THE IMPORTANCE OF PRE-COMPACT WATER RIGHTS IN THE CLIMATE CHANGE ERA OF COLORADO RIVER WATER PLANNING

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Abstract

In the West, there is a distinction between "wet water" and "paper water." In a drought year, newer water rights cannot draw water until older rights are fulfilled, and so a junior water right holder may find themselves stuck with paper that doesn't get them water. The community of Moab holds unused newer water rights, with priority dates between 1958 and 2017, to the Colorado River. Reaching the limits of local wells and streams, some are looking to use these water rights to feed continued growth. The necessary equipment—a strong pumping and distribution system— would be expensive, but the State of Utah, relying on optimistic climate predictions, is behind new water diversions. However, a Law of the River analysis and the best available science foresee a shrinking river system in which junior water rights like Moab's will be unusable "paper" more often than "wet." However, there may be a legal loophole: water rights that predate the Colorado River Compact, signed in 1922, may be allowed to keep using water even during a Compact shortage. Rather than funding controversial new diversions, the State of Utah needs to recognize the importance of pre-Compact rights, and start planning a possible future in which those rights are the only ones available. Moab's current river rights are not reliable enough to justify a major infrastructure expense. Localities like Moab, with junior rights and looming growth, should plan to limit growth to an existing water budget, or start fundraising to buy and litigate the transfer of pre-Compact water rights.

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I. INTRODUCTION

The Colorado River system[1] is one of the most heavily used in the world. In the river's long way through its high upper basin to the massive cities and farms around its lower reaches, the river passes the small desert town of Moab, Utah.[2] Facing fast growth and dwindling local water supplies, Moab may try to pump water from the river, and that could be a problem.

Moab's drinking and irrigation water comes from local creeks, springs and wells. Until recently, there was little reason to pump Colorado River water uphill. However, Moab has filled to bursting with tourists and "amenities" migrants while a warming climate threatens streamflows and groundwater replenishment.

What happens when current sources aren't enough to serve a growing population? One answer: Look to the river. Public water providers serving the Moab area have unused rights to draw water from the Colorado, and may shift more to that source. However, all of these potential water diversions are based on "paper water"—formal rights to use water that may not actually be available when river levels are low.

The amount of water in the Colorado River system is shrinking steadily, and nearly every prediction says that it's likely to get worse. Water levels keep passing milestones: the first "emergency lever" release from Upper Basin reservoirs in July 2021,[3] the first federal Colorado River shortage declaration in August 2021, a surprise third rounds of cuts in the Lower Basin in December 2021, a threat to hydropower production in 2023. Scientists tell us this is not just

[1] The "Colorado River system" refers to the Colorado River and its tributaries within the United States.

[2] In this paper, "Moab" is used in its colloquial sense to mean the entire populated area centered around the City of Moab, including all of the unincorporated Moab valley in Grand and San Juan Counties, and including all public water providers for that area.

[3] Molly Taft, *Officials Pull 'Emergency Lever' as Lake Powell Plunges Toward Dangerous New Low,* Gizmodo (July 15, 2021, 3:02 PM), https://gizmodo.com/officials-pull-emergency-lever-as-lake-powell-plunges-1847308190.

another drought: it's most likely a changed climate. As water demand now equals or exceeds the 21st century's average flow, Lake Powell's ability to serve as a buffer against dry years diminishes.[4] The Lower Basin has already cut water use substantially, and the Upper Basin has formally committed to reducing water demand (while making forced local cuts to match the amounts actually available in upper watersheds as drought intensifies).

Against these conditions, should Moab, or any similarly situated water user, rely on its "paper water" from the Colorado River? This paper analyzes that question, putting Moab's water rights into the context of the basin's latest law and hydrology. Part II follows a thread through the "Law of the River,"[5] explaining how the law affects whether Moab's water rights will be available during a shortage. Part III looks at the intertwined life of supply forecasts and demand planning. Part V narrows to Utah, looking at how the state is likely to handle a water shortage. Part VI ties all of the foregoing analysis to Moab's water future. Part VII shows that while this analysis began to figure out a Moab problem, it ended up with an answer entirely relevant throughout the Upper Basin.

Navigating the labyrinth of Colorado River law and science to arrive at Moab and the Upper Basin's likely future is a convoluted affair. But once done, it brings us to a clear prediction with a high degree of certainty: absent foundational changes to water law or the reversal of climate change, Moab's Colorado River water rights, with priority dates between 1958 and 2017, are not reliable. To justify a major infrastructure expense, as well as the reliance of thousands of

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[4] Brad Udall & Jonathan Overpeck, *The Twenty-first Century Colorado River Hot Drought and Implications for the Future*, 53 WATER RESOURCES RESEARCH 2404, 2407 (alternatively 3) (2017) [hereinafter "Udall and Overpeck"] [The pagination from the original journal was not available at the time of this paper's finalization, so this paper refers to the pages from the pdf printed from the source liked here].

[5] The "Law of the River" is a commonly used colloquial term for the collection of interstate compacts, treaties, federal laws, state laws, policies, and agreements regarding the Colorado River system.

people on this water, Moab's water suppliers should research obtaining bombproof water rights that predate the Colorado River Compact (mostly likely 1929) (or limit growth to local water supply). The State of Utah, rather than approving new water diversions based on old science, should be preparing to facilitate the voluntary transfer of large volumes of pre-Compact water rights to the places that need them the most. Without that foresight, Utah risks leaving its major municipal water users confused and scrambling in the event of a federally enforced curtailment on the Colorado River.

II. THE LAW OF THE RIVER

Local governments, when seeking to draw water directly from a source as large and contested as the Colorado River, must understand how their own water rights nest within the complex of treaties, laws, regulations and policies governing the river system. Faced with falling supply and rising demand, the Law of the River is currently undergoing a stress test. This stress may induce the basin states and the federal government to modify the river's existing allocation framework, but any changes will take place against a massive and complex legal edifice that is difficult to alter. Below is a review of the parts of the Law of the River that are most critical to understanding Moab's position within the system.

A. Prior Appropriation in Utah

Western water law is based on a principle pioneered during the California Gold Rush of the 1840s: prior appropriation,[6] also known as "first in time, first in right." The first person to appropriate (divert and beneficially use) water from a source gets a right to that amount of water

[6] *Prior Appropriation Doctrine*, CORNELL UNIVERSITY LEGAL INFORMATION INSTITUTE, https://www.law.cornell.edu/wex/prior_appropriation_doctrine (last visited July 20, 2021).

from that source for as long as they continue to use it; that right has the senior priority. The second person to appropriate water gets the second priority right, continuing with each arrival until all the the water in the source is claimed. After that, any newcomer may only obtain water from existing users. In a dry year, there may be more water rights than actual water available. Then, the user holding the most recent ("junior") right must stop using water, with cutoffs going backwards by priority date until the aggregate volume of the fulfilled rights matches the available water.

Prior appropriation is used in both state and federal water law, though most water law is kept within the purview of the states. Utah law works in this priority date cutoff system.[7] Changing that to prioritize certain users or uses is possible, but the Utah legislature, or possibly Congress, would have to reengineer the fundamental basis of Western water law. The political will to support this degree of change would not materialize without a major water crisis.

B. Water for Tribes[8]

The prior appropriation system has cradled a sleeping giant since 1908, when the Supreme Court held that tribal reservations gained reserved water rights upon their creation.[9] Most reservations were created in the late 1800s, giving tribal rights very senior priority dates. State law has limited power over tribal rights: they are valid even without state approval[10] and the state cannot subject them to forfeiture or diminishment.[11] In the arid lands of the Southwest, the quantity of a tribal right is usually the amount needed to farm the irrigable lands of the

[7] Utah Code Ann. § 73-3-21.1 (West) (Describing "priorities between appropriators" in Utah).

[8] The term "Indian" is traditionally used in American law to describe the indigenous natives of the United States. However, the term "tribe" is now becoming increasingly common, particularly in documents the tribes participated in producing. This paper will use "tribe" and its forms to mean the same as the older term "Indian."

[9] Winters v. United States, 207 U.S. 564 (1908).

[10] Baley v. United States, 942 F.3d 1312, (Fed. Cir. 2019).

[11] Cappaert v. United States, 426 U.S. 128, 138 (1976).

reservation;[12] a court decision or an out-of-court settlement sets the precise volume. However, the law does not require that a tribe use its water only for irrigation.[13] In the Colorado River Basin, hundreds of thousands of acre-feet of water rights, most notably those of the Uintah-Ouray Ute Tribe of Utah,[14] remain either unsettled or unused (or both).

When put to use, tribal water counts as part of the Colorado River system apportionment of the state in which the water is used.[15] If tribes begin to use more of their large senior water rights, and available water continues to shrink, junior users could see their water use curtailed. Generally, tribes and agriculture have the oldest water rights; growing urban areas, relative latecomers to the scene, have junior water rights unless they have purchased them from senior holders. Moab, with its junior rights to the river, finds itself in this situation. A tribe's ability to sell or lease its water is defined by its treaty and other governing law, but often a tribe cannot sell its water rights unless Congress authorizes it.[16] Sometimes, a tribe may lease water off reservation with approval from the Secretary of the Interior.[17]

C. 1922 Colorado River Compact

Concerned about a federal judicial or *ex post facto* approach to Colorado River apportionment, in 1922 the basin states and the federal government drafted an interstate treaty,

[12] Technically, whether each reservation gains water rights upon creation, and the type and amount of those water rights, depends Congress' intent (as reflection in statutory language) in creating the reservation. In the Pacific Northwest, for example, a tribal water right may involve sufficient in-stream flows to protect important native fisheries. In the Southwest, the Supreme Court has held that Congress' intent to provide a permanent homeland for native Americans included the ability to sustain themselves via irrigated agriculture, which means water rights similar to those held by any other irrigator (aside from the special attributes of tribal reserved rights).

[13] Arizona v. California, 439 U.S. 419, 422 (1979).

[14] *See* Section III.B *infra* for discussion.

[15] Arizona v. California, 373 U.S. 546, 601 (1963).

[16] 25 U.S.C. § 177. The word "land" in Indian statutes includes Indian reserved water rights. Holmes v. United States, 53 F.2d 960, 963 (10th Cir. 1931).

[17] 25 U.S.C. § 415.

