THERE'S NO WATER AVAILABLE

Commonsense Recommendations To Limit Colorado River Conflict

Analysis from Great Basin Water Network and its Colorado River partners.

INTRODUCTION

The Colorado River System represents what it means to be American. From the Rocky Mountains to the Grand Canyon — from Boulder Canyon to the Gulf of California — the river exemplifies our expanse of landscapes, culture, and industriousness.

The 20th-Century infrastructure on the river continues to serve our nation's hunger for fresh foods, urban growth, and recreational opportunities.

With its extensive system of man-made dams, canals, pump stations and pipelines — for farming, hydropower, municipalities, leisure, and public safety — the river symbolizes our inherently American desires to build, control, and grow the world around us.

There's also a legacy of inequity. Indigenous communities with senior water rights and exigent needs, cannot get the waters to which they are entitled. It is a venal part of our flawed management system.

Today, the river system is increasingly becoming a symbol of hubris, conflict, injustice, and uncertainty — illustrated in real-time by unfilled reservoirs, depleted groundwater, unseeded fields, and the unrealistic promise of endless societal growth.

The river – and those who depend on it – has lost nearly 20 percent of natural flows in the past quarter century. The nation's top scientists think it is possible to lose another 20 percent in the coming decades.[1] Public officials and water managers know that the demand in all sectors of the river system — in all corners of the watershed — outpaces supply.[2] But addressing the supply-and-demand problem leads to conflict among all who depend on the river system's waters.

Officials from the federal government and the seven basin states have a 2026 deadline to develop a new framework for managing the Colorado River System's largest reservoirs (Post-2026 Guidelines).[3] The current moment, despite the ever-

present uncertainty, poses an opportunity to implement lasting solutions that can endure any drought or political climate. But impasses among state-level negotiators and changes at the federal level cast a pall over the future.

The deadlines, personnel, and complicated history do not limit the need for change or our collective ability to implement it. But they can propel meaningful action and participation.

The future problems we face will only be made worse by the impacts of our changing climate: erratic precipitation events, surprising shifts in temperature, unreliable snowmelt runoff patterns, dry soils, dust storms, and many other factors that are simply out of our control. There is scientifically driven evidence that we will have hotter and longer droughts, more wind-blown wildfires, and unpredictable weather patterns year by year in the foreseeable future.

The shifts in the natural world signal a high likelihood of increasing conflict among human communities that are already sparring over smaller and smaller supplies of water. The prospects of serious interventions from litigation or emergency legislation on these matters indicate a future of uncertainty rather than stability and equity.

Moreover, some officials in the Colorado River Basin are planning to divert even more water away from the river system in the coming years — believing that water is available for new industrial, municipal and agricultural uses. This includes the shift toward excessive groundwater depletion that serves as a surrogate water supply to satisfy surface water deficits but, ultimately, imposes greater strain on the system.

It is clear that the future will be about adapting to hydrologic extremes. It is also clear that the water laws and hydraulic engineering developed in the 20th century did not foresee the realities we face today.

The supply-focused approaches during the last 120 years — i.e. encouraging use — has landed us in crisis. It's time for a fresh, modernized approach. Nevertheless, we believe that the necessary change isn't as complicated as people in power want us to believe. We need to prevent waste, inefficiencies, and overuse. We don't need a change in laws as much as we need a shift in mindsets.

Our recommendations take a simple approach. We must reduce use and prevent the continued over-consumption of the river system. We can do so in an equitable way that does not involve foot-dragging and finger-pointing.

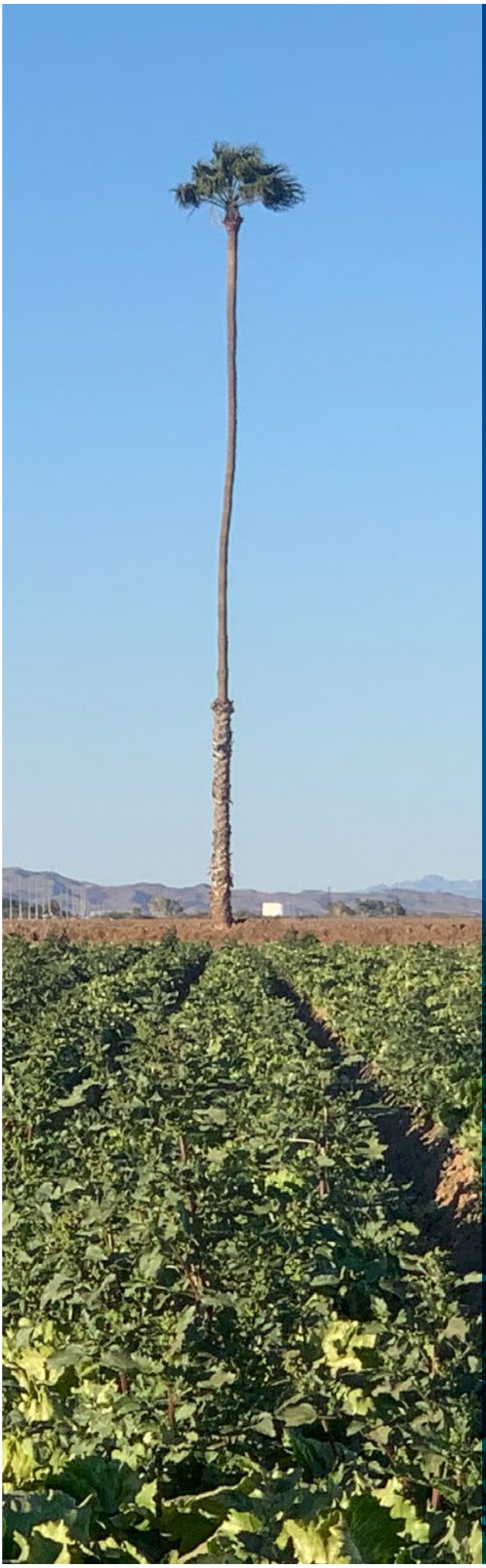
This report offers nine recommendations for the new administration and any subsequent administration, to weigh as we watch reservoir levels decline in conjunction with our snowpacks and runoffs. We implore the principal negotiators representing the seven basin states to consider this framework as they decide what is best for their waters and communities moving forward. We hope that the public uses this document as a springboard for increased awareness and engagement.

We can't make new water and turn back time. But we can create solutions to make our existing supplies work harder for human populations and natural communities.[4]

WE BEGAN DRAFTING THIS REPORT AS A RESPONSE TO THE COLORADO RIVER CRISIS.

But what's within can be applied to arid regions anywhere in the world. Our organization knows from experience the cutthroat realities of managing flows on the river system. We were born out of Colorado River conflict. For 30-plus years the Southern Nevada Water Authority attempted to import groundwater from hundreds of miles away to augment Lake Mead's supply. Since we halted that dangerous proposal in 2020, the need for a long-term conservation ethic among all parties in the western U.S. grows by the day. Some water managers adapt more responsibly than others. Consequences are inevitable. We continue to work with longstanding partners in hopes of preventing future challenges. These solutions are concepts that don't require major statutory overhauls as much as they demand a willingness to understand that outlooks have to change when there's no water available. As we have for many years, we lean heavily on our NGO partners for their knowledge and guidance. This report was done in partnership with Living Rivers-Colorado Riverkeeper, Utah Rivers Council, and the Glen Canyon Institute.

Kyle Roerink,
Executive Director
Great Basin Water Network



CONTENTS

GREAT BASIN WATER NETWORK

Summer 2025
greatbasinwater.org
info@greatbasinwater.org

Photo: Colorado River near Dead Horse State Park, Grand County, UT.

