deliveries cannot be made approximately doubles with an 11.5% increase (500,000 acre feet) in Upper Basin uses.
8. Currently unused Upper Basin tribal water rights are developed, putting additional pressure on the Colorado River system and increasing the risk of shortage and curtailment of water rights to ensure Compact compliance. Unused tribal rights in the Upper Basin, including as yet unresolved tribal reserved right claims, total approximately 1.0 MAF.

**Inadequate Mitigation Measures**

9. The Drought Contingency Plan measures are insufficient to halt the declines in Lake Mead and Lake Powell. The DCP is already acknowledged to be insufficient to address the overall imbalance in the Colorado River system.
11. No Upper Basin demand management program or other insurance policy is put in place in the Upper Basin before the need for Compact curtailment occurs. Each Upper Division state is investigating demand management independently, including Colorado. But it is far from clear that such a program will be put in place or established quickly enough to provide a buffer against curtailment.
12. A demand management program is put in place in the Upper Basin but is insufficient to halt the decline in Lake Powell. Demand management will be difficult and expensive. It is not clear that sufficient interest exists to produce voluntarily the amount of water savings required to support a Lake Powell water bank sufficient to protect against curtailment.
13. The Structural Deficit in the Lower Basin continues in some form and the resulting declines in Lake Mead put additional pressure on Lake Powell. Lower Basin water users have become accustomed to receiving and using greater releases from Lake Powell than the target level of 8.23 MAF and further reductions will be difficult and potentially fiercely opposed.
14. The successor agreement to the 2007 Guidelines is insufficient to address climate change impacts or halt the decline in Lakes Mead and Powell. The outlines and effects of the successor agreement are largely unknown. While likely to incorporate the salient provisions of the DCP, it is very difficult to predict any further details. A good guess would be that the successor agreement will be

more robust than the DCP with contingencies for deeper or sustained decreases in flows, but will not fully address the structural imbalance in the system. Meaning that a risk of curtailment in the Upper Basin will continue.

**Litigation**

15. Interstate litigation is initiated in the U.S. Supreme Court that freezes negotiations, undermines collaboration, and requires many years to reach conclusion. Such a process could deal a significant blow to cooperative efforts to address the Structural Deficit and create a more resilient system. While the pendency of litigation might stay any efforts to impose Compact curtailment, the risks could be magnified by a decision adverse to the Upper Basin.

While it is difficult to predict which of the above listed risks will or will not occur, the possibility that some combination of these threats and consequences will materialize cannot be disregarded.

## INSURANCE OPTIONS OR "GOING BARE"

Even if the risk of curtailment of Colorado River rights were assumed to be low, the consequences are not. Cities, and farmers and ranchers on the West Slope, would lose economic activity, jobs, income, and community benefits. This is a classic example of something natural resource managers and governmental organizations around the world must grapple with - how to prepare for and respond to high consequence, low probability events.[154] Analyzing the impacts of a credible range of physical and institutional futures in the form of scenario planning is increasingly recognized as a valuable technique for water planning in complex systems.[155] Scenario planning suggests preparing contingency plans, like the DCPs, to be better prepared to respond to the biggest risks.

In the Colorado River Basin, preparations and proposed responses fall into two categories: basin-wide governance and local scenario planning.

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[154] *See, e.g.,* Gregg Garfin *et al., Preparing for High Consequence, Low Probability Events: Heat, Water & Energy in the Southwest*, Report to the U.S. Bureau of Reclamation from the project Enhancing Water Supply Reliability, University of Arizona, 2016; Bernice Lee and Felix Preston, *Preparing for High-impact, Low-probability Events,* Chatham House Report, 2012.

[155] Christopher A. Scott, *et al.*, *Scenario Planning to Address Critical Uncertainties for Robust and Resilient Water-Wastewater Infrastructures Under Conditions of Water Scarcity and Rapid Development*, Water 2012, 4, 848-868; doi:10.3390/w4040848, available at https://www.mdpi.com/2073-4441/4/4/848/htm; *see* also Water Research Foundation, Joint Front Range Water Vulnerability Study, 2012; Marc D. Waage and Laurna Kaatz, *Planning Water Supply Systems for Multiple Future Conditions*, Colorado Water, Colo. State Univ., Vol. 27. Iss. 2, 2010.

**The Basin Scale**

The best hope for avoiding curtailment at the basin scale flows from the continued effort of Colorado River water managers to reach agreements that bring better balance to the system through voluntary reductions. There is a history and culture of collaboration in the Basin and, therefore, reason to expect that Colorado River water leaders will devote considerable effort to reaching a negotiated solution that decreases the risk of Compact curtailment in the Upper Basin. These leaders recognize that the litigation and disruption likely to occur if the 1922 Compact's enforcement provisions are invoked should be assiduously avoided.