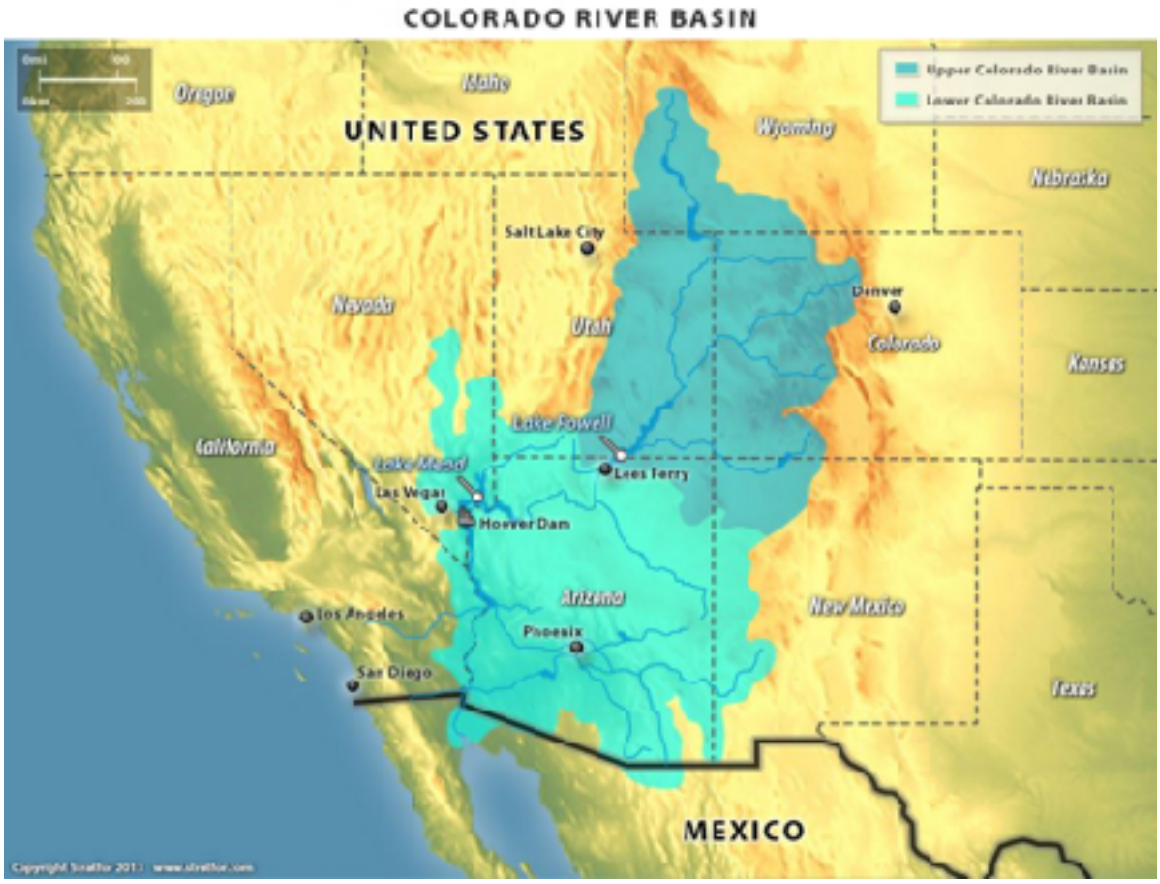

Figure 1. The Upper and Lower Basins and Lee Ferry. (Source: Glenwood Springs Post Independent, https://www.postindependent.com/news/local/good-and-bad-news-for-colo-river-basin/)

the cornerstone of the Law of the River: the Colorado River Compact of 1922.[18] Later laws and agreements have added to or interpreted it, but nothing has overruled it. Congressional approval gave it the force of federal law, its provisions able to overrule state law.[19] The Compact split the Colorado River between the Upper Division (lands mostly in Utah, Wyoming, Colorado and

[18] Colorado River Compact, Colo. Rev. Stat. Ann. § 37-61-101 (West), art. III(a) (2021) [hereinafter "1922 Compact" or "the Compact"]. In 1928, Congress passed the Boulder Canyon Project Act which, among other things, split the Lower Basin's 7.5 million acre-feet per year between the three states of the Lower Basin. Boulder Canyon Project Act, 43 U.S.C. § 617 (1929). These amounts have little effect on what happens in the Upper Basin, so they won't be covered in more detail.

[19] U.S. Const. art. 4, cl. 2

New Mexico) and Lower Division (lands mostly in California, Arizona and Nevada). Lee Ferry (*see* Figure 1)[20] is the dividing point between these sub-basins.

The Compact says that each of the two sub-basins may consume 7.5 mafy from the Colorado River and its tributaries,[21] with the Lower Basin taking the first small round of surplus.[22] However, over any *ten*-year period, the Upper Basin must allow at least 75.0 maf past Lee Ferry.[23] The effect of the Lee Ferry flow requirement is critical to understanding the Upper Basin's current situation: during a long-term dry period, the Lower Basin is entitled to its full share while the Upper Basin bears the burden of any shortfall.[24] The Lower Basin, with its greater political power and earlier developed water rights, secured a tight but certain future; the Upper Basin, despite being upstream, must "build a future on a right to leftovers."[25]

There is a loophole to the Lee Ferry flow requirement: the Compact explicitly states that it does not affect water rights that were "perfected" (legally established and in use) prior to the Compact, the most likely official date of which is November 24, 1922 (but could be June 29,

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[20] There is a difference between "Lee Ferry" and "Lee's Ferry." Lee's Ferry was once the site of an actual ferry, and is now the launch point for Colorado River rafting trips. Lee Ferry is a mile downstream, below the confluence with the Paria River. Lee Ferry is the dividing line between Upper and Lower Basins, meaning that the small, variable flow of the Paria (just under 20,000 afy on average) is added to the Glen Canyon Dam releases to make up the official Lee Ferry flow measurement.

[21] 1922 Compact, art. III(a). The Compact does not mention groundwater, and the issue of whether, or when, groundwater use might be counted against a sub-basin's Colorado River apportionment has not been settled. The difficulty of measuring groundwater pumping's affect on river flows would make this question difficult to adjudicate.

[22] 1922 Compact, art. III(b).

[23] 1922 Compact, art. III(d). There is some dispute over whether the Upper Basin can be held responsible for reduced flows due to drought or climate change, since the Compact says that the Upper Basin cannot *cause* the flow to be depleted rather than terming it a delivery obligation. This issue has not been formally decided, but the Upper Basin itself undermined that argument by referring to assigning states shares by percentages of a variable amount, rather than flat amounts, and by referring to the eventuality that "curtailment of the use of water" by Upper Basin states that may "at any time shall become necessary in order that the flow at Lee Ferry shall not be depleted below that required by Article III of the Colorado River Compact." UBC art. IV. Again, since the language of the law appears to most closely align with the interests of the wealthier and more populous Lower Basin, it seems most likely that future governance will assign the delivery responsibility to the Upper Basin states.

[24] The Compact contained more robust plans for surplus water. The first maf of any annual surplus (over the 7.5+7.5 maf described above) must go to the Lower Basin. 1922 Compact, *supra* note 17, § 37-61-101, art. III(b).

[25] Jason Robison, *The Colorado River Revisited,* 88 UNIV. OF COLO. LAW REV. 475, 525 (2017), quoting David H. Getches & Charles J. Meyers, *The River of Controversy: Persistent Issues*, *in* NEW COURSES FOR THE COLORADO RIVER: MAJOR ISSUES FOR THE NEXT CENTURY 51, 56 (Gary D. Weatherford & F. Lee Brown eds., 1986).

1929).[26] The Supreme Court included federal reserved water rights in this category. This leaves a large pool of pre-Compact water rights (including most tribal rights) in every state that cannot be cut under the Compact's authority, even if their continued use in the Upper Basin brings Lee Ferry's decadal flow below 75.0 maf.

D. Water for Mexico

In 1944 the U.S. and Mexico activated another provision of the 1922 Compact, agreeing to leave 1.5 mafy in the river for Mexico.[27] When water flows are high, each sub-basin gets its full Compact apportionment and Mexico's water comes from the surplus.[28] Unfortunately, both the Compact and the treaty were vague regarding how much water each basin must send to Mexico from its share during a shortage.[29] Because of that vagueness, it is uncertain how much of Mexico's water the Upper Basin legally owes at Lee Ferry in any particular year. The amount could vary between nothing and over 800,000 af.[30] Since the 1970s, however, the river has been operated as though the Upper Basin owed half of the Mexican treaty obligation,[31] which seems to

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[26] 1922 Compact, art. VII. The Supreme Court has decreed that the Compact term "present and perfected rights" means "a water right in accordance with state law… [with] actual diversion of a specific quantity of water" irrigating "defined" land, municipal or industrial works;" and federal reserved rights (such as tribal rights) regardless of whether the water was put to use. State of Arizona v. State of California, 376 U.S. 340, 341 (1964). However, this Supreme Court decision was technically an interpretation of the Boulder Canyon Project Act (BCPA), not the 1922 Compact, and thus is not binding when a situation isn't bound by the BCPA (such as a Compact call in the Upper Basin). The opinion does, however, hint at the decision the Supreme Court would be most likely to deliver *if* asked to interpret the CRC: that water physically in use under a valid state water right by June 25, 1929 is not subject to Compact curtailment.

[27] Utilization of the Waters of the Colorado and Tijuana Rivers and of the Rio Grande, Treaty Between the United States of America and Mexico, U.S.-Mex., Feb. 3, 1944, T.S. 994, art. 10(a) [hereinafter Treaty]. An exception removes the 1.5 maf minimum during "extraordinary drought," Treaty, article 10(b), but that term was not defined and has never been invoked; it may be inadministrable.

[28] 1922 Compact, art. III(c).

[29] Eric Kuhn, *Risk Management Strategies for the Upper Colorado River Basin* 2 (Jan. 2, 2012), http://www.riversimulator.org/Resources/Purveyors/DraftRiskMgtStrategiesUCRBKuhn2011.pdf.

[30] Eric Kuhn and John Fleck, *The Upper Basin, Lower Basin, and Mexico: Coexisting on the Post-2026 Colorado River,* Working Paper 2019-2, pp. 4-5, available at http://www.inkstain.net/fleck/wp-content/uploads/2019-06-09_SBDWP_2019-02.pdf) (the extra 50,000 afy (bringing 750,000 afy to 800,000 afy) is to cover the water lost in transit, due to evaporation and leakage, from Lee Ferry to the Mexican delivery point).

[31] *Id*. at 4.

be the most plausible interpretation of the Compact[32] and treaty. There is currently no indication that this practice is about to be discontinued, and so approximately 723,000 afy, or 7.23 maf every ten years, is added to the Lee Ferry flow obligation for a likely minimum requirement of 82.3 maf every ten years for the foreseeable future. That leaves even less water for the Upper Basin in the event of long-term drought.

E. Upper Colorado River Basin Compact

In 1948, the states of the Upper Basin made the Upper Colorado River Basin Compact (UBC).[33] Unlike the Lower Basin, which parceled out its water in acre-feet,[34] the Upper Basin divided its water among states by percentages. Of whatever is left after the Lower Basin and Mexico get their water, Arizona gets a flat 50,000 afy and then of the remainder Colorado may deplete[35] 51.75%, New Mexico 11.25%, Wyoming 14%, and Utah 23%.[36] Water losses due to reservoir storage (evaporation, leakage) are split between states according to which states use that reservoir's water.[37] Reservoir evaporation is a major water user, eliminating at least 500,000 afy from the Upper Basin's water supply.[38]

The UBC also created the Upper Colorado River Commission (UCRC) to administer the Compact. UCRC is charged with, among other things, calculating the amount of water each state

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[32] The Upper Basin's argument that perhaps it need not provide half the Mexican treaty water is a "glimmer of hope" that "likely would be snuffed out by the materials favoring the Lower Basin's position." COLORADO RIVER RESEARCH GROUP, OBLIGATIONS REGARDING THE DELIVERY OF WATER TO MEXICO, pp. 64-65, available at http://www.waterpolicy.info/wp-content/uploads/2015/09/Obligations-Regarding-the-Delivery-of-Water-to-Mexico.pdf

[33] Upper Colorado River Basin Compact, ch. 48, 63 Stat. 31 (1949) [hereinafter UBC].

[34] Boulder Canyon Project Act, 43 U.S.C. § 617 (1929).

[35] UBC art. III(b)(1) (explaining that the apportionment figures in the UBC refer to depletions, not diversions). With depletions, the water is completely removed from from the terrestrial water system, but with diversions some of the water may flow back to the stream after partial use, as is common in irrigation systems).

[36] *Id*. at art. III(a).

[37] UBC, art.V(a)-(b).