ISSUES AND RECOMMENDATIONS SUMMARY

If we don't stabilize our system and prepare for a drier world, we will pay a painful price as a nation and as individuals.

The following report highlights nine policy prescriptions that can help us forge a new future on the Colorado River System. These recommendations are predicated on three simple facts:

1. **On average, there is less surface water in the system than during the 20th Century.**
2. **There will be continued declines in average flows on the river in the coming decades.**[5]
3. **Diminishing groundwater supplies, which are connected to the system, are contributing to the losses.**

COLORADO RIVER MATH

- **1922 compact asumes 18 million acre-feet annually**
- **Seven U.S. states divvy 15 million acre-feet annually**
- **21st century average flows are 12.5 million acre-feet annually**
- **Scientists expect more losses in coming years**
- **Demand continues to outpace**

The indisputable evidence of drier times ahead illustrates a few simple conclusions: All parties currently using water must commit to using less than they have in the past. No new infrastructure shall divert, store, and siphon away water from the river system. Entities with junior rights should, as laws require, reduce their usage first. We need newfound respect for tribes and their senior, pre-compact allocations of water. Major metropolitan areas must be able to serve their people on a more limited supply, and they are not entitled to endless supplies for endless growth in the arid regions of the desert southwest. Endangered species have rights that must be upheld. Outdated infrastructure must be replaced with forward-thinking frameworks. Agriculture's role in solving the crisis must be carefully and equitably conducted. And, lastly, groundwater management must improve or declines will continue.

To do this, we don't have to tear up compacts, rewrite laws, or sue one another. However, we need a shared sense of responsibility. A stable, reliable system requires reducing consumptive uses across all corners of the Colorado River Basin. No water user, tributary, or regulator should be exempt. Respect, shared responsibility, and a commitment to future generations must all guide our collective actions.

Here is how we can make that happen.

RECOMMENDATION 1: Forgo New Dams and Diversions

Click here to see our interactive map.

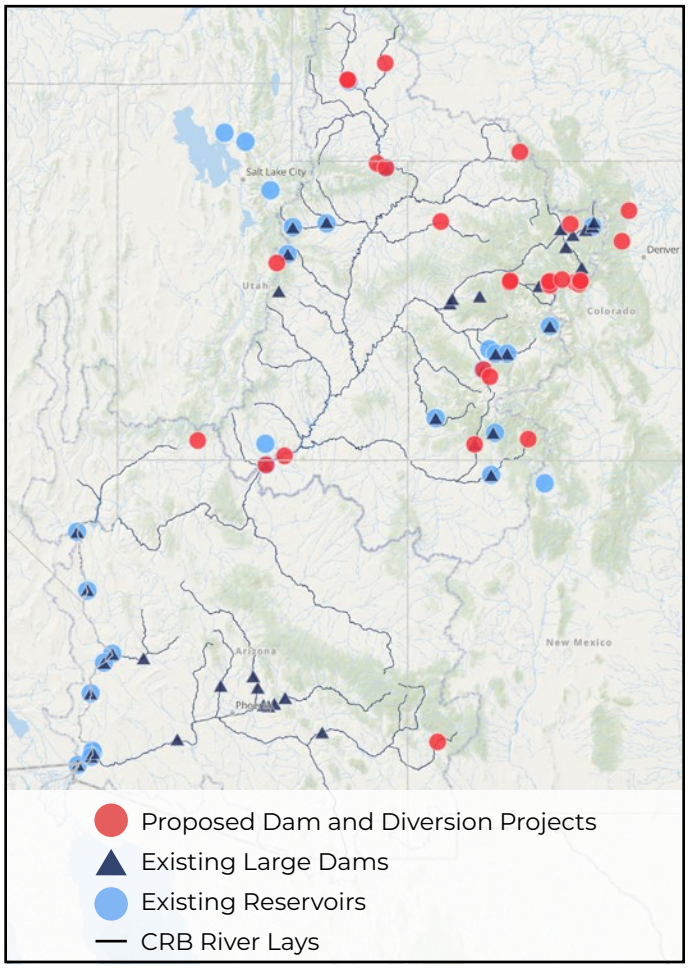
There are more than 1000 existing dam and diversion projects in the Colorado River System. There are 15-20 major projects, many of which were federally authorized and constructed at the behest of the Bureau of Reclamation. Additionally, there are hundreds of smaller water impoundment structures throughout the mainstem of the river and its tributaries. In order to protect flows, local, State and federal regulators must prohibit new dam and diversion projects — barring exceptions for tribes who have senior water rights. Unfortunately, other entities have different ideas.

A new dam, diversion, pipeline, pump, or canal means that water benefitting the system today or going to an existing rights holder may not be there in the future. It will be used by another entity elsewhere.

This will lead to more conflict and uncertainty.

A host of powerful interests wants to take more out of the system rather than prepare for drier times.

After reviewing regulatory documents, developer proposals, and news stories, we have tallied more than 30 project proposals in the Upper Basin that could consume more than 1 million acre feet from the river system. The analysis excludes tribal projects, and some are speculative efforts that may never happen. But many of those efforts are backed by interests with the resources and clout to execute more consumptive uses of the river system.



A map of proposed dam and diversion projects in the Colorado River Basin from Great Basin Water Network.

Other news reports highlight that approved water rights in the state of Colorado could take an additional 2.6 million acre feet away from nature and downstream users.[6] This could mean dozens of new reservoirs storing water that's currently headed somewhere else in the river system.

One of the easiest ways to ensure a stabilized system is by prohibiting new infrastructure that impounds and diverts additional water away from the river system.

RECOMMENDATION 2:
All States Need Curtailment Plans

Right now, Upper Colorado River Basin States do not have water curtailment plans for times of shortage that are understood by their sister states and other water users in the region. Colorado, New Mexico, Utah and Wyoming have detailed estimates of how much more water they want to use, which is known as a depletion schedule. This gets the priorities all wrong. Rather than planning on using more, we need states to plan on cutting.

Curtailment is a principal element of the Prior Appropriation Doctrine. In theory, regulators resort to curtailment when demand far exceeds supply and junior water users threaten or impact senior rights. Without a curtailment schedule — an index of cuts for users based on priority dates and other factors — states are not abiding by the Doctrine of Prior Appropriation and jeopardizing the rights of other users.

Cuts can manifest in a variety of ways, but there needs to be equity in understanding who gives up what and when. Having a clear-cut understanding of what entities have to cut during shortages is something that's already in place in the Lower Basin. The Upper Basin must develop a similar system of cuts predicated on water availability and delivery obligations that consider downstream use and Upper Basin water availability.

FIGURE 1: Lower Basin Curtailment Plan as agreed upon by the states.

	Lake Mead Elevation (feet msl)	2007 Interim Guidelines Shortages		Minute 323 Delivery Reductions	Total Combined Reductions	DCP Water Savings Contributions			Binational Water Scarcity Contingency Plan Savings	Combined Volumes by Country *US: (2007 Interim Guidelines Shortages + DCP Contributions) Mexico: (Minute 323 Delivery Reductions + Binational Water Scarcity Contingency Plan Savings)*					Total Combined Volumes
		AZ	NV	Mexico	*Lower Basin States + Mexico*	AZ	NV	CA	Mexico	*AZ Total*	*NV Total*	*CA Total*	*Lower Basin States Total*	*Mexico Total*	*Lower Basin States + Mexico*
	1,090 - 1,075	0	0	0	*0*	192	8	0	41	192	8	0	*200*	*41*	*241*
Tier 1 →	1,075 - 1050	320	13	50	*383*	192	8	0	30	512	21	0	*533*	*80*	*613*
Tier 2a →	1,050 - 1,045	400	17	70	*487*	192	8	0	34	592	25	0	*617*	*104*	*721*
Tier 2b →	1,045 - 1,040	400	17	70	*487*	240	10	200	76	640	27	200	*867*	*146*	*1,013*
Tier 2c →	1,040 - 1,035	400	17	70	*487*	240	10	250	84	640	27	250	*917*	*154*	*1,071*
Tier 2d →	1,035 - 1,030	400	17	70	*487*	240	10	300	92	640	27	300	*967*	*162*	*1,129*
Tier 2e →	1,030 - 1,025	400	17	70	*487*	240	10	350	101	640	27	350	*1,017*	*171*	*1,188*
Tier 3 →	<1,025	480	20	125	*625*	240	10	350	150	720	30	350	*1,100*	*275*	*1,375*

Courtesy of Arizona Department of Water Resources.