It is quite possible that further negotiations will result in yet more reductions in deliveries and use triggered by Lake Mead elevations or on sustained dry hydrology. Similar to the DCP's supplementary contributions to the baseline set in the 2007 Guidelines, a new operational regime could call for even deeper reductions.

Another possibility for a basin scale pact is a "grand bargain" that trades off future Upper Basin water use growth against a Lower Basin commitment not to enforce a Lee Ferry priority call. Such a compromise has been suggested for a number of years as an alternative to resolve the legal uncertainties in the Law of the River and thereby reduce risk.[156] The politics of a grand bargain are very difficult, however, in that each of the states would be forced to explain to its constituents why theoretical rights under the 1922 Compact are being compromised. If any such bargain is limited to a term of years, it will be critical to ensure that no party is in a worse position at the end of the term than it would have been in the absence of the bargain.

Getting to closure on any such agreement is a painful process, however, and it has historically taken years. Even with the best of intentions, tentative agreements have been undone. Political headwinds, even those only indirectly related to Colorado River operations, can delay or block a negotiated agreement.[157] The primary terms of the Lower Basin DCP were substantially agreed to for approximately five years prior to the finalization of that agreement. Discussions concerning a Colorado water bank for conserved water have been ongoing for almost ten years, but little significant progress has been made. Dry years, such as that experienced in 2018, can throw a vulnerable system suddenly out of balance even while negotiations are continuing. The impacts of climate change have the potential to outpace the

[156] Eric Kuhn and John Fleck, *Is there a 'Grand Bargain' to be had in the Colorado River Basin?,* http://www.inkstain.net/fleck/2019/06/is-there-a-grand-bargain-to-be-had-in-the-colorado-river-basin/, June 2, 2019.

[157] *See, e.g., Imperial Irrigation District wants $200 M for Salton Sea in exchange for Colorado River drought plan OK,* Desert Sun, January 30, 2019, https://www.desertsun.com/story/news/2019/01/31/california-imperial-irrigation-district-200-million-dollar-salton-sea-colorado-river-drought-plan/2733780002/; *Maui Mayor, supra* note 153.

efforts of the Basin States to bring the system into balance.[158] All of this means serious discussions of next steps need to start immediately.

**Upper Basin and State-Based Approaches**

Because there is no certainty of a basin-wide negotiated agreement, the best advice is to provide as much as reasonably possible for a resilient system that will allow adaptation to potentially adverse future conditions. This is the same logic that underpins the design of reservoir spillways for rare high flows, or the concept of "firm yield" as representing a worst case estimate of the reliable amount a water right will produce. These precepts point to the desirability of having various levels of contingency plans ready, based on hydrological and storage volume triggers, in order to provide increased resilience and allow adaptation to adverse future conditions.

Approaches being considered in Colorado and the other Upper Division states fall into two categories:

- Demand management - reductions in use of existing water rights in the short term as a hedge against cuts in the future, and policies that take seriously the risks each new use poses to existing water users
- Wait and see - not taking proactive action, but rather letting the chips fall where they may, recognizing that involuntary curtailment could be the result

**Demand Management**

It has long been understood that relatively modest reductions in Colorado River water use have the cumulative effect, over time, of substantially reducing worst-case risks by increasing starting point storage as the river system enters droughts.[159] This is the foundation of the Lower Basin's approach in the years since the approval of the 2007 Guidelines, with voluntary measures among Lower Basin water users leaving water in Lake Mead as a hedge against risks should inflows decline. By the end of 2018, such efforts had created a 1.7 million acre foot "savings bank" in Lake Mead, staving off Lower Basin curtailments that would otherwise have been required under the 2007 Guidelines.[160]

Similarly, a demand management program and water bank may be put in place in the Upper Basin that can be used to meet downstream obligations and avoid or mitigate the need for

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[158] USGCRP, 2018: *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II,* U.S. Global Change Research Program, Washington, DC, Ch. 28: Adaptation, available at https://nca2018.globalchange.gov/chapter/28/, (Key Message #2: Climate Change Outpaces Adaptation Planning).
[159] Balaji Rajagopalan, *et al., Water supply risk on the Colorado River: Can management mitigate?,* Water Resources Research 45.8 (2009).
[160] USBR, Colorado River Accounting and Water Use Report, May 2019, Table 1, available at https://www.usbr.gov/lc/region/g4000/4200Rpts/DecreeRpt/2018/2018.pdf.

curtailment for Compact compliance. The Demand Management Storage agreement that is a component of the Upper Basin DCP erects the foundation for such a program, but does not establish it nor require its establishment.[161] The agreement does, however, provide for a demand management program to utilize 500,000 acre feet of storage capacity in Lake Powell, free of charge, that would be insulated against depletion by releases that would otherwise be required to balance the contents of Lakes Powell and Mead.[162] This capacity would be used to store water voluntarily produced through conservation upstream and would serve as a "bank" from which releases could be made to remedy a deficit in the 10-year average Lee Ferry flow requirement, thus avoiding involuntary curtailment.