[38] UPPER COLORADO RIVER DIVISION STATES: CURRENT AND FUTURE DEPLETION DEMAND SCHEDULE 1 (2016), http://www.ucrcommission.com/RepDoc/DepSchedules/CurFutDemandSchedule.pdf.

owes downstream in order to comply with the Lee Ferry flow obligation of the 1922 Compact.[39] The UBC sets up a two-stage system in which states that have overrun their percentage apportionment must take the first cuts,[40] then each state takes cuts in proportion to their previous year's use.[41] However, water rights perfected before November 24, 1922 (one of the two possible pre-Compact deadlines) are not counted in this equation,[42] and thus once again states have an incentive to preserve pre-Compact water rights because their use lessens the amount of water that the state would have to contribute to make up a shortage.[43] After UCRC identifies the total amount each state must contribute, state governments administer in-state water cutoffs as necessary, according to state law.

F. Adapting to Scarcity

The threat of cutoffs increased after the year 2000, which began several years of record-breaking low flows. Spurred to action, in 2007 the basin states and Reclamation approved the Interim Shortage Guidelines (ISG), which established rules to coordinate the levels of Lakes Powell and Mead in times of increasingly short water supply. A shortage condition occurs when less than 7.5 maf will be available for release from Lake Mead to Lower Basin users the next year.[44] A formal shortage declaration triggers mandatory water cuts in the Lower Basin and

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[39] UBC, arts. IV, VIII(d)(8).

[40] *Id*. at, art. IV(b). The interpretation of this provision, as it has never been used, is not entirely settled, but this version seems mostly likely. *See* Ann Castle and John Fleck, *The Risk of Curtailment under the Colorado River Compact,*10 (November 8, 2019), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3911652. [Hereinafter "Risk of Curtailment"].

[41] 1922 Compact, art II.

[42] UBC, art. IV(c).

[43] The State of Colorado has already incorporated this concept into their water rights administration strategy. See, e.g., Heather Sackett, *State Engineer Gives Oldest Water Rights Extra Protection*, Post Independent, July 5, 2020, https://www.postindependent.com/news/local/state-engineer-gives-oldest-water-rights-extra-protection/.

[44] U.S. DEP'T OF THE INTERIOR, RECORD OF DECISION, COLORADO RIVER INTERIM GUIDELINES FOR LOWE BASIN SHORTAGES AND COORDINATED OPERATIONS FOR LAKE POWELL AND LAKE MEAD 5 (2007), http://www.usbr.gov/lc/region/programs/strategies/RecordofDecision.pdf [hereinafter ISG ROD]; Agreement Concerning Colorado River Management and Operations (Apr. 23, 2007), http://www.usbr.gov/lc/region/programs/strategies/DEIScomments/State/ BasinStates.pdf. This agreement appears as attachment A of the linked document.

Mexico.[45] The ISG also contained measures to keep Lake Powell levels up during a shortage, trying to keep the Upper Basin in compliance with the Compact's Lee Ferry flow obligation.[46]

The ISG was not, however, enough to keep reservoirs from dropping further, so in 2019 the Basin states signed the Drought Contingency Plan (DCP), which increased the size of the Lower Basin and Mexico's cuts.[47] In December 2021, after another dire set of predictions from Reclamation, the Lower Basin states and several tribes agreed to yet another round of cuts.[48]

The DCP also committed the Upper Basin states to action if Lake Powell was in danger of dropping below critical levels.[49] These provisions were triggered in the summer of 2021.[50] The Upper Basin states committed to creating a formal Demand Management (use reduction) program to lessen the likelihood of formal shortages, though this program contains no mandatory cuts and is still in its infancy as of 2021.

Nothing in the ISG or DCP affects the Upper Basin's Compact obligation to allow at least 75.0 maf per decade, plus up to half the Mexican apportionment of up to 825,000 afy, to pass Lee Ferry.[51] The Upper Basin DCP is expressly aimed at ensuring that this obligation is not violated.

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[45] *ISG ROD* at 6; 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.

[46] (As embedded within several other laws and policies, particular Section 602 of the Colorado River Basin Project Action and the Long Range Operating Criteria).

[47] AGREEMENT CONCERNING COLORADO RIVER DROUGHT CONTINGENCY MANAGEMENT AND OPERATIONS ("COMPANION AGREEMENT") (2019), available at https://www.usbr.gov/dcp/docs/final/Attachment-B-LB-DCP-Agreement-Final.pdf.; 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.

[48] Brandon Loomis, A*rizona joins Nevada, California and Tribes in a Pledge to Slash Colorado River Water Use,* ARIZONA REPUBLIC, Dec. 15, 2021, https://www.azcentral.com/story/news/local/arizona-environment/2021/12/15/facing-mandatory-cutbacks-arizona-pay-users-save-more/8918026002/.

[49] Agreement for Drought Response Operations at the Initial Units of the Colorado River Storage Project Act 7-10, https://www.usbr.gov/dcp/docs/final/Attachment-A1-Drought-Response%20Operations-Agreement- Final.pdf. 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.

[50] Luke Runyon, *Colorado River Basin Reservoirs Begin Emergency Releases to Prop Up a Troubled Lake Powell*, FOUR CORNERS PUBLIC RADIO, July 6, 2021, https://www.ksut.org/2021-07-16/colorado-river-basin-reservoirs-begin-emergency-releases-to-prop-up-a-troubled-lake-powell.

[51] ISG ROD at 4.

The ISG and DCP provisions expire in 2025 or 2026,[52] and basin stakeholders are poised to write successor agreements. As dropping reservoir levels demonstrate, these programs are "already acknowledged to be insufficient to address the overall imbalance" between supply and demand in the Colorado River system.[53]

G. Summary

The Colorado River Compact sets up a situation, perhaps unintentional at the time, which leaves the Upper Basin to shoulder by far the lion's share of a major long-term drought. So far, a combination of higher flows and a less fully developed Upper Basin have cushioned the Upper Basin from this aspect of the Compact. Without major changes to the law, the Upper Basin cannot allow the ten-year average flow at Lee Ferry to drop below 8.25 mafy,[54] regardless of what this means for the Upper Basin's supply and demand balance. If the Upper Basin states wish to avoid sudden, federally enforced water curtailment, then they must pursue demand management and pre-Compact rights transfer programs far more aggressively. They must start now, because water levels have continued to drop as fast as the grimmest edge of science's water supply predictions.

III. Supply and Demand

On August 16, 2021, the Secretary of the Interior declared the first-ever formal water shortage over the entirety of the Colorado River system.[55] Though a milestone, the event was not

[52] *Id*. at 56.
[53] *Risk of Curtailment at* 41.
[54] XXXXXXXX
[55] By Josh Lederman and Kailani Koenig, *Feds declare first Colorado River shortage, order water cuts for 2022, NBC News, Aug. 16, 2021,* https://www.nbcnews.com/politics/politics-news/feds-declare-first-colorado-river-shortage-order-water-cuts-2022-n1276934.

a surprise—any resident of the West can see accelerating aridity etched in the landscape and confirmed in the headlines. While the population of the Upper Basin grows fast, the average annual flow of the river shrinks as fast as predictions can track reality. The discussion below explores the interaction between the flows of the past, the river system's ongoing diminishment, and the Upper Basin's hopes for future expansion.

A. Supply

The 1922 Colorado River Compact incorporated a hidden assumption, based on limited monitoring during a short wet period, that the river system could provide at least 17.0 mafy at Lee Ferry—[56] a flow the river has rarely matched again. This is often characterized as bad luck, leading unwitting leaders into overestimating the basin's water supply.[57] However, historical research tells a different story: that Compact-era scientists knew that the river's long-term flows were much smaller, but the Compact framers deliberately ignored facts that didn't fit their hopes for the growth of the West.[58]

[56] "Based on my reading of the compact minutes, I'm convinced that the negotiators believed that there was at least 17 million acre feet per year of natural flow at Lee Ferry and between 20 and 22 million acre feet per year of natural flow of the Colorado River." Eric Kuhn, *How Much Water,* COLORADO RIVER DISTRICT 22 (source no longer available).

[57] *See*, e.g., MARC REISNER, CADILLAC DESERT: THE AMERICAN WEST AND ITS DISAPPEARING WATER, 124-25 (1986).

[58] John Fleck, *Taking Climate Change Seriously on the Colorado River: a Practical Step,* INKSTAIN.NET, May 27 2021, http://www.inkstain.net/fleck/2021/05/taking-climate-change-seriously-on-the-colorado-river-a-practical-step/; s*ee also* ERIC KUHN AND JOHN FLECK, SCIENCE BE DAMMED: HOW IGNORING INCONVENIENT SCIENCE DRAINED THE COLORADO RIVER (2021).

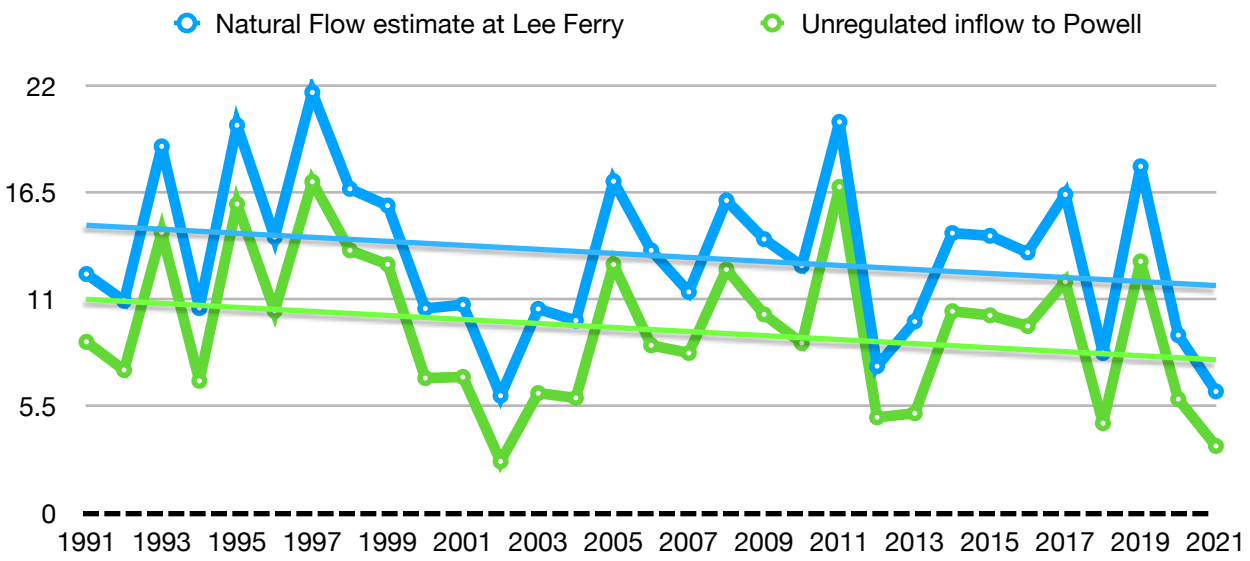

Fig. 2. Lee Ferry flows since 1991, with trendlines. (Sources: Author-made graphic, UCRC 76th annual report for data).