For years, Upper Basin states proclaimed that in dry times they use less water. But new data show that in the drier years, Upper Basin States use more water than in an average year.[7]

In 2025, Lakes Mead and Powell are each hovering around 30 percent of their capacity. We are not far away from the dangerous elevations we saw in Summer of 2022. While we can't predict the future, we do know that one big winter like that of 2022-2023 cannot return us to reservoir levels that compare to 1998 or 1999. Because of the imbalance in the system, basin-wide curtailment will ensure that senior rights holders, including tribes, have water to which they are entitled.

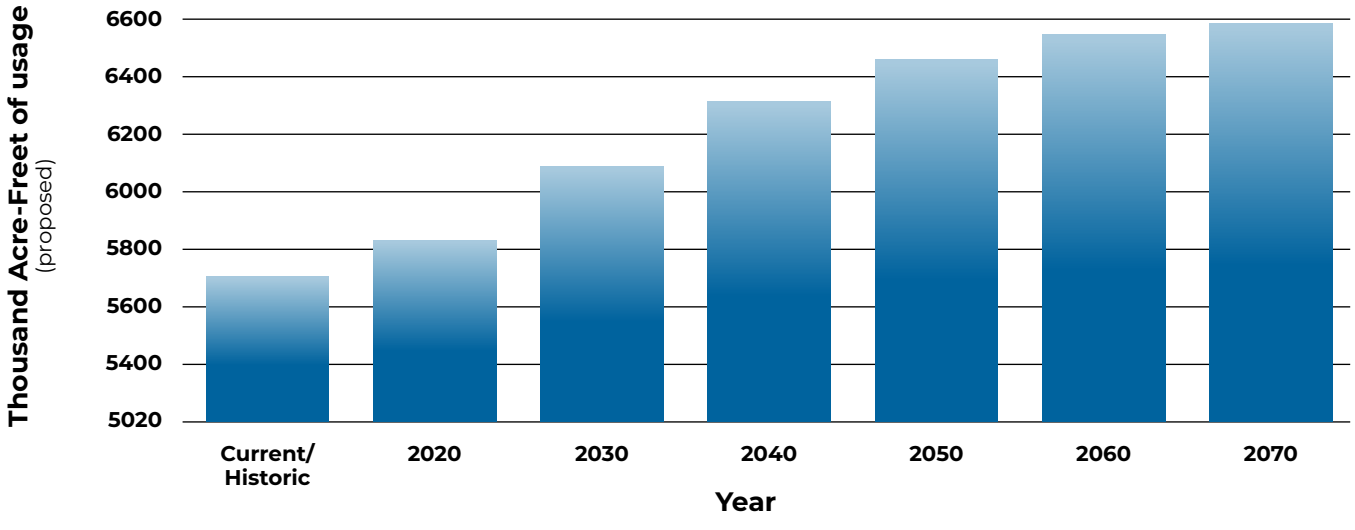
Following the onset of the Millennium Drought, Lower Basin regulators, including Mexico, began developing an agreed-upon curtailment plan. That was expanded with the 2019 Drought Contingency Plan (**See Figure 1**). The current Lower Basin plan outlines more than 1.4 million acre feet of cuts in times of shortage. Lower Basin entities have agreed to continue that in the future and likely foresee additional conservation as necessary.

Upper Basin states have no such plan. That must change in order to provide certainty, predictability and accurate accounting. Recently, a cohort of academics called on the Upper Basin to begin drafting a plan that would also require more of a shared burden among all states in the Colorado River Basin.[8]

For all states in the region, the current levels at the nation's largest reservoirs exemplify the need to devise a commonsense reduction plan. **Figure 3** shows total capacity vs existing contents of Lake Mead and Lake Powell. The fact that both lakes' total capacity is about one third of their total capacity after winters 2023 and 2024 should be alarming. And the reservoir levels should also be a call for bold action to decision-makers.

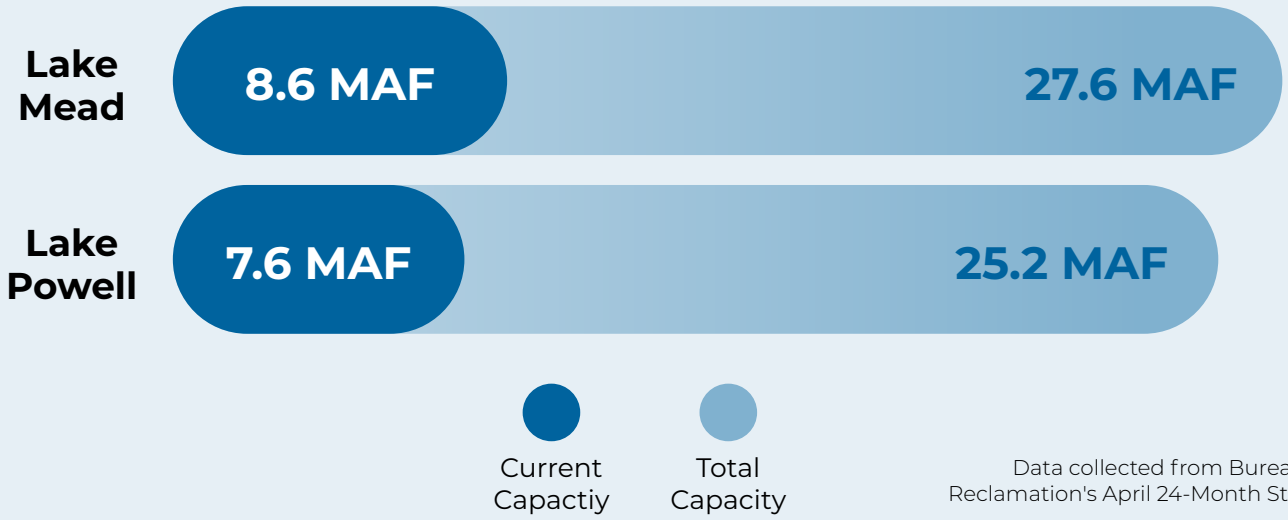
Furthermore, what we can say for certain is that, while the Upper Basin has no long-term, identifiable plan to reduce consumption, those states do have concrete plans to use more. **Figure 2** shows the proposed increase in water use in the upper basin states, despite this tenuous state of affairs. This plan, approved by the Upper Colorado River Commission, charts the expected increases in annual water use of Colorado River water by at least 800,000 acre-feet by 2070. The table shows a breakdown of the increasing water use by sector, and the map provides a visual representation of proposed new water use projects.