While demand management in the Upper Basin was investigated and was tested in a pilot program for four years through 2018, no long-term program has been adopted.[163] Colorado and the other Upper Division states are each currently involved in internal processes exploring how a demand management program might work within those states.[164] These discussions are likely to continue through 2020 and beyond.

The Colorado Water Conservation Board has made it clear that any demand management program within the state of Colorado would consist of "voluntary, temporary, and compensated reductions in consumptive use" for the purpose of assuring compliance with the 1922 Compact.[165] Additionally, the CWCB is committed to avoiding disproportionate negative economic or environmental impacts to any single sub-basin or region within the state and will investigate mechanisms for obtaining "roughly proportionate contributions" from participants on each side of the Continental Divide.[166]

Demand management for the purposes of Compact security is by no means universally supported within the state of Colorado.[167] There are many barriers - legal, operational, and political - that must be addressed in order to stand up a viable demand management program and water bank in Lake Powell.[168] Difficulties include the perception that the Upper Division state governments would be prematurely requiring curtailment for the benefit of the Lower Basin, the depletion of the saved water by evaporation, and disagreements about an acceptable level of risk. The rights and responsibilities of each Upper Division state *vis à vis* the others have not even begun to be addressed and lasso in difficult questions about new development

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[161] *See supra* notes 54 and 55 and accompanying text.
[162] Agreement Regarding Upper Basin Demand Management Program, *supra* note 54, Section III.B.2.c.
[163] *See* Final Report, Colorado River System Conservation Pilot Program in the Upper Colorado River Basin, February 2018, available at http://www.ucrcommission.com/RepDoc/SCPPDocuments/2018__SCPP_FUBRD.pdf.
[164] *See* description of the state of Colorado's investigation of demand management feasibility at http://cwcb.state.co.us/water-management/Pages/DemandManagement.aspx.
[165] Colorado Water Conservation Board, Support and Policy Statements, November 15, 2018, available at http://cwcb.state.co.us/Documents/ShortTermHomePage/SUPPORTANDPOLICYSTATEMENTSFINAL11-15-18.pdf.
[166] *Id.*
[167] *See, e.g., Water Equity a Concern for West Slope Water Users,* Aspen Times, Aug. 27, 2019, https://www.aspentimes.com/news/water-equity-a-concern-for-western-slope-water-users/.
[168] *See, e.g.,* Reports from Workshop on Shepherding Water in Colorado for Colorado River Compact Security, available at http://cwi.colostate.edu/Shepherding.aspx.

proposals, relative state shares of overall usage, and how to allocate benefits. It is not clear at the time of this writing whether a demand management program will be put in place in Colorado or the Upper Basin. Demand management does, however, represent a proactive insurance policy against the potentially catastrophic risk of curtailment.

**Going Bare (or Wait and See)**

The difficulties associated with practical implementation of demand management have led some to question whether simply waiting to see if curtailment happens, and dealing with the consequences then, might be a preferred solution. Demand management has its downsides, as described above, and may be opposed particularly by pre-Compact water rights holders as an unnecessary, unduly complicated, and costly program. Any such decision to forego insurance and roll the dice to see if curtailment happens should be informed by a clear-eyed understanding of the risks and likely impacts as opposed to a "head in the sand" refusal to acknowledge potential hazards looming.

The Risk Study suggests that curtailment would cut deeply into the priority list of post-Compact water rights, and, in Colorado, would fall heavily on municipal transmountain diversions to the East Slope.[169] While that might sound superficially attractive to West Slope agricultural interests, it has also been recognized that such a prospect would motivate affected municipal water providers to buy or lease pre-Compact West Slope irrigation water rights, possibly in substantial volume. Although these would almost certainly be market-based, arms-length transactions, the resulting economic impact could be geographically concentrated and tremendously disruptive to commodity supply chains.