After the Compact was enacted, Colorado River flows varied greatly but rarely matched Compact era estimates; the average annual Lee Ferry flow of the 20th Century was approximately 15 mafy.[59] Serious trouble began in the year 2000, the start of the ongoing Millennium Drought. In 2021, the 10-year average natural flow at Lee Ferry dropped below 12.0 mafy, making current flows "unprecedented in the gauged record."[60] From dangerously overflowing in the 1980s, in 2022 Lake Powell will drop to the point of endangering its power generation capacity.[61] After subtracting the slowly growing volume of water that the Upper Basin and its sunlit reservoirs consume every year, the 2000-2021 average "unregulated inflow" into Lake Powell was 8.44 mafy,[62] getting close to the minimum 8.25 mafy (on average) owed

[59] UPPER COLORADO RIVER COMMISSION, SEVENTY-SECOND ANNUAL REPORT OF THE UPPER COLORADO RIVER COMMISSION, pp. 42-46, Tables 7 and 8 (2020), http://www.ucrcommission.com/wp-content/uploads/2021/06/UCRC-WY2020-Annual-Report-Final-June-10-2021.pdf.

[60] *Hot Drought* at 7; BUREAU OF RECLAMATION, 24-MONTH STUDY (August 2019), https://www.usbr.gov/lc/region/g4000/24mo/index.html.

[61] Emma Newburger, *Lake Powell Hydropower at Risk as Water Levels Plunge Say BLM*, CNBC (Sep. 3, 2021) https://www.cnbc.com/2021/09/23/lake-powell-hydropower-at-risk-as-water-levels-plunge-says-blm.html.

[62] BUREAU OF RECLAMATION, 24-MONTH STUDY (MAY 2021) 7; plus adding 3.502 unregulated inflow for WY 2021 from the Dec 2021 24-month study, https://www.usbr.gov/uc/water/crsp/studies/24Month_12.pdf

downstream, with nothing left to refill the reservoir.[63] Even if it gets no worse, if it it gets no better there is almost no capacity for the Upper Basin to expand its water use.

The Bureau of Reclamation reports that up to this point, "demands are largely met as a result of the considerable amount of reservoir storage capacity."[64] But by April 2022, Lake Powell's storage will have dropped to 5.379 maf, its elevation at 3,515 feet.[65] The water stored in the two largest reservoirs could be below usable levels after two to three more years of flows like 2021's.[66]

While current conditions are extreme, it has been decades since anyone thought the river's volume matched the Compact's assumptions. By the 1990s, studies of fossilized trees indicated that the long-term average precipitation in the basin was far below the early 20th century average.[67] On the heels of that unpleasant news came the high temperatures, stunningly low flows and emptying reservoirs of the Millennium Drought. Trying to make sense of it, much work has gone into predicting long-term supply at Lee Ferry.

In 2012 the Bureau of Reclamation, joined by the seven basin states, published the "Basin Study."[68] This study's goal was to assess "water supply and demand imbalances [in the Colorado

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[63] If the Upper Basin continues to be responsible for half the Mexican apportionment as well as transit losses of that water to the Mexican delivery point.

[64] BUREAU OF RECLAMATION, COLORADO RIVER BASIN SECURE WATER ACT SECTION 9503(C) REPORT TO CONGRESS 2, Mar. 2021, https://www.usbr.gov/climate/secure/docs/2021secure/basinreports/ColoradoBasin.pdf.

[65] BUREAU OF RECLAMATION, 24-MONTH STUDY (DEC. 2021) 7, https://www.usbr.gov/uc/water/crsp/studies/24Month_12.pdf

[66] As this paper is being completed, the Lower Basin states have announced another round of cutbacks to their water consumption totaling 500,000 acre feet, in order to preserve the cushion of water stored in Lake Mead. This does not, however, change the amount of water that the Upper Basin must release past Lee Ferry.

[67] BUREAU OF RECLAMATION, COLORADO RIVER BASIN WATER SUPPLY AND DEMAND STUDY PUBLIC WEBINAR, OVERVIEW OF FINAL STUDY REPORT 10 (January 25, 2013) https://www.usbr.gov/lc/region/programs/crbstudy/WebinarJan2013.pdf [hereinafter "Webinar"].

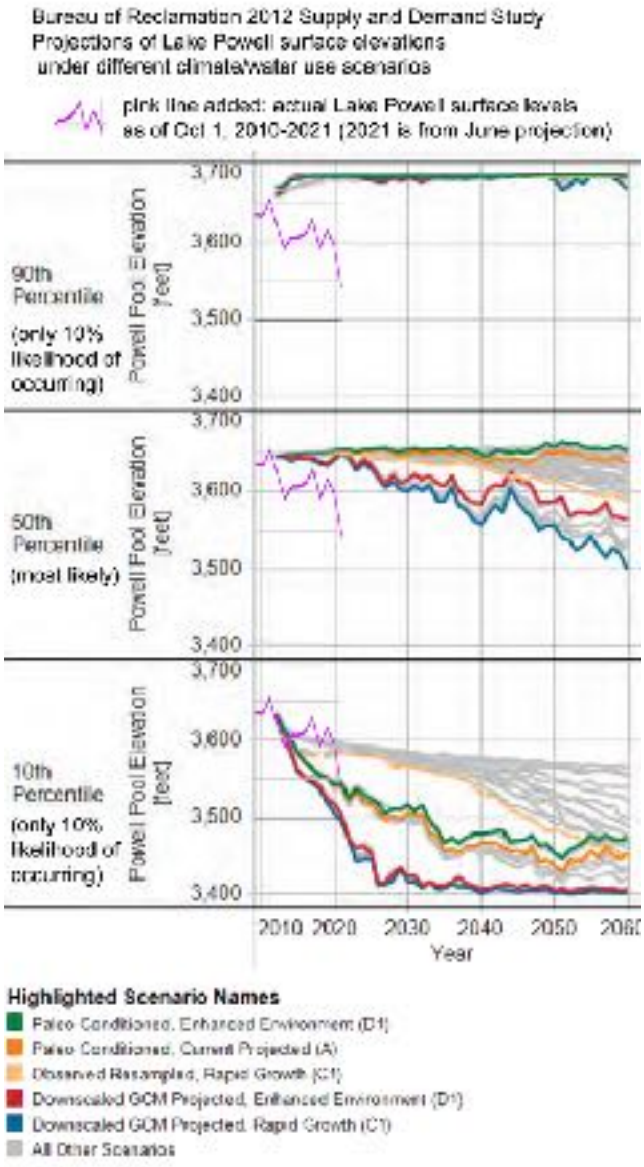
[68] Formally Titled the "Colorado River Basin Water Supply and Demand Study," U.S. BUREAU OF RECLAMATION, COLORADO RIVER BASIN WATER SUPPLY AND DEMAND STUDY, http://www.usbr.gov/lc/ region/programs/crbstudy/finalreport/Study%20Report/CRBS_Study_Report_FIN AL.pdf [hereinafter BASIN STUDY].

River Basin] over the next 50 years."[69] The Basin Study is still extremely influential in water planning efforts basinwide, and its methodology deserves further scrutiny. The Basin Study delivered what was, at the time of its release, a shocking verdict: if the Upper Basin continued to expand as planned, and water supplies continued to drop further below the Compact's hidden estimate, by 2060 demand would exceed supply by about 3.2 mafy.[70]

The Basin Study's most well known estimate of future Lee Ferry average flow[71] comes from four numbers: measured historical flow, two tree ring study flow estimates, and a climate change flow projection of 13.59 mafy.[72] The median of those numbers gave an estimate of 14.8 mafy at Lee Ferry. This is the number that the State of Utah uses to justify its efforts at increasing water use.

However, since 2012, the numbers have often fallen well below the predictions in the Basin Study. For example, actual Lake

Figure 3.



[69] Webinar at 3.

[70] BUREAU OF RECLAMATION, COLORADO RIVER BASIN WATER SUPPLY AND DEMAND STUDY PUBLIC WEBINAR, OVERVIEW OF FINAL STUDY REPORT 10 (January 25, 2013). Available at https://www.usbr.gov/lc/region/programs/crbstudy/FactSheet_June2013.pdf.

[71] Webinar, *supra* note 66 at 7.

[72] BUREAU OF RECLAMATION, COLORADO RIVER BASIN WATER SUPPLY AND DEMAND STUDY PUBLIC W

Powell levels have been far below the Study's projections. (see Figure 3)[73] and as of 2021, the ten-year average natural flow at Lee Ferry is just below 12.0 mafy.[74] The scientific community has widely criticized the Basin Study and Reclamation's later flow estimates as too high, prompting statements like "our work, as well as [the] larger body of literature, appears to be at odds with the recent Reclamation projections for the Colorado River Basin, which are widely cited and used."[75] Several studies have cast light on why Reclamation's numbers have not been accurate.

The future water supply of the Colorado River system depends primarily on two factors: precipitation and temperature. Precipitation's influence is obvious: rain and snow fall and make their way into rivers. High temperatures, however, decrease water availability even after it falls: moisture evaporates out of soils, from snowpack, and from vegetation before it can flow into streams and groundwater.[76]

The studies found that "high temperatures alone," even with normal precipitation, "can lead to anomalously dry conditions."[77] When the temperature rises, a year with average precipitation will have below average river flows, and low-precipitation years will bring droughts more severe than the basin's systems are designed to handle. Recent conditions have borne out this analysis: in water year 2020, for example, the Upper Basin received 107% of the

[73] In the Basin Study, Lake Powell dipped below 3560 feet elevation between May and September before 2027 in only 26% of 2012 Study scenarios, and 8% of the years in those scenarios. This occurred in July 2021. Powell is projected to drop to 3516 elevation in April 2022. BUREAU OF RECLAMATION, 24-MONTH STUDY (December 2021).
[74] As of BUREAU OF RECLAMATION, 24-MONTH STUDY (August 2019).
[75] *Hot Drought* at 16.
[76] *Hot Drought* at 8.
[77] *Id*.

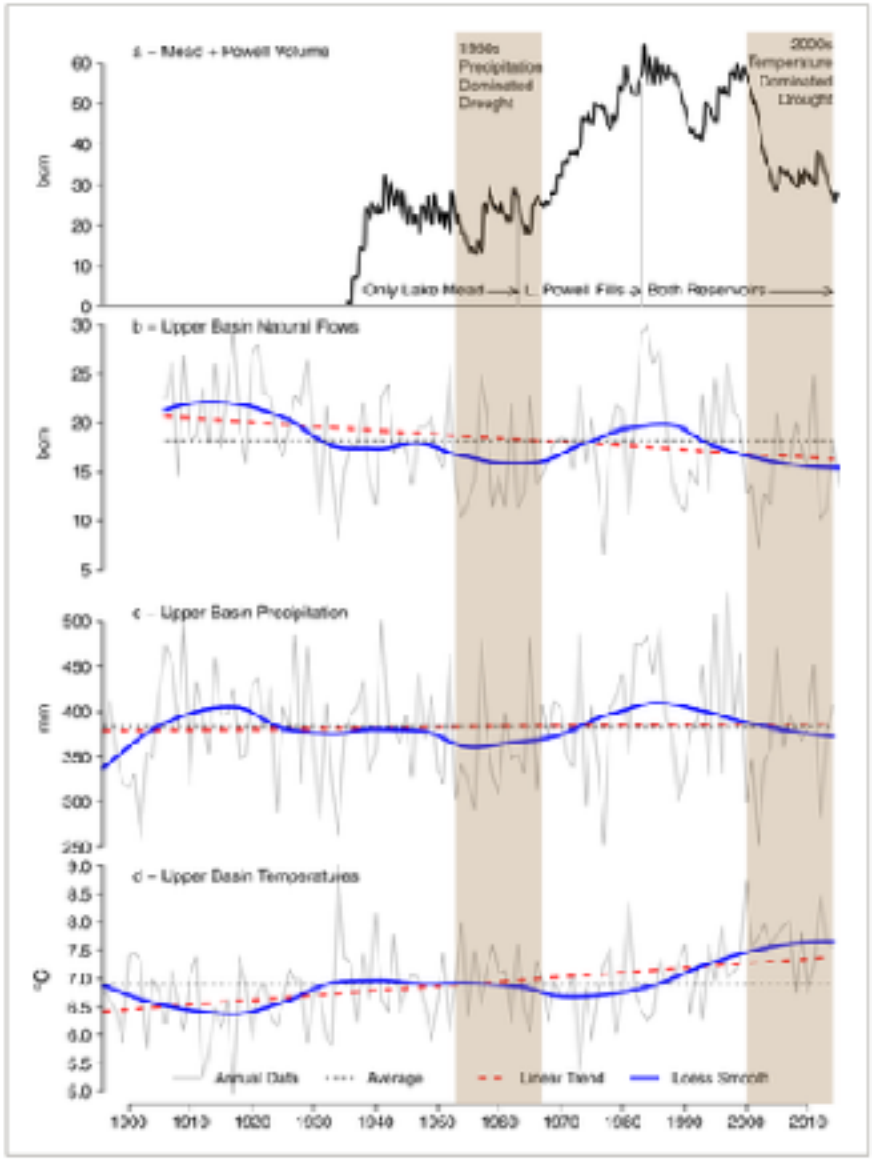


Figure 4. "(a) Lakes Mead and Powell combined monthly contents. Upper Basin annual Colorado River (b) runoff at Lees Ferry from 1906 to 2014, (c) precipitation and (d) temperatures from 1896 to 2014. Mead first filled in 1935, Powell in 1963."