FIGURE 2: Proposed Upper Basin Increase Approved by the Upper Colorado River Commission



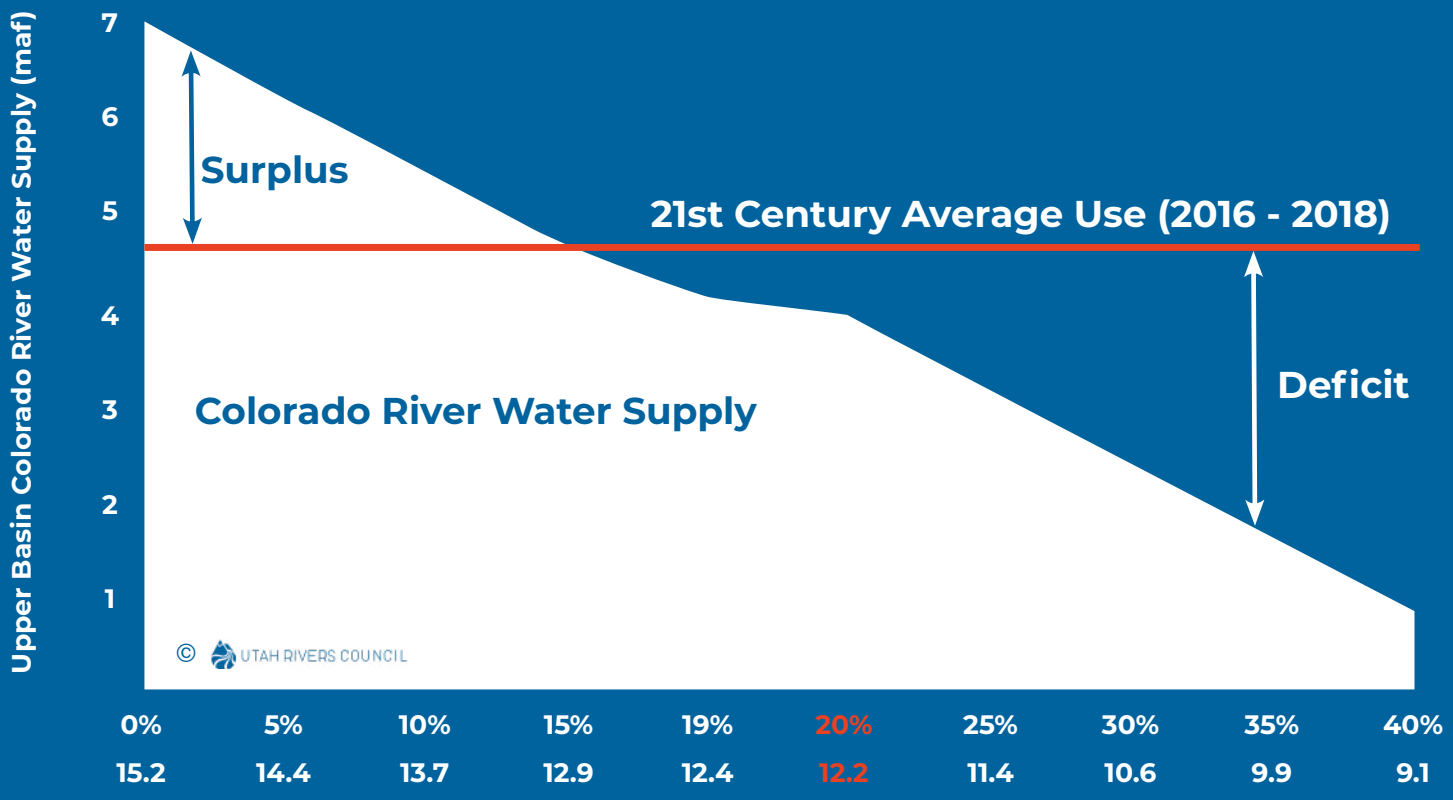
*See footnote 10 at Works Cited.

FIGURE 3: Full Capacity of the Nation's Two Largest Reservoirs Vs Their Current Storage



Data collected from Bureau of Reclamation's April 24-Month Study.

FIGURE 4: Declining Upper Basin Water Supply vs. Current Water Use



Percent Reduction Scenarios in Colorado River Flows Below 20th Century Average & Equivalent Water Volume (maf)

This graph shows how the Upper Basin's Colorado River water supply declines rapidly as climate change depletes the flows of the Colorado River, quickly outpacing the Upper Basin's current Colorado River use, shown as a red line. The Upper Basin has been using 4.6 million acre feet annually on average in recent years. A 20 percent reduction in flow signals that Upper Basin interests are using more than what's available.

Photo: Wahweap Marina at Lake Powell near Page, AZ.

How can this happen in a system where the largest reservoirs are not full?

The Colorado River Compact outlines that the Upper Basin could use 7.5 million acre feet per year. The 1948 Upper Basin Compact, however, outlines that Upper Basin states are to use percentages of what's available. Currently, those states proclaim to use less than their compact obligations allow.[9] Therefore, the Upper Basin states claim an entitlement to use more water — even though it doesn't exist in the Colorado River System. That is why, as detailed in **Figure 2**, Upper Basin states believe they can ultimately use more water during the next 45 years.[10] But, as graphed in **Figure 4**, the Upper Basin should already be using less water because it is likely already exceeding its allocation pursuant to the 1948 law. To wit: There is less water in the system now, and the Upper Basin has to act accordingly by cutting usage.

The Upper Basin has some problems ahead if they don't want to go down this path. Any new uses would be junior to the existing users in the Upper and Lower Basin — meaning, in theory, that they would be cut first during times of shortage. But, most importantly, the laws of the Upper Basin states require that water actually be available. And, a seminal question moving forward: Does anyone believe that water is actually available — especially if that water is already going to Arizona, California, or Nevada.

In Wyoming, Utah, New Mexico and Colorado, water availability is an important consideration when regulators make new appropriations under those state statutory constructs.[11] [12] [13] [14] Water must be available in order for regulators to make a new appropriation on the Colorado River System in those states, and any new appropriation must not harm an existing senior right. We cannot find credible science that shows unappropriated, available water in the Colorado River Basin.

The need for a basinwide curtailment plan becomes obvious if you answer YES to the following questions.

- Did the drafters of the Colorado River Compact over-estimate supply?
- Have we lost 20 percent of flows in the last quarter century?
- Will we lose more flows to changing water cycles on the river in the coming years?

Curtailment plans reduce conflict while depletion schedules foment uncertainty. Agreements to reduce basinwide usage allow all water users to know their priority in relation to one another and provide certainty about how much water they will receive in times of shortage. It is dangerous to discuss proposals for using more water. We must discuss how we use less.

FIGURE 5: Upper Colorado River States, Current and Future Water Use Depletion Schedule in Acre Feet as Approved by the Upper Colorado River Commission

Item	Year						
	Current/ Historic	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**
Agriculture-Irrigation & Stock	3,548	3,567	3,596	3,620	3,629	3,633	3,622
Municipal/Industrial	118	129	158	168	184	195	200
Energy	148	156	168	173	183	183	178
Minerals	53	59	73	90	107	125	136
Export	1,055	1,135	1,242	1,339	1,427	1,477	1,513
UT Tribal Water Settlements	-	2	70	141	148	153	153
Reservoir Evaporation (in-state)	261	261	261	261	261	261	261
TOTAL Forecasted Depletions	**5,183**	**5,309**	**5,558**	**5,792**	**5,939**	**6,027**	**6,063**
Shared Evaporation	520	520	520	520	520	520	520
TOTAL	**5,703**	**5,829**	**6,078**	**6,312**	**6,459**	**6,547**	**6,583**

*See footnote 10 at Works Cited.

RECOMMENDATION 3:
The "Natural Flow" Plan Won't Work Until There Are Better Data

In early Summer 2025, regulators ballyhooed a forward-looking plan to apportion water usage in the Upper and Lower Basin based on natural flows. Officials told the public the concept was a "breakthrough" to solve the negotiation impasse over long-term management. But they forgot to mention one thing: Agencies do not yet have the means to quickly and accurately measure natural flow data, a measurement metric that tracks water as if there were no human usage and infrastructure. That's because the basin at-large is missing key data points. Until officials begin to adequately collect water data, we will be making guesses about how humans and the environment consume water in the river system.