The potential economic consequences of curtailment should be carefully weighed in any decision to forego demand management or other forms of insurance. Such an economic analysis is beyond the scope of this paper, and there is little in the way of hard data on this issue. But the limited analyses available suggest that reductions in water supplies, whether through drought or involuntary curtailment, impact rural economies both directly through reductions in output and lost revenues and indirectly through reduced payments to entities along the supply chain.[170] Losses to Colorado's economy of tens of millions of dollars, as well as thousands of job losses, have been estimated and predicted.[171]

Advance planning for the possibility of curtailment could assist in mitigating economic losses and disproportionate impacts, but it should be recognized that the imposition of curtailment

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[169] Risk Study Phase III, *supra* note 103, at 3, Slides 17, 22, 24-27.
[170] *See* Allison Bauman, et al., *Estimating the Economic and Social Impacts from the Drought in Southern Colorado,* Universities Council on Water Resources, Journal of Contemporary Water Research & Education, Issue 151, Pages 61-69, August 2013; Tim James, et al., *The Economic Importance of the Colorado River to the Basin Region,* Arizona State University (2014); *Economic Impacts of Climate Change on Colorado,* Center for Integrative Environmental Research, University of Maryland (2008).
[171] *Id.*

could conceivably cause panic and chaos in the Upper Division states. Going bare is high stakes poker.

**"If It's Possible, We Need To Plan For It"**

The 2018 and 2019 Colorado Water Congress conferences were replete with presentations on the "looming crisis" on the Colorado River. The advice from water managers and experts included "expect the improbable," "if it's possible, we need to plan for it," and "it would be mistaken to plan based on hope that the situation will get better."[172] This theme continues to be heard in gatherings of Colorado water professionals, with similar sentiments expressed that water managers should "plan for the possibility" of Colorado River curtailment[173] and a municipal portfolio that includes a significant amount of post-Compact water rights is "potentially problematic" because of the risk of Compact curtailment.[174] Concern has been voiced that "this river can turn on a dime," so water users need to be prepared for that.[175]

## CONCLUSION AND RECOMMENDATIONS

With the risks described in this paper that could cause curtailment of water rights in Colorado and the Upper Basin, and the grave potential consequences of that curtailment, it seems inarguable that some type of insurance policy is needed. Hoping for big snowpacks, or that the lawyers will win a court battle against the Lower Basin, leaves us with enormous risks. Hope is not insurance. We hope that our houses will not burn down, but we also buy insurance. Such a policy could take a number of forms, with a demand management program at or near the top of the list.

This paper is intended to provide an objective evaluation of the risk of curtailment in order to inform the kind of cost-benefit analysis that would support a conclusion that a demand management program or some other form of insurance is necessary and appropriate, or the converse. The State of Colorado and the other Upper Division states will need to make informed decisions about the risks and consequences of involuntary curtailment and weigh them against the costs and benefits of a demand management program.

Voluntary, temporary, and compensated conservation by water users in Colorado in advance of Compact curtailment, despite its complexities and downsides, seems preferable to involuntary and uncompensated curtailment of unknown duration and magnitude. Such a program would take the form of a contingency plan, with conserved water contributions triggered by bad hydrology and proximity to violation of the ten-year flow obligation to the Lower Basin.

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[172] Comments of Barton Thompson, Jim Lochhead, and Andy Mueller, respectively, Colorado Water Congress, Summer Conference, August 22-24, 2018.
[173] Comments of Jim Lochhead, Colorado Water Congress, Annual Conference, Jan. 30 – Feb. 1, 2019.
[174] Colorado River District, Western Slope Water Webinar, August 29, 2018, comments of Andy Mueller, available at https://www.coloradoriverdistrict.org/events-directory/webinar/.
[175] Comments of Jim Lochhead, Colorado River Symposium, Santa Fe, NM, Sept. 19, 2019.

A demand management program should not be the only risk management solution pursued. Because any such program ultimately accrues to the benefit of the Lower Basin, it should be coupled with reforms that will phase out Lower Basin overuse, address the Structural Deficit, and provide adaptation mechanisms for further reduced flows in the Colorado River.

Regardless of the form, some type of insurance policy is indispensable. The risks are too substantial and the consequences too massive to go bare. We acknowledge that there are significant logistical and implementation problems with demand management, such as verification and accounting, funding, agricultural and tribal impacts, and water rights barriers, to name a few. But even with all its difficulties, exploration of demand management seems to be the right path for the Upper Basin, and no other alternative to the turmoil and disorder of forced curtailment has been proposed thus far. It is incumbent on state agencies and water users to objectively work toward an appropriate form of insurance, considering the various risks and consequences described in this paper.