(Source: Udall and Overpeck, Hot Drought (Fig. 2 in original)).

average snowpack, but the snowmelt runoff was 52% of average "due to extremely hot and dry conditions in the Upper Basin during the spring and summer of 2020."[78]

[78] *Statement on the Bureau of Reclamation's August 24-Month Study*, ARIZONA WATER NEWS, AZ DEPT OF WATER RESOURCES, August 14, 2020, https://azwaternews.com/2020/08/14/statement-on-the-bureau-of-reclamations-august-24-month-study/.

The scientific community has run numerous models to predict future temperatures and precipitation levels in the basin. In those models, precipitation levels vary widely, from a slight increase to a notable decrease. Temperature predictions, however, are fairly consistent: basin temperatures have risen and will continue to do so.[79] In a major report in 2017, scientists Udall and Overpeck found that Reclamation's relatively optimistic flow predictions relied on speculative precipitation increases to make up for an almost certain increase in evaporation rates.[80] However, the "[l]arge precipitation increases necessary to offset substantial temperature-induced flow decreases appear unlikely to occur."[81]

If Reclamation's flow projections are wrong, what are the right ones? How much will temperature increases reduce river flows at Lee Ferry? Udall and Overpeck found that the Millennium "hot drought" owed 30-50% of its reduction in flow to temperature increase, and the rest to lack of precipitation.[82] In the future, the study concluded, "warming will drive temperature-induced declines in river flow, conservatively −20% by midcentury and −35% by end-century, with support for losses exceeding −30% at midcentury and −55% at end-century."[83]

Another study, published in February 2021 by Utah State University's Center for Colorado River Studies, agreed that the public is "falsely comforted" by Reclamation's "standard" use of 14.8 mafy for planning purposes.[84] That flow, which is the 1906-2008 average, is "an amount that climate science concludes is unlikely to occur in the future."[85]

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[79] See Figure 4, excerpted from *Hot Drought* at 2407.
[80] *Hot Drought* at 18.
[81] *Id*.
[82] *Hot Drought* at 8.
[83] *Hot Drought* at 1 (Abstract).
[84] Center for Colorado River Studies at Utah State University, Alternative Management Paradigms for the Future of the Colorado and Green Rivers 33 (Feb. 5, 2021), https://qcnr.usu.edu/coloradoriver/files/WhitePaper_6.pdf. [Hereinafter "White Paper 6"].
[85] CITE

The studies continued to emerge. In May 2021, *Science* published an article by Milly and Dunne, pegging evaporation at the high end of Udall and Overpeck's numbers. They estimated that Lee Ferry flow was already lowering by 9.3% for every degree Celsius of warming.[86] The study supported Udall and Overpeck's assertion that, barring a "major and unprecedented change [increase] in precipitation,"[87] "flows are unlikely to return to the twentieth

Predicted temperature-caused flow reductions at Lee Ferry			
	2050	**2036-2065 average**	**2100**
Udall and Overpeck (2017)*	17-27% drop 10.95-12.45 mafy supply		25-35% drop 9.75-11.25 mafy supply
Milly and Dunne (May 2021)**		14-31% drop 9.98-12.44 mafy supply	

Fig. 5 Predicted temperature-caused flow reductions at Lee Ferry
* Using those temperatures, Udall and Overpeck predicted that, due to temperature increase alone, Lee Ferry flows would drop 17-27% by 2050 and 25-35% by 2100 (from the 20th century average). This means, assuming no drop in precipitation, average flows of 12.45-10.95 mafy by 2050, and 11.25-9.75 mafy by 2100.
** The 2021 Milly and Dunne study found that, measured against the 1913-2017 average flow, average annual flow from 2036-2065 would decline 14-26% in the lower-emissions scenario and 19-31% in the higher-emissions scenario. Again, assuming fairly stable precipitation, 2036-2065 average flows would fall between 12.44 maf and 9.98 mafy. Milly and Dunne, p. 1255.

century averages"[88] of 15 mafy at Lee Ferry. Milly and Dunne concluded that "an increasing risk of severe water shortages is expected."[89]

[86] P. C. D. Milly and K. A. Dunne, *Colorado River Flow Dwindles as Warming-Driven Loss of Reflective Snow Energizes Evaporation,* 367 SCIENCE, 1252-1255 (February 20, 2020). [Hereinafter "Flow Dwindles"].
[87] *Hot Drought* at 14.
[88] *Hot Drought* at 18-19.
[89] P. C. D. Milly and K. A. Dunne, *Colorado River Flow Dwindles as Warming-Driven Loss of Reflective Snow Energizes Evaporation,* 367 SCIENCE, 1252-1255 (February 20, 2020).

How severe? A lot of it depends on temperature. Reclamation's Basin Study used a prediction that the Upper Basin would warm 2.7ºC by 2050 and between 3.6-5.4ºC by 2100.[90] Using those numbers, the different studies predicted notable reductions in Lee Ferry flows.

All told, the best currently available science tells us that, in the near future, the Colorado River Basin will experience average Lee Ferry flows somewhere between 9.75 mafy and 12.45 mafy. This is far from 14.8 or 14.0 mafy, the numbers that Reclamation and the State of Utah have been using to plan growth in the demands placed upon the river system.

B. Demand

A 2021 study from the USU Center for Colorado River Studies asserted that growth in Upper Basin water demand is a "more important determinant of the sustainable management of the Colorado River" than flow loss, over which water managers have little control.[91] The Upper Colorado River Commission, using data provided by the states, estimates that the Upper Basin depleted 5.056 maf of water in 2016 (its most recent published estimate).[92] The Bureau of Reclamation pegged it considerably lower, estimating 2016 depletions at 4.366 maf and 2018's at 4.817 maf.[93] Reclamation's current use estimates are always lower than UCRC's, and neither explains the discrepancy, though Reclamation's methodology is more transparent.

UCRC's estimate includes a "demand schedule" showing the Upper Basin's anticipated growth in water use. UCRC's document shows Upper Basin water use growing to approximately

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[90] *Hot Drought* at 10. The range of warming by 2100 depending upon the level of future greenhouse gas emissions.

[91] White Paper 6 at 33.

[92] UPPER COLORADO RIVER DIVISION STATES, CURRENT AND FUTURE DEPLETION DEMAND SCHEDULE, UPPER COLORADO RIVER COMMISSION, December 31, 2016, available at http://www.ucrcommission.com/RepDoc/DepSchedules/CurFutDemandSchedule.pdf [hereinafter known as "2016 DEMAND SCHEDULE"]

[93] U.S. BUREAU OF RECLAMATION, PROVISIONAL UPPER COLORADO RIVER BASIN CONSUMPTIVE USES AND LOSSES REPORT 2011–2015 at 18 tbl.UC-8 (2016), http://www.usbr.gov/uc/library/envdocs/reports/crs/pdfs/cul2011-15prov.pdf.

6.0 mafy by 2060 or 2070.[94] 6.0 mafy is approximately what would be available to the Upper Basin under Reclamation's long-term supply projection of 14.8 mafy at Lee Ferry.[95]

The USU study, however, calls UCRC's predictions "aspirational,"[96] claiming that despite major population growth in the Upper Basin, its water use has barely grown since the late 1980s.[97] This is likely due to some combination of conservation measures and the conversion of irrigated agricultural land to development. If urban areas continue to convert irrigated land (rather than undeveloped land), and water managers vigorously pursue urban conservation measures, it may be some time before the Upper Basin needs significantly more water to fuel its growth.[98] However, two factors outside government control may add a non-negligible amount of water demand to the Upper Basin: rising temperatures and the use of tribal water rights.

Increased evaporation rates due to rising temperatures bolster water demand. The same plants require more water in a hotter climate. Hotter weather also extends the irrigation season, which may increase crop yields but requires more annual water. This is also true for irrigation

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[94] 2016 DEMAND SCHEDULE; UPPER COLORADO RIVER DIVISION STATES CURRENT AND FUTURE DEPLETION DEMAND SCHEDULE, UPPER COLORADO RIVER COMMISSION, December 12, 2007 available at http://www.ucrcommission.com/RepDoc/DepSchedules/CurFutDemandSchedule.pdf.

[95] This is assuming that the Upper Basin continues to contribute half of Mexico's share. Rough calculations for a flow of 14.8 mafy: The Lower Basin gets 7.5 mafy and Mexico gets .75 mafy, totaling 8.25 mafy at Lee Ferry. Lake Powell loses approximately .5 mafy through evaporation. 14.8-8.75=6.05 mafy.

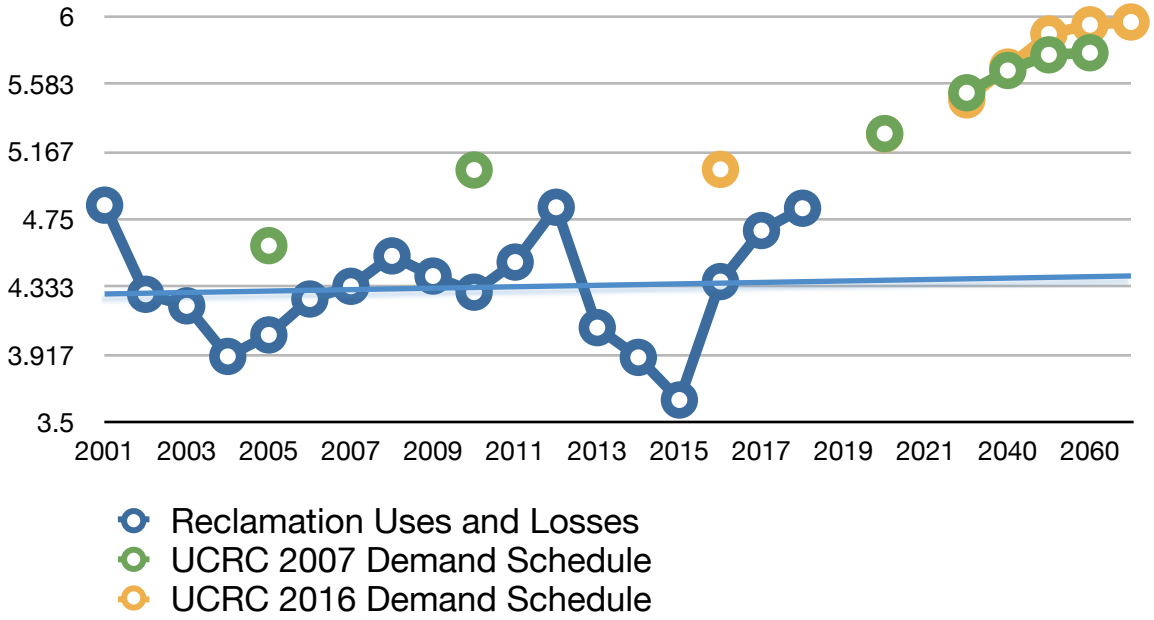
[96] White Paper 6 at 36.