Courtesy of the University of Arizona.

Every drop of water should be accounted for in the Colorado River Basin. There's a basinwide need for a more complete network of consumptive use measurements to better understand demand, availability, and conflict. Congress, state legislatures, and water users must fund more programs to install more gauges, implement efficiencies, and collect other necessary data on indirect consumptive losses associated with the movement and storage of water in the system.

Evaporative and seepage losses must be considered and charged to water users at all tributaries, reservoirs and canals throughout the whole system. Evapotranspiration — what plants consume — must be considered along with other estimates for return flow, solar radiation, humidity and other factors that tell us more about the journey of water in the Colorado River Basin.

While there are new technological advancements, no consensus exists on how to assess evaporative and system losses in the Colorado River Basin to individual water users. The framers of the 1922 compact mostly punted on the issue.[15] For years, there have been discrepancies and gaps about who is using what and where.

The U.S. Geological Survey and the Bureau of Reclamation exemplify the problem. They have different ways of assessing consumptive uses, leaving uncertainty and gaps in the data.[16]

Pursuant to the 1948 Upper Basin Compact, the Upper Basin currently has a framework for assessing net evaporation from Lake Powell, Flaming Gorge Reservoir, and the Aspinall Unit — imposing state-by-state reductions according to their percentage share of the river.[17] But what about all the other parts of the system?

Photo: Canal carrying Colorado River water near the California-Arizona border.

For years, evaporative and system losses in the Upper Basin were not consistently quantified.[18] However, the Upper Colorado River Commission is willing to adapt and test new models for measuring consumptive uses with satellite data.[19] But the Upper Basin states must extend the hydrographic considerations of natural phenomena like evaporation, channel losses, and seepage losses beyond the extent of the current reporting at Colorado River Storage Project Units. Regulators must account for every tributary, canal, ditch, and riparian area.

The Lower Basin, which doesn't charge users for these losses or have a compact governing the three states and Mexico, has an incomplete framework for measuring evaporation at major reservoirs and tributaries.[20] [21] There are estimates that evaporation at Lakes Mead, Mojave, and Havasu, along with losses from canals and other means of transporting water in the region, amount to about 1.5 million acre feet per year.

Funding from the Inflation Reduction Act, coupled with the Lower Basin's curtailment schedules, helped to make up for the losses in dry years by incentivizing conservation at Lakes Mead and Powell. But it is a precarious and uncertain calculation at the moment. Without a regulatory proposal in public view and laws like the Inflation Reduction Act in limbo, Lower Basin states must commit to forever zeroing out its evaporative uses post-2026.

Until there is an exacting and equitable means of accounting for those losses, there will continue to be imbalances and declines at Lake Mead.

We believe that Congress, state legislatures, local governments and water users should all play a role in footing the bill.

One way or another, all water users in the Colorado River Basin will have to manage water evaporation and seepage in ways they never have before. States need to consistently reduce use in a way that accounts for evaporation.

Without the proper accounting, we will not be prudently and responsibly managing the river system. The "breakthroughs" that regulators will be nothing but futile public relations gimmicks unless they take meaningful action immediately.

RECOMMENDATION 4:
Alter Glen Canyon Dam to Protect the Water Supply for 25 Million People

The Bureau of Reclamation must make major modifications to Glen Canyon Dam as soon as possible to ensure that, if the dam must continue to exist, that it will be adapted to the threats imposed by climate change and changing flow regimes. This process must be transparent and undertaken swiftly.

As we have highlighted in past reports, modifications could include constructing a bypass that allows water to flow freely from one side of the dam to the other. Next, the Bureau of Reclamation must publicly detail its future plans for Glen Canyon Dam. The Bureau must also include modifications to Glen Canyon Dam as part of the ongoing negotiations and proposed alternatives for Post- 2026 Operations — something regulators have signaled they are unlikely to do.

We don't have time to waste. More than 25 million Americans live downstream of Glen Canyon Dam and Grand Canyon National Park. Water must pass through this man-made infrastructure before reaching communities like Las Vegas, Phoenix and Los Angeles.

When the levels of Lake Powell dip below the benchmark elevation of 3,490 feet above sea level, dramatically less water can pass downstream due to Glen Canyon Dam's engineering. This is because below 3,490 elevation, the only way for water to pass through the dam is through small tubes called the "river outlet works." When the dam was constructed, it was inconceivable that the reservoir would ever drop near these levels, but in 2023, it came within 30 feet of that benchmark elevation.

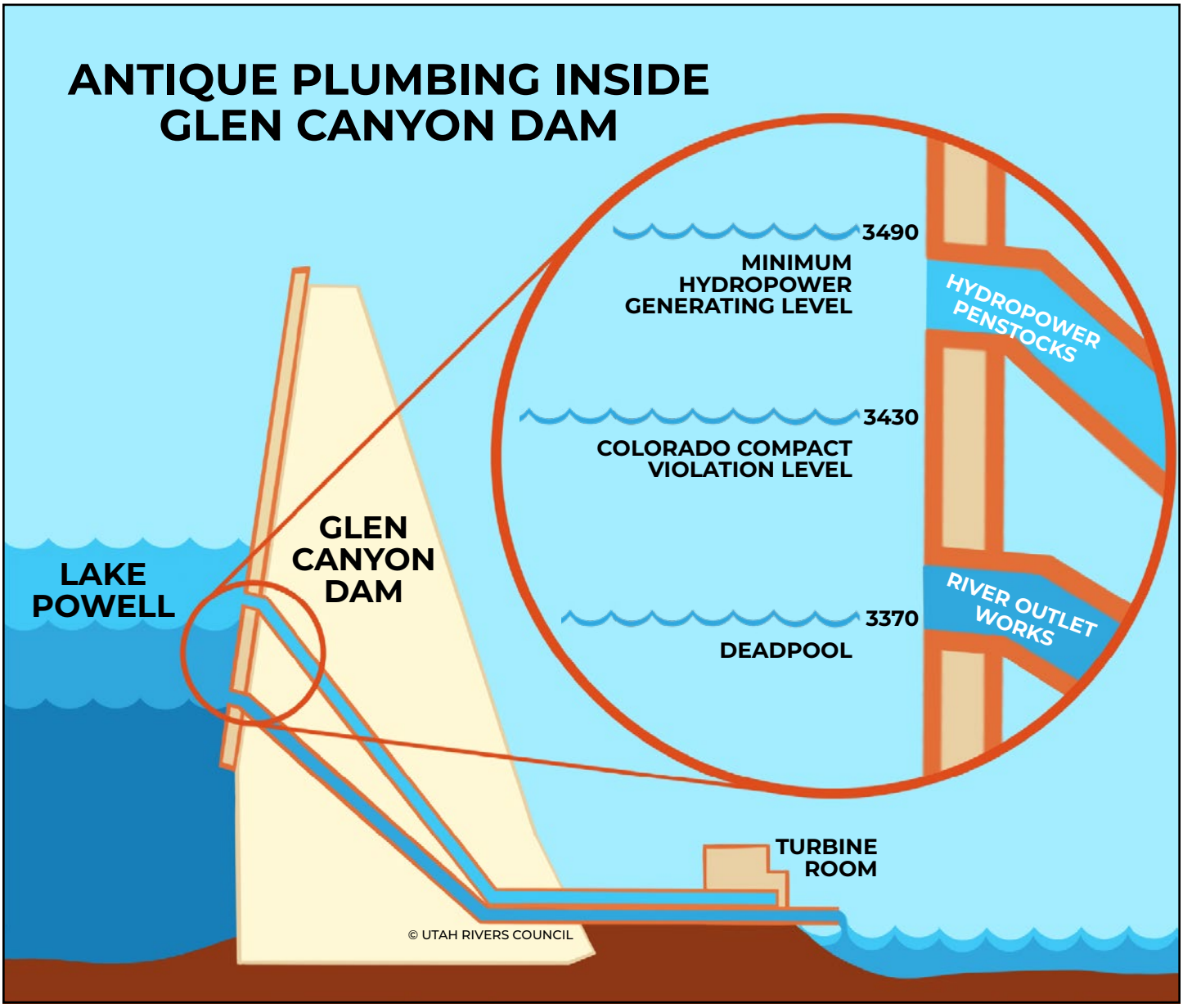
Photo: Lake Powell near Page, AZ.