[97] White Paper 6 at 13, 29, 77.

[98] Flattening demand should not make water managers complacent that water need not limit urban growth, however. Using conservation to fuel growth presents a serious long-term problem: "demand hardening." Let's say small farming town of 500 people has access to 1,000 acre-feet of water per year. They use that full amount, 20% of it for indoor use and 80% of it for irrigating alfalfa. In a drought year, if only 800 af of water is available, the farmers fallow some fields. It's hard on their incomes, but is not life-threatening or a disaster—the solution is relatively simple to manage. Let's say, however, that the town's population grows, and it retires its fields to be covered with hyper-efficient apartment buildings and commercial centers. The town grows to 10,000 people, each one taking short showers; the one small farm left, which is the only local source of fresh produce, uses the least amount of water possible. The town was able to grow its population 20 times its original size by being a model of water efficiency. Now, 900 afy is used for efficient essential purposes, and only 100 af is used for irrigation. Then, a drought comes and never leaves, and the supply drops to 700 afy. This efficient town is now facing a disaster because they have cut all the soft water demand—there is nothing to easily eliminate. Water managers need to be extremely careful about using the ability to lessen per capita water demand as a justification for endless growth. A gallon of water used for drinking is not the same animal as a gallon used on a large, easily abandoned lawn.

needs in urban areas. Denver Water, for example, estimated that due to rising temperatures its water demand may increase 6% just to serve existing uses.[99] The demand increase percentage for

Fig 5: Upper Basin current water use and future demand



agriculture, which uses the vast majority of the water in the Upper Basin, might be even higher, since all of that is temperature-reactive outdoor use. A mere 6% increase would add approximately 300,000 afy to Upper Basin demand.

The Upper Basin's demand calculus must also take unused tribal water into account. Upper Basin tribes have claims to approximately 1.823 mafy of Colorado River system

[99] Eric Kuhn, *How Much Water* at 106, citing Betsy Woodhouse, *Climate Change Through the Eye of Water Managers*, SOUTHWEST HYDROLOGY MAGAZINE, January /February 2007, page 22 (discussion on Waage efforts at Denver Water).

diversions.[100] Of that amount, approximately[101] 1.38 mafy are legally confirmed rights, and .45 mafy are unresolved claims.

However, great deal of tribal water, even in confirmed rights, is not currently in use[102]—it would not be counted in Reclamation's or UCRC's current use figures. Upper Basin tribes currently divert 672,964 afy, with 432,071 afy of depletion.[103] That leaves 1.15 mafy of established or credibly claimed diversion rights unused. The depletion associated with this is an unknown factor—if used for irrigation it could be as low as 50%, and for municipal uses it could be closer to 100%. Tribal water rights, therefore, represent something in the neighborhood of 600,000 afy (very roughly) of unused Upper Basin depletions.

Native American tribes might provide their pre-Compact water rights to off-reservation entities, but the law controlling whether tribes can do so is limiting,[104] complex, and varies from tribe to tribe.[105] If a tribe is permitted to sell or lease its water off-reservation, it could provide

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[100] COLORADO RIVER BASIN TEN TRIBES AND BUREAU OF RECLAMATION, COLORADO RIVER BASIN TEN TRIBES PARTNERSHIP TRIBAL WATER STUDY REPORT: STUDY REPORT. December 2018, Ch. 5.11, Fig. 5.11-A, "Current Tribal Water Use and Total Reserved Water Rights including Unresolved Claims in the Upper Colorado River Basin," available at https://www.usbr.gov/lc/region/programs/crbstudy/tws/finalreport.html. [hereinafter TRIBAL WATER STUDY]

[101] This number, though essentially accurate, requires a little explanation. The Ten Tribes Partnership study tallied 1.061 mafy of confirmed water rights and .762 afy of unresolved claims. Since the publication of that study, the Navajo Nation finalized the settlement of their water rights in Utah (https://navajotimes.com/reznews/utah-settles-with-nation-on-water-rights/). Under that agreement, the Navajo Nation can divert up to 435 cfs from the San Juan (which translates to 314,926 afy), or any amount from Lake Powell or groundwater, so long as the total depletions in Utah do not exceed 81,500 afy. TRIBAL WATER STUDY, Table 5.11-A, footnote 3; *Proposed Navajo National Council Resolution; An Action Relating to Resources and Development Committee, and Naabik'iyáti' Committee and the Navajo Nation Council; Approving the Proposed Utah Navajo Water Rights Settlement Agreement*, December 16, 2015 ("Resolution") (http://www.navajonationcouncil.org/pressReleases/2016/Jan/0412-15_Full_Version.pdf). To get the annual diversion estimate, though that number is not actually in the Navajo Utah water rights settlement, I estimated the annual volume of the 435 cfs, the amount of which approximated the unsettled amount of diversion the Ten Tribes Study has assigned to the Utah Navajo. I then shifted that amount from the "unsettled" tally into the "confirmed" tally. The numbers all lined up with other tallies, such as "The Status of Tribal Water Rights in the Colorado River Basin" document, with a small allowance for rounding error, so they appear to be accurate.

[102] Bidtah Becker, et al., THE STATUS OF TRIBAL WATER RIGHTS IN THE COLORADO RIVER BASIN 1 (April 9, 2021), https://www.naturalresourcespolicy.org/publications/policy-brief-4-final-4.9.21-.pdf.

[103] TRIBAL WATER STUDY, Table 5.11-C.

[104] 25 U.S.C. § 177.

[105] See, e.g., Dan McCool, NATIVE WATERS: CONTEMPORARY INDIAN WATER SETTLEMENTS AND THE SECOND TREATY ERA (2006).

junior water users (often growing cities or towns) with a source of senior water rights. If a tribe develops most or all of its unused water on the reservation, it would be an entirely new depletion added to the system, and could result in cutoffs to major junior users in the event of large curtailments. Locality water managers on the lookout for senior water rights should look carefully at tribes whose water rights might lawfully be changed to a local point of use. Tribal water rights, with their very early priority dates, could be an extremely valuable commodity in the event of a curtailment on the Colorado River.

Put together, if not managed correctly, heat-induced demand increase and tribal water rights could add something like 1.0 mafy to Upper Basin demand even without any population growth. Even if Upper Basin water use is now trending flat, Upper Basin water managers will need to deal with these issues to keep demand within supply.

IV. SYNTHESIS: UPPER BASIN

In February 2021, an Utah State University (USU) analysis looked aggregated supply and demand numbers. USU found that if average Lee Ferry flow stayed at the higher predicted level, around 12.4 mafy, Upper Basin use would have to stay below 4.0 mafy and the Lower Basin must maintain its ISG and DCP-mandated cuts to keep Lake Powell and Mead from dropping below 13.0 maf of combined storage. (Reclamation recently predicted that combined storage will fall to 14.0 maf in April 2022).[106] At 10.54 mafy of Lee Ferry average flow, the reservoirs would empty even if the Upper Basin cut its use to 3.0 mafy and the Lower Basin cuts increased to 3.0 mafy.[107]

[106] BUREAU OF RECLAMATION, 24-MONTH STUDY (August 2021), Powell and Mead table figures added together.
[107] White Paper 6: Executive Summary at 6.

Those two scenarios, however, ignore the 75.0 maf decadal Lee Ferry flow requirement in the 1922 Compact and the probable continuation of the Upper Basin's contribution to Mexico. Factoring those in, USU found that if Lee Ferry average flows fall to 11.78 mafy[108] and the Upper Basin continues to deliver 82.5 maf every ten years, "curtailments necessary to cover Compact deficits drop total annual [Upper Basin] uses to less than 2.5 mafy …representing the use of only pre-Compact rights in the Upper Division states."[109]

Utah and Moab, in other words, must start taking a serious look at what Utah water apportionment will look like if only legally defensible pre-Compact rights could provide reliable water. Further, Utah must consider the possibility that even pre-Compact rights are not entirely safe: in such a scenario, interstate water law may revert to prior appropriation between states, meaning that, for example, a challenge from a 1910 water right from Arizona or Colorado could cause the curtailment of a 1911 water right from Utah.[110] While the most important date for current analysis of water reliability is that of the Compact, place like Moab cannot ignore the uncertainties and courtroom conquests that serious near-term water scarcity would trigger.

V. UTAH

A. Supply and Demand in Utah

[108] The "Paleo Tree Ring Drought (1576 resample)" scenario. White Paper 6 at 36.
[109] White Paper 6 at 39.
[110] This gets deeper into the realm of speculation, but is not farfetched: what if Colorado River flows fell so low that the Lower Basin states went after pre-Compact Upper Basin water rights? In a case just barely before the 1922 Compact, *Colorado vs. Wyoming*, 259 U.S. 419 (1922), the Supreme Court extended the concept of prior appropriation to rivers shared between states. The Court held that when states fought over an interstate river, and no other law or interstate agreement ruled how the water was shared, prior appropriation applied across state lines—that the river would be apportioned among users in both states according to priority dates of their water rights, even though those rights originated in different state administration systems. Were Colorado River Basin states to stray into legal territory not governed by the Compact, such as sharing pre-Compact rights between the states, *Wyoming vs. Colorado* appears to be the ruling precedent.

The State of Utah's official, often-repeated position is that Utah has a reliable supply of 1.4 mafy of Colorado River water, leaving ample opportunity for growth.[111] Under existing law, in dry times Utah gets 23% of what water is left after the Upper Basin and Mexico get their 8.25 mafy. For Utah to receive 1.4 mafy, Lee Ferry flows must average approximately 14.0 mafy.[112] This is well above the range of flows predicted by the aggregate of recent science.[113]

Fig. 5: **Water remaining for Utah under predicted flows*** * without considering pre-Compact water rights protections			
	Flow Range		**For Utah** (once Arizona's share and shared reservoir evaporation are removed)
Low end of predictions	9.75 mafy	Water to Mexico	223,100 afy
		No water to Mexico	391,000 afy
High end of predictions	12.45 mafy	Water to Mexico	844,100 afy
		No water to Mexico	1,012,000 afy
Utah's claims	14.0 mafy		1,400,000 afy "annual reliable supply"

[111] *Colorado River Basin Drought Contingency Plans: How they affect Utah, the Colorado River and Drought Planning*, UTAH DEPT. OF WATER RES., 1 (last accessed July 21, 2021). EDIT TO ADD NOTE: Utah has removed many of its claims to 1.4 mafy from its website as of the autumn of 2022, though it is still available on their graphic designer's website at https://lpputah.watermarksmartdesign.com/wp-content/uploads/2020/11/LPP-FactSheet-LPP-and-CO-River-11-2020.pdf. The 1.4 mafy "annual reliable supply"claim is also memorialized, among other places, in the February 2019 press release "The Colorado River is a reliable source of water for Utah, says the Utah Division of Water Resources," available at https://water.utah.gov/the-colorado-river-is-a-reliable-source-of-water-for-utah-says-the-utah-division-of-water-resources/ (last accessed Nov 14, 2022). The press release also contains this quote:

"Modeling conducted by BOR in August 2018, taking into account future water uses in the Upper Basin including the Lake Powell Pipeline, indicates a near 0 percent probability of a declared 1922 Compact shortage for the Upper Basin through the year 2050 presuming hydrology remains similar to what the basin has experienced over the last 100 years. On the other hand, if the future hydrology of the basin is similar to drier, hotter climate change predictions, more closely resembling the last 30 years including historic drought, the risk of a declared 1922 Compact shortage rises to less than 13 percent through the year 2050."

The first declared 1922 Compact shortage occurred in 2021, as noted *supra*.

[112] The amount is approximate because some variables are not known, most importantly the amount of the Mexican apportionment and its transit losses the Upper Basin may have to supply. Utah's share of reservoir evaporation, both in state and main stem, is currently estimated at 23,000+198,950=221,950 afy. UPPER COLORADO RIVER COMMISSION DEMAND SCHEDULE 2016 (UCRC 2016).

[113] See Sections III-IV *supra*.

Reclamation's most recent water use estimates show Utah depleting 1.15 mafy from the Colorado River system;[114] UCRC numbers show the state's demand hitting 1.3 mafy by 2060.[115]

That's the tally of water that would be actually in use; "paper water" tallies are considerably higher. The Utah Division of Water Rights (UDWR) has indexed over 950,000 afy of annual depletion attached to perfected or tribal[116] water rights predating November 24, 1922.[117] UDWR also mentions more than 400,000 afy of pre-1922 depletion rights whose validity needs further investigation.[118] Utah's as-yet-uncounted 1922-1929 water rights would increase the tally, should 1929 be the operative date. The list does not note whether it includes reservoir evaporation, at least 200,000 afy currently,[119] but since most major reservoirs were constructed after the Compact, it may not.[120] That brings Utah's total (claimed[121]) pre-Compact water tally to between 950,000 afy and upwards of 1.45 mafy.

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[114] Reclamation predicts reservoir evaporation from Upper Basin main stem reservoirs at 477,800 afy; Utah is responsible for 23% or 109,894. Bureau of Reclamation, Consumptive Uses and Losses Colorado River Basin, 2016-2020. UCRC shows "shared CRSP evap" at .52 mafy in their 2016 depletion schedule document. 23% of that is 198,950 af. UCRC 2016.

[115] UCRC 2016 AT 1.

[116] The state has offered the Ute tribe a settlement containing 105,000 af of depletion for its late-1800s water rights, which is in this tally, but the Uintah-Ouray Ute Tribes has claimed 152,000 afy in an ongoing lawsuit. TRIBAL WATER STUDY, Table 5.1-G.

[117] *Colorado River Water Rights: Summary of water rights perfected before 11/24/1922*, UTAH DIVISION OF WATER RIGHTS, https://waterrights.utah.gov/distinfo/colorado/WRPriorityDDSummary.asp. (last accessed Dec. 15, 2021). Note: this website lists the Navajo Nation's 81,500 afy as "proposed," but it has since been settled. It is included in this paper's tally of confirmed water rights, as tribal water rights don't have to be perfected through the normal process of "proving up" actual diversion and use.

[118] *Id*.

[119] Shared CRSP evap" is, according to UCRC, .52 mafy. 23% of that is 198,950 af. Reservoir evaporation only lessens if reservoirs dry up or are decommissioned, so in a severe curtailment reservoirs might have to be assigned pre-Compact water rights, which would take them away from senior users.

[120] The state of Colorado, one possible challenger, estimates its pre-Compact (1929) water rights at 1.5-1.75 mafy, a far smaller amount than Utah's claim considering that Colorado gets nearly twice the Colorado River water that Utah does. *Risk Management* at 34.

[121] The Colorado River Compact says that "present perfected rights are unaffected" by the Compact (1922 Compact, Art. VIII). What constitutes a perfected right as of the Compact date is a matter of state law, though the Supreme Court's Special Master report in *Arizona vs. California* (found at 364 U.S. 940) found that a perfected water right must be a defined amount diverted and "applied to a defined area of land or definite municipal or industrial works." Challenging the provenance of pre-1929 or pre-1922 water rights according to each state's internal water laws would be a challenging process, but if by doing so a state could eliminate a sizable chunk of water claims from another state, it would make sense to try. Those seeking to acquire pre-Compact water rights for long-term use should try to be sure that those rights will survive close legal scrutiny.

However, there is some evidence that many of these water rights would not withstand heavy legal scrutiny (to which they would undoubtedly be subject if the Upper Basin became dependent on pre-Company water rights). Utah's numbers may be more a matter of strategy than a defensible tally. The best water rights would remain tribal and federal reserved rights, which have early priority dates and cannot be challenged based on "non-use" (non-diversion). In the late 1920s, the Colorado River Commission estimated that Utah was "probably" using 538,500 afy on irrigation as of 1920.[122] There is no contemporary estimate for municipal or industrial uses in Utah as of the early 1920s, but since there were no major urban or industrial areas in the Utah part of the Basin at the time, and the big trans mountain diversions to the Wasatch Front had not yet been constructed, non-irrigation uses of Colorado River surface water were likely small. Adding a ballpark estimate of 200,000 afy for tribal and federal reserved water rights, This would bring Utah's pre-Compact water rights to just under 750,000 afy.

Under even the most optimistic climate-change scenario, Utah can depend on only 1.015 mafy of Colorado River system water. At the lower end of the range, that number might drop to less than a quarter of a million, meaning that it would need to defend (against other Upper Basin states) its pre-Compact water rights, which may be anywhere from 600,000 to 1.4 million afy. Not only does Utah have no room to expand its system diversions, it will almost certainly need to make cuts, possibly major, to its current use. If Utah does not find a way to use less water (partly by shuffling around the pre-Compact water it has) it may face a mandatory curtailment if the federal government calls on the Upper Basin to send water downstream.

B. Curtailment in Utah

[122] *Risk Management* at 10, citing the minutes of the 6th Annual meeting of the Colorado River Commission.

In the event of a basinwide water shortage, would the state of Utah truly dare to shut off water supplies to major junior users? Because it has never happened on the scale of the Colorado River Basin, it's important to review what the law, and previous state actions, have said or hinted about the process.

First, if the Secretary of the Interior determines that the Upper Basin must cut its water use to comply with the Compact, the Upper Basin must obey (or face a trip to the Supreme Court against the might of the much larger Lower Basin states). The UCRC would, at that point, determine how much water each state must cut according to the rules set in the Upper Basin Compact. Then, it is up to each state to decide how cutoffs must be ordered within that state (so long as they comply with relevant federal law, such as the law prioritizing reservations).[123]

Under Utah law, water cutoffs in time of drought occur according to prior appropriation —the newest water rights are shut down first.[124] The exceptions are first, a temporary emergency of very limited duration;[125] and second, rearrangement of water use priorities within the service area of a water provider, such as a municipality or an irrigation company, which may distribute the water held in its water right(s) according to internal rules. Though the Utah Legislature could change the law to, say, permanently prioritize drinking water regardless of priority dates, it would be a seismic shift in state water law that would involve forcibly taking water from agriculture—not likely in Utah.

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[123] Under the Supremacy Clause of the Constitution (U.S. Const. Art. 6, cl. 2.), state law still must comply with federal law when managing water within the state, assuming that is possible. It is not entirely settled whether Compact flow obligations themselves (which are federal law) trump other federal laws such as the Endangered Species Act or the Clean Water Act. Tribal reserved and other federal reserved water rights cannot be eliminated or diminished by state law.

[124] "Appropriators shall have priority among themselves according to the dates of their respective appropriations, so that each appropriator is entitled to receive the appropriator's whole supply before any subsequent appropriator has any right." Utah Code Ann. § 73-3-21.1(2)(a) (West).

[125] Utah Code Ann. § 73-3-21.1(2)(b) (West).

Utah has not published any analysis of how different Colorado River system shortage levels would affect the dates of water cutoffs. Such a simulation for the State of Colorado concluded that, to cut 300,000 acre-feet from the state's Colorado River system use, the state must completely curtail any water right newer than 1940.[126]

UDWR has not written a generally applicable curtailment process for a large water source. However, in 2014 UDWR administered a call on the Virgin River, providing an example of how a Colorado River Compact call might work within Utah.[127] After a low flow complaint from a senior downstream user, the UDWR began to regulate all water taken out of the Virgin system upstream of his diversion. UDWR sent a notice to every upstream user: diversions with a priority date after December 31, 1900 "must immediately cease use of water." This included "tributary…springs and seeps," which must "be allowed to run [their] natural course."[128] It did not matter how small the diversion, as "[a] junior appropriator" with a "minimal or negligible effect on a senior appropriator" may not "avoid curtailment. No matter how small the effect… the junior right must yield."[129] Only "underground wells and developed springs which have not been shown to directly affect the flow of surface sources" were exempt,[130] indicating that underground sources which *were* shown to affect surface flows might be curtailed. UDWR warned users that it would be "field checking actual practice" and that violators "could be subject to significant fines,"[131] removing hopes that this letter might be a formality. One of the

[126] *Risk Management* at 34.
[127] Letter from Kent Jones, Utah State Engineer, Utah Dept. of Water Rights, to water rights holders on the Virgin River 1 (July 7, 2014) (https://www.stgeorgeutah.com/wp-content/uploads/2014/07/July-7-2014-Utah-Engineers-priority-call-on-Virgin-River-water-rights.pdf).
[128] *Id*.
[129] *Id*. at 2.
[130] *Id*. at 2.
[131] *Id*.

largest cutoffs under this order was two dozen junior water rights belonging to the Washington County Water Conservancy District, one of the most powerful water districts in the state.[132]

Though only one example, the state's approach on the Virgin is consistent with other official statements, including regarding Moab area water rights from the Colorado River. UDWR and San Juan County[133] ("San Juan")[134] relied heavily on the possibility of a curtailment to justify the controversial transfer of a water right, one of the ones at issue in this paper, to the Moab area. In its letter approving San Juan's application, UDWR said that climate models "predict a wide range of future climate conditions" including a more than 30% drop in flow, and that a water right "does not guarantee the applicant water in the future except as may be available…under the respective priority…. Should curtailment under the Compact be necessary," San Juan's water right would be curtailed.[135] However, "the potential of rights to be curtailed is not a reason to deny this [transfer] application."[136]

In a gesture against relying on curtailment, Utah has joined the DCP's Upper Basin "demand management [reduction] program," still in its infancy compared to the robust programs in the Lower Basin. The state, when approving San Juan's 2017 water rights, also mentioned "targeted investment in water conservation."[137] Since agriculture uses by far the most water,[138]

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[132] *Id*. Attachment to letter labeled "Virgin River priority listing."

[133] Letter from William H. Johnston, Chairman, San Juan Spanish Valley Special Service District, to Kent Jones, Utah State Engineer (Mar. 16, 2012) (on file with the Utah Division of Water Rights).

[134] Technically the San Juan Spanish Valley Special Service District (SJSVSSD), a creation of the San Juan County Commission but not San Juan County, applied for the water right change at issue, but for the sake of clarity to non-Moab-area readers, "San Juan" will be used as a stand-in for the SJSVSSD.

[135] Order of the State Engineer, Utah Division of Water Rights, Kent L. Jones on Permanent Change Application Number 09-2349 (a37400) (August 8, 2013) (SEO San Juan Letter 2013) (on file with the Utah Division of Water Rights).