Because of the tubes' small size and reduced "head" pressure, operating the dam solely on the river outlet works would severely constrict downstream flows. The river outlet works were designed for emergency releases, not for long term use.

Furthermore, the river outlet works are susceptible to cavitation — a phenomenon of erosional forces that threatens the dam's structural integrity.[32] During a high-flow release in 2023, the river outlet works experienced cavitational damage, requiring months' long repairs and keeping a portion of the river outlet works offline.

River outlet failures have occurred at Flaming Gorge Dam in 1997 that severely limited downstream releases. This engineering flaw means that, as water levels decline in the future, legally required amounts of water may not make it to residents in major metropolitan areas, farmers growing our winter crops, and wildlife species.

FIGURE 6: Representation of Glen Canyon Dam's River Outlet Works Courtesy of Utah Rivers Council



This engineering defect at Glen Canyon Dam is the subject of much scrutiny and uncertainty — especially as the dam shows signs of wear and tear time and again.[33] This could lead to litigation, dangerous and expensive water importation schemes, and other problems in communities. It has prompted Lower Basin officials to ask the Bureau of Reclamation to "modify" Glen Canyon Dam so that it delivers water at low levels, and spurred some Lower Basin farmers to call for studying abandoning storage at Lake Powell entirely.

The Bureau of Reclamation itself revealed that it is looking into modifications at the dam, but stated that any such modifications would take a minimum of 10 years. With the exception of one webinar in 2023, Reclamation's study of modifications are taking place out of the public eye — preventing any input from the public and stakeholders.[34]

RECOMMENDATION 5: Curtailing Junior Users to Serve Tribes

All tribal communities need clean drinking water supplies. The seven states and the federal government must prioritize delivery of a potable supply for native communities and respect the date of acquisition associated with tribal rights via Winters Doctrine. This level of seniority shall indeed warrant curtailment of non-tribal rights in some cases. We believe that focusing on 1-for-1 reductions/transfers is one way to ensure equity. States must reduce junior water usage until tribes' pre-compact rights are fulfilled.[28] If that cannot be done, tribes must be justly compensated and in agreement with any means of fulfilling unmet obligations.

The Colorado River Compact has clear language: Nothing shall affect the obligations of the United States of America to Indian Tribes. Unfortunately, we have not lived up to that standard in a demonstrable, meaningful way.

There is not enough water in the system for new uses. Under the priority doctrine, junior users must accede to senior users. And under the Winters Doctrine, the 1908 federal case law that affirms reserved tribal water rights, non-federal entitles like states cannot appropriate the tribal waters. But for more than a century, settler communities have been living and profiting off of tribal senior water rights in practice. Tribal senior water rights users must be made whole. And the basin states and the federal government have failed to deliver. In order to meet the obligations to tribes, we believe that junior users must curtail to account for the tribes' federally reserved water rights. This cannot be ignored in the negotiations for long-term management among the states and the federal government. Since there are no new water supplies, there must be a long-term plan to limit junior, non-tribal water rights used by settler communities.

Photo: Daryl Vigil, middle, the co-director of the Colorado River Water and Tribes Initiative, speaks at the 2023 Colorado River Water Users Association Conference in Las Vegas.

As the Colorado River Water and Tribes Initiative underscores: Twenty-two of the region's 30 tribes have recognized rights to use 3.2 million-acre feet of Colorado River system water annually, or approximately 25 percent of the basin's average annual water supply. Yet 12 of the tribes have unresolved water rights claims, which could increase the overall volume of tribal water rights in the Basin. But it is estimated that 65 percent of tribal water is unused by tribal communities.[29]

Currently, many tribes are not fully using their recognized rights for several reasons, including lack of necessary infrastructure and funding; antiquated and inefficient delivery systems; and constraints on off-reservation use. The lack of use, however, does not imply that others can appropriate the water. Tribal water rights under the Winters Doctrine are not rights granted by the United States. These are rights that the tribes maintained after they ceded territory and waters to the United States.

With tribes planning to fully develop and use their water rights, many water users express concern throughout the Upper and Lower Basin about how the expanded development of tribal water rights can be integrated with existing and future non-Indian uses of Basin water.

RECOMMENDATION 6:
Tackle Municipal Waste And Invest In Reuse Basinwide

Photo: Reducing municipal water waste can help make meaningful conservation gains in urban areas.

Municipal supply accounts for 18 percent of the use in the Colorado River System — with many of those users like Denver or Los Angeles existing outside of the Colorado River Basin. These cities that depend on the Colorado River must invest in maximizing every drop of water. Federal, state, and local governments must continue to invest in efforts for municipal water conservation and reuse. Cities and municipalities will not be able to rely on the Colorado River as they once did. Governments at all levels must invest in resilience efforts today to prepare for tomorrow.

The Southern Nevada Water Authority boasts a number of successful policy mechanisms and can serve as a model for the southwest. [22] [23]

To achieve those goals, SNWA has developed programs for ensuring watering happens on certain days and at certain times to minimize evaporation and have converted many turf lawns to native and drought-resilient landscapes. In addition, they have implemented water rate tiers so that wealthy users who water elaborate landscapes pay more for water than middle-class families. Finally, SNWA has imposed water restrictions on businesses like data centers that require water-intensive evaporative cooling. Other cities can and must learn from SNWA's approach.

Today, water exported outside of the Colorado River Basin includes 47 individual inter-basin transfer systems (i.e., canals, pipelines, pumps) that in aggregate export ~12% of the river's water.[24] Cities like Denver and Los Angeles aren't in the Colorado River watershed. But they continue to look elsewhere to meet their unrealistic demands for water that feeds endless growth. That cannot persist. There are better options.

For example, in 2021, the Infrastructure Investment and Jobs Act authorized funding for a toilet-to-tap partnership between the Metropolitan Water District of Southern California (MWD), the Central Arizona Project (CAP), and the Southern Nevada Water Authority (SNWA). It's a way to make more water available in Los Angeles while reducing the community's reliance on the Colorado River. And, simultaneously, it makes more water available in Phoenix and Las Vegas.

As passed by Congress, the law helps cover 25 percent of costs for a $3.2 billion water recycling facility. The project maximizes supply in those service areas by allowing MWD to recycle wastewater for potable uses in the Los Angeles Area. In return for additional financial investments in the project, CAP and SNWA will bolster their supplies in Phoenix and Las Vegas with a share of MWD's Colorado River allocation.

In optimistic news, the fast-growing community of St. George, which relies on the Virgin River, is considering a reuse program. The Washington County Water Conservancy District, which still considers the Lake Powell Pipeline a long-term option, is beginning to analyze and study the prospects of toilet-to-tap.[25]

Additionally, we must consider the impact of federal dollars. The Congress sent billions of dollars flowing into western communities to combat drought with a mix of short-term and mid-term funding for municipal conservation between 2021 and 2024.

Funding in the Bipartisan Infrastructure Bill and Inflation Reduction Act provided significant resources for urban conservation, focusing on WaterSMART grants for aquifer recharge, groundwater storage options, watershed health, and other projects. The Bureau of Reclamation's WaterSMART program budget was $1.8 billion in 2025, which was a $41 million decrease from 2024.[26] WaterSMART programs have helped fund more than 2,357 projects since 2010.

Cities across the West must stop trying to take more water from the Colorado River and instead build resilience in their own watersheds by pursuing conservation, water recycling, and groundwater recharge projects.

This will require government entities at all levels to invest in reductions via mandatory, voluntary, subsidized, and non-funded mechanisms.

See our list[27] of municipal water conservation ordinances in the desert southwest.

RECOMMENDATION 7:
Protect Endangered Species

Photo: Humpback Chub courtesy of the U.S. Fish and Wildlife Service.

USFWS, the Bureau of Reclamation and other agencies must prevent continued declines of the Humpback Chub and other endangered species in light of the rapid changes in the Colorado River System. Furthermore, the U.S. Fish and Wildlife Service must re-establish the Humpback Chub as endangered and prevent the reclassification of any other endangered species that are facing inevitable jeopardy.

First listed as endangered in 1967, the Humpback Chub population declines continue due to mismanagement of Colorado River water. This fish's colorful scales and fins make it a beauty to behold, and its unique humpback and snout make it a treasured part of the Colorado River ecosystem. The fish is native to the area near Dinosaur National Monument, and is a barometer for the health of the Colorado River more broadly.

Populations of Humpback Chub, Colorado River Pikeminnow, Razorback Sucker, and Bonytail have all declined immensely since the development of the river in the past 100 years. Native fish populations downstream of Colorado River Storage Project dams like Glen Canyon are facing immense uncertainty as climate change, aridification, and predation from non-native species portend an imperiled future in the river system. And, even with the Endangered Species Act in place, federal officials are not yet reviving populations and stabilizing an ecological system resembling anything near pre-development on the river.

While federal officials proclaim that certain populations of Humpback Chub are stable[30] or that optimism abounds for other populations, facilities like Glen Canyon Dam pose major long-term threats and challenge our ability to manage a river in balance with nature.

Water temperature, flow, habitat fragmentation, and turbidity all play a major role for the long-term survival of species like the Humpback Chub. And, again, the uncertain future leaves many to wonder if populations are 1) resilient, 2) representative, and 3) redundant — the three Rs USFWS uses to measure a species' ability to survive.

Of all native species in the Colorado River, the future of the Humpback Chub is most vulnerable to immediate peril. The recent invasion of predatory smallmouth bass in the Grand Canyon — caused by low water levels at Lake Powell — threaten the stronghold of Humpback Chub populations in the river system. Serious consideration must be given to managing a drastic invasion in the Grand Canyon.

Agencies like U.S. Fish and Wildlife Service, the Bureau of Reclamation, and the National Park Service should study entirely abandoning reservoir storage in Lake Powell by drilling river-level diversion tunnels around Glen Canyon Dam, which may prove to be the best hope for the Humpback Chub.

Jack C. Schmidt, one of the top academics and scientists on the river, believes the benefits would be valuable. "Such an action would restore a natural streamflow and sediment regime to the Grand Canyon and might benefit some pre-dam elements of the Colorado River ecosystem... and may represent a lesser threat to the continued persistence of native fish species..."[31]

Short of drilling diversion tunnels, the Bureau must consider major management changes at the dam by expediting new fish screens, modernizing temperature control, and augmenting sediment.

RECOMMENDATION 8:
Make Farms Resilient to New Realities

Farms must begin to adapt along the Colorado River Basin as they continue to grow food for human consumption, diversify income with renewable energy, and invest in approaches that make demand more flexible each year. There should be funding support for farmers to make these transitions, and each farmer should be able to make their own decisions about how they adapt to the future. But adapt they must. As cities increasingly turn to agricultural communities for leasing contracts and buy-and-dry efforts to augment supply, there must also be considerable environmental and economic analysis to ensure that big-money deals for water do not harm front-line residents and businesses in rural communities.

Agricultural producers are seen as an enemy in the eyes of some Colorado River observers. Farms have lots of water that big cities and powerful businesses want. Nevertheless, agricultural water also has the greatest potential to solve the Colorado River crisis. While it is undeniable that the sector uses more than half the water consumptively — a fact that holds true globally — agriculture is often on the front lines in droughts. As droughts become more frequent, cities go to farms to purchase water, and farms are where wildlife goes for water and habitat. We all go to farms for food. It is an intricate web.

As they have been for decades, agricultural operations with senior water rights will be vital for stabilizing water supplies in times of drought and feeding the nation in the winter months for decades to come.

As we've seen for decades in the Imperial Valley and Palo Verde, big cities rely on agricultural water to fill gaps and to stabilize reservoirs in times of shortage (See QSA and 2023 drought negotiations).

If entities want agricultural water, they should buy or lease it from farmers. If farming businesses don't want to sell off their water, they could be enticed to lease it.

To make it possible for farms to provide water to cities and wildlife in times of drought, we must support farms to focus on crop rotations and marketing efforts for more waterwise crops. But we must also implement advanced irrigation techniques to maximize return flows or limit systems losses with drip. Canal and ditch linings, split season leasing, diversion infrastructure for return flows and other factors can benefit the system. Entrepreneurial farmers may also want

FIGURE 7: Share of water use by sector in the Colorado River Basin

Sector	Percent of Consumptive Use on the River
Agriculture	52%
Municipal, Commercial, Industrial	18%
Reservoir Evaporation	11%
Evapotranspiration	19%

*See footnote 21 at Works Cited

Photo: Courtesy of Imperial Valley Farm.

The Salton Sea Tells a Co River Story

The Salton Sea and the Colorado River are inherently connected via geologic forces that have occurred over millions of years. Development of the Colorado River and transfers of irrigation water to big cities have greatly impacted inflows to the Salton Sea in the last century. Because of society's control of the river system, the sea is largely dependent on agricultural runoff that was once diluted with more freshwater sources. Deals to prop up Lake Mead's elevation have led to declines at the Salton Sea that impose new challenges for the survival of wildlife, public health management, and agricultural production. While many see agricultural water as a silver bullet for the river system, the situation at the Salton Sea highlights the challenges of ag-to-urban transfers and the problems that natural and human communities must face when their water leaves.

to invest in solar development and dry farming techniques, which could diversify income and/or allow for selling crops at a premium. It's critical that farmers be given support to make these changes with funding and technical support. Furthermore, these farmers must be able to choose how to adapt for the future themselves. They know their land and business models the best.

It is easy to say that we need to take water away from farms. But what will that look like in practice? The reality in the Colorado River Basin is that taking away water from downstream agriculture in Southern California and Western Arizona will likely mean less water for the Salton Sea, the Colorado River Delta, and reservoirs like Lakes Mead, Mojave, and Havasu. Undoubtedly, unless management regimes are mindful to not repurpose water, agricultural water in the Lower Basin will not be conserved. It will likely be dammed and diverted in the Upper Basin.

We may never agree on the best way to do something. But we can agree that the pool of agricultural water that currently exists in the system will be a lifeline for reservoirs and big cities when aridity hits us harder than we've ever seen it. However, places like the Salton Sea tell us a story about the impacts of taking rural water to urban communities. There are environmental and human impacts that must be considered.

RECOMMENDATION 9: Stabilize Groundwater Decline

Photo: Courtesy of the U.S. Fish and Wildlife Service.