[136] *Id.*

[137] *Id*. at 6.

[138] Non-household agriculture makes up around 72% of Utah's overall water use, which is normal for the American West. *See* https://geology.utah.gov/map-pub/survey-notes/glad-you-asked/does-utah-use-more-water/ (most recently accessed Dec. 15, 2021).

that's where conservation measures can make the most difference. However, when a farmer conserves water, he will not lose part of his water rights—he will sell or lease them. Conservation will not make junior rights more reliable. It will simply make some of the pool of senior rights available for acquisition.

Because irrigation arrived in the West before cities, agriculture holds most of the pre-Compact water in Utah and elsewhere. Under Utah's priority cutoff system, a looming water shortage may prompt a scramble to purchase pre-Compact rights. This future is in line with at least the first and third prongs of the Demand Management program slogan: "voluntary, temporary, compensated."[139]

This analysis is speculative, of course—the state or federal government could change water law as the crisis deepens. However, the firmament of water law in Utah is such that making major changes during a severe drought would be highly controversial, and arguably unfair and impractical. Water rights holders like Moab's should not count on changes to Utah water law to enhance the reliability of junior Colorado River rights.

V. MOAB

All of the previous discussion narrows to the final question: should Moab's water managers rely on their Colorado River water rights? First, however, it's necessary to understand

[139] *Demand Management Feasibility: Protecting Colorado Water,* COLORADO WATER CONS. BOARD*,* found at https://cwcb.colorado.gov/focus-areas/supply/demand-management. (last accessed Dec. 10, 2021).

the nature and context of those rights. Two public water providers in Moab possess unused[140] rights to divert from the Colorado River main stem: Grand Water[141] and San Juan.

Fig. 6 Colorado River Water Rights Held By Moab Entities

Holder	Priority Date (year)	Amount (diversion) in acre-feet	Water right #
Grand	1958	622	05-3163*
Grand	1966	2,220	05-1458**
Grand	1969	8	01-1128***
Grand	1969	147	01-1133****
	Total - Grand	*2,997*	
San Juan	2017	5,000 (2,503 depletion)	09-2349*****

* https://www.waterrights.utah.gov/asp_apps/wrprint/wrprint.asp?wrnum=05-3163
** https://www.waterrights.utah.gov/asp_apps/wrprint/wrprint.asp?wrnum=05-1458
*** https://www.waterrights.utah.gov/asp_apps/wrprint/wrprint.asp?wrnum=01-1128
**** https://www.waterrights.utah.gov/asp_apps/wrprint/wrprint.asp?wrnum=01-1133
***** https://www.waterrights.utah.gov/asp_apps/wrprint/wrprint.asp?wrnum=09-2349

[140] The State of Utah considers these water rights valid despite nonuse because municipal water providers get more time to "prove up" a water right than a private entity, so the rights can be held a long time to "meet the reasonable future water … requirements of the public." Utah Code Ann. § 73-3-12.

[141] The actual owner of the Grand County water right is Grand County Water Conservancy District, but in this paper it will be called by its commonly used name, "Grand Water."

Moab area water providers are currently discussing using these water rights to supply a new secondary water system for the Moab valley.[142] This system would use the Colorado River for irrigation water, saving (the already potentially overtapped[143]) groundwater for indoor use. Moab's fast-moving urban growth is driving this idea—especially the state's plan to develop another city, larger than the City of Moab, on state-owned land in the southern valley.[144] If river water is brought in for irrigation, groundwater would be freed for development. However, building a secondary irrigation water system to pump water 11 miles and over 1,000 feet uphill would be costly. To justify the expense, the system needs a reliable water supply, or it may sit empty for much of its lifetime.

Fig. 7. Map of the Moab area.

How reliable, under current law, are Colorado River water rights with priority dates between 1958 and 2017? The answer, after the foregoing analysis, is actually simple: not very.

If Utah's tally is correct, its pre-1922 water rights total between 950,000 afy and 1.4 mafy—higher if the pre-Compact date is 1929. However, 1.0 mafy is Utah's long-term share of Upper Basin water under the most optimistic climate change scenario modeled by current science (essentially assuming the situation will not, in any decade, get worse than the current 20-year average). If Utah can prove that it has anywhere

[142] According to multiple conversations in 2021 between the author and Moab area officials.

[143] Kate Groetzinger, "Moab's Aquifer May Be Maxed Out, Prompting City To Explore Water Conservation," KUER (February 9, 2021, 5:41 PM), https://www.kuer.org/health-science-environment/2021-02-09/moabs-aquifer-may-be-maxed-out-prompting-city-to-explore-water-conservation.

[144] Bill Boyle, "San Juan County delays action on SITLA's Spanish Valley plans," MOAB TIMES-INDEPENDENT (June 25, 2020), https://www.moabtimes.com/articles/san-juan-county-delays-action-on-sitlas-spanish-valley-plans/.

near that much pre-Compact water, then pre-Compact rights are probably the only water that Utah can count on long term. Any Utah water right sourced in the Colorado River System with a priority date in 1930 or later is at serious risk of being curtailed on a regular or permanent basis.

To secure a water source reliable enough to justify infrastructure, the Moab area should consider obtaining Colorado River water rights that predate the Colorado River Compact (June 25, 1929, or to be very safe, November 24, 1922). Such water rights will become increasingly valuable, as the state will be very motivated to protect the use of any of its water that federal law cannot force downstream. Possible sources of these rights include transfer of any underused rights from local tributaries, long-term leases from Ute or Navajo tribes (if lawful for that tribe), or purchase from irrigators wishing to retire. UDWR has recently invested in "water banking" pilot programs designed to provide a marketplace for streamlined water transfers, both sale and lease; that program may prove useful to a public water provider looking for older water rights.[145] Since purchasing an expensive water right to replace a junior one is not yet common practice among Utah water providers, it may be difficult to match common funding sources such as bonds or grants to this kind of purchase; more research is required. The longer Moab waits, however, the more expensive and sought after pre-Compact water rights are likely to become.

There is, of course, another option, which may be inevitable in many places: limit urban growth to the locally available water supply, reserving an annual water surplus large enough to withstand any predicted change in climate. Against the push to cash in on a lucrative market like Moab, this option may be even more challenging than securing senior water rights.

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[145] See "Utah Water Banking Pilot Program," UTAH BOARD OF WATER RESOURCES, found at https://utahwaterbank.org.

VI. CONCLUSION

The Colorado River is now in the national news almost weekly, water levels dropping dramatically with predictions for more. The board is set for upcoming high-level negotiations that will decide the new iteration of the Law of the River.

As the law stands, every 10 years the Upper Basin must allow at least 75 maf to pass Lee Ferry, with the likely addition of the Mexican obligation bringing the total to an average of 8.25 mafy.[146] Upper Basin states may only use whatever water is left. Utah gets approximately[147] 23% of the Upper Basin's share, which the state apportions according to state law based on prior appropriation. The only exception to the Compact's downstream pull lies with water rights that predate the Compact, with a priority date before 1929 (or possibly 1922).

The best available science predicts that Lee Ferry flows will drop within the next few decades, to between 9.75 and 12.45 mafy. After counting Arizona's Upper Basin share and shared reservoir evaporation losses, the Upper Basin states may use between 1.0 and 4.4 mafy, with a median of 2.32 mafy.[148] Utah's 23% share is between 230,000 afy and 1.012 mafy, with a median of 534,000 afy. Utah currently uses just over 1.0 mafy, and contains likely over 300,000 afy of unused, very senior tribal water rights that may displace junior water rights holders if those holders do not buy or lease them.

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[146] This is usually referred to as 8.23 mafy because that's the release form Glen Canyon Dam necessary to make 8.25 mafy at Lee Ferry, several miles downstream. The Paria River, which adds its water to the Colorado between Glen Canyon Dam and Lee Ferry, adds approximately 20,000 afy.

[147] Utah gets 23% of the Upper Basin's share after Arizona's relatively small 50,000 afy is taken off the top.

[148] If the Upper Basin ceases to provide water to Mexico, that leaves between 2.25 and 4.95 mafy for the Upper Basin. However, the Lower Basin has a far larger population and more political power than the Upper and the Lower Basin has already taken significant cuts to its existing water use while the Upper has taken none. Further, the plain language of the Compact appears to favor a half-and-half split for the Mexican obligation, which is the approach that federal policy has taken for decades. Given all this, it seems unlikely, though it is possible, that the rules will change to make the Lower Basin supply the full Mexican apportionment, cutting another 750,000 afy from its own use. This paper will not, therefore, continue to include the possibility in its analysis fo likely futures.

As the 2021 USU study found (and the state of Colorado is anticipating), Upper Basin states may be limited to the use of only their proven pre-Compact water rights (or less) for much of the time. Places like Moab, which like many localities has water rights with priority dates decades post-Compact, should start looking to tribal governments and agricultural interests to acquire older water rights—or accept that sufficient water is not available for major urban growth.

All of these numbers involve speculation, and no one claims that they can predict with certainty how the basin's climate or politics will evolve. However, climate studies have been consistent, both with each other and with the recently observed conditions, that there will be major flow losses associated with rising temperatures. At the same time, the Lower Basin continues to have a more political power than the Upper Basin, and thus the upper hand in negotiations. These facts all point inexorably to what at first glance sounds like an extreme conclusion: the Upper Basin will have to subsist on significantly less than 3.0 mafy of Colorado River system water within our lifetimes, putting many important water rights under constant threat of curtailment.

As of December 2021, the State of Utah has not addressed this possibility in any public way, and instead is still busily engaged in fueling new real estate development with new, often very junior water rights.[149] This behavior wastes something even more important than taxpayer dollars: time. Until Utah acknowledges and plans for the rapidly approaching possibility of major water cuts, local water planners like Moab's are operating blindly, approving continued

[149] Such as the Lake Powell Pipeline and the rights held by San Juan and Grand.

urbanization on the theory that they can always, as Utah has assured them, spend some money to pump from the Colorado River.

Curtailments in Colorado River water use are almost certainly coming, and now, because of Utah's poor planning, we are wasting time when we should be inventorying bombproof older water rights, making plans to purchase and transfer them to where they are most needed, and matching local levels of growth to reliably available water. Such an approach would keep the priority system intact, which would avoid the political battles, tangle of lawsuits and fairness issues associated with upending the priority system upon which water users have relied for over 150 years. It would involve the acknowledgement that, if a community wants to add residents, they must start buying pre-Compact or older water rights from agriculture and tribes instead of trusting new appropriations (or secretly depending on taking water from agriculture by legal force, which is the only other path). As over 70% of Utah's water is used for irrigation, a *partial* buyout could help farmers install far more efficient systems or retire low-value crops, and could help tribes fund much-needed drinking water systems. Water is about to become more expensive, and no one wants to limit their future hopes because of worries about drought. However, the alternative to planning for scarcity is to keep pretending that the problem isn't there until it's an unplanned catastrophe.

The history of the Colorado River is full of people who have told decisionmakers to be cautious about promising water to fuel growth, and were ignored. Over 100 years ago, scientists and analysts could see the moment we've now reached: when demand begins to exceed supply. We no longer have the excuse of ignorance, or of blind faith that something will come along to rescue us from consequences. Though the State of Utah continues to encourage the development

of junior water rights, these rights' holders should be cautious about relying on a place near the end of the line. It's one thing to fill a swimming pool with flood-year water and another thing to build a new town's drinking water supply upon it. The law does not prevent Moab from building a pumping, pipeline, and distribution system to serve a valid water right, but the law may prevent Moab from turning it on.