Groundwater and surface water are connected systems. And what we see happening at the surface level is happening at a greater degree to our groundwater systems. Rapid warming, drying soils, changing runoff patterns, human activity, and other phenomena are impacting groundwater availability. Underground water sources make up a considerable chunk of the overall available regional supply and serve the river system itself in the Colorado River Basin. In order to balance our surface water systems, we must consider the major declines we are witnessing in groundwater systems. State and federal regulators must consider how further groundwater appropriation will lead to conflict, limit availability, and harm the overall state of the river system. We believe that, as in the case of surface water allocations, there is no "new" groundwater available for appropriation in any Colorado River Basin State. State regulators, all of whom oversee groundwater management independently, should act accordingly. There must be a greater focus on curtailing when necessary, limiting new appropriations, and managing the supplies with the understanding that it is all one conjunctive source.

It is important to understand the connected nature of groundwater and surface water in the Colorado River Basin. Shallow aquifer systems capturing precipitation and connected to deeper aquifers contribute what are known as groundwater baseflows, which feed surface water systems. Additionally, there are deeper, older

aquifers, hundreds or thousands of feet below the surface, that also have discharge into surface flows. From deep brines to last year's snowpack, water that is now underground is on a journey to discharge aboveground in most cases. In some cases that journey may be a few months or a few years. In others, it might take a century or more.

Reports and analysis conducted in the past decades show that groundwater systems in the Upper and Lower Basin are experiencing declines and stresses.

In the Upper Basin, half of the water we see at the surface comes from groundwater baseflows, according to research from the US Geological Survey.[35] This seminal USGS analysis underscores that as temperatures rise and evapotranspiration rates increase, there will be less groundwater entering surface water systems.

Recent studies have begun to quantify the losses with startling results.

Between 2004 and 2013, scientists estimated that groundwater supplies lost more than 5 million acre feet in the Colorado River Basin and contributed to the overall loss of water that we can see in the river system and its reservoirs.[36]

A new study published in May 2025 affirms the downward trend, highlighting that groundwater supplies in the Colorado River Basin are shrinking by nearly 1.3 Million acre feet per year.[37]

Our understanding of groundwater availability, connectivity, and stressors improves years after year. And in Nevada, for example, there has been a longstanding battle over groundwater sources that ultimately feed an important Colorado River Tributary, the Muddy River. In 2023, after years of analysis and litigation among parties, the Nevada Supreme Court upheld state-level actions to limit usage and manage for a connected system that serves rural communities, endangered species, and the Colorado River System.[38]

Other states will have to follow the lead of Nevada as scarcity increases conflict and uncertainty.

Photo: Canyonlands National Park downstream of Mineral Bottom, Grand County, Utah.

CONCLUSION: Water Is Not Available, But Hope Is

Water officials can implement our recommendations without major changes in law or regulation. These suggestions, first and foremost, require a change in mindset focused on conservation unlike any other ever seen in the southwest. Congress, state officials, and local water managers must all take note.

There are allocations of water on paper. And there are drops of water on the surface and in the ground. We must reconcile the differences between what truly exists in reality and what is a construct of the human mind.

The biggest threat to the Colorado River is not climate change. It is human intransigence. The river system will always take care of itself. But do we know how to take care of ourselves?

The behavioral problem on the Colorado River is not without a cure. Our nine recommendations ensure better hydrologic accounting, shared sacrifice, and system resilience. If implemented, we can improve ecosystems and human communities. We can respect native communities, farmers who grow our food, metropolitan hubs, and public interest values like wildlife, recreation, and the serenity of nature.

Our fates are inherently tied with one another. We must limit future conflicts and work to resolve long-standing ones. As we await a long-term plan for future management on the beleaguered river system, know that right now we can make a difference.

WORKS CITED

[1] Udall, Bradley and Overpeck, Jonathan. The Twenty-First Century Colorado Hot Drought and Implications For The Future. Water Resources Research. Volume 53, Issue 3. March 2017.
[2] U.S. Fish and Wildlife Service. Species Status Assessment for the Colorado River Pikeminnow (Ptychocheilus lucius). Version 1.1. Page 29. April 2022.
https://ecos.fws.gov/ServCat/DownloadFile/219586
[3] Bureau of Reclamation, Colorado River Post-2026 Operations, Web Page, Last Visited on January 23, 2025.
https://www.usbr.gov/ColoradoRiverBasin/post2026/index.html
[4] Abdelmohsen, Karem, Famiglietti, James S., et al. Declining Freshwater Availability in the Colorado River Basin Threatens Sustainability of Its Critical Groundwater Supplies. Geophysical Research Letters. Volume 52. Issue 10. May 27, 2025.
https://doi.org/10.1029/2025GL115593
[5] Supra at 2
[6] Sackett, Heather. Colorado has big dreams of storing millions of acre-feet of water — but will planned reservoirs ever be built? Aspen Journalism. December 16, 2024. https://www.aspentimes.com/news/aspen-journalism-colorado-has-big-dreams-of-using-more-water-from-the-colorado-river/
[7] Corona, Austin. How Much Water Flows Down the Colorado River. The Right Answer Is More Important Than Ever. Arizona Republic. April 1, 2025.
https://www.azcentral.com/story/news/local/arizona-environment/2025/04/01/upper-colorado-river-states-are-measuring-their-water-use-better/82696955007/
[8] Castle, Anne, et al. White Paper: Essential Pillars for the Post-2026 Colorado River Guidelines. April 25, 2025.
https://www.colorado.edu/center/gwc/sites/default/files/2025-04/2025-04-25%20Principles%20%28003%29.pdf
[9] Colorado River Upper Division State Representatives. Letter. Additional Information Regarding The Upper Division States' Alternative. March 11, 2024. http://www.ucrcommission.com/wp-content/uploads/2024/03/Additional-Information_UDS-Post-2026-Alternative_Final.pdf
[10] Upper Colorado River Commission. Resolution of the Upper Colorado River Commission: Updated 2016 Upper Division States Depletion Demand Schedule. Passed on June 14, 2022. http://www.ucrcommission.com/wp-content/uploads/2022/06/UCRC-and-Upper-Division-States-Combined-Resolution-and-Updated-2016-Depletion-Demand-Schedule-June-14-2022-1.pdf
[11] See Colorado Constitution Article 16 Section VI and C.R.S. Title 37
[12] See N.M.A.C. Title 19, Chapter 26, Part 2, Section 12
[13] See U.C. Title 73, Chapter 3, Section 8
[14] See W.S. Title 41, Chapter 4, Section 503
[15] Fleck, John and Kuhn, Eric. An Historical Perspective on Accounting for Evaporation and System Losses in the Lower Colorado River Basin. June 2023. http://www.riversimulator.org/Resources/Hydrology/AnHistoricalPerspectiveOnTheAccountingForEvaporationAndSystemLossesInTheLowerColoradoRiverBasin2023Kuhn.pdf
[16] Bruce, B.W., Prairie, J.R., Maupin, M.A., Dodds, J.R., Eckhardt, D.W., Ivahnenko, T.I., Matuska, P.J., Evenson, E.J., and Harrison, A.D. U.S. Geological Survey Scientific Investigations Report 2018–5021: Comparison of U.S. Geological Survey and Bureau of Reclamation water-use reporting in the Colorado River Basin. September 2019.
https://doi.org/10.3133/sir20185021
[17] Upper Colorado River Basin Compact. https://www.usbr.gov/lc/region/g1000/pdfiles/ucbsnact.pdf
[18] Bureau of Reclamation. Upper Colorado River Basin Consumptive Uses and Losses Report 2016–2020.
https://www.usbr.gov/uc/envdocs/plans.html
[19] Upper Colorado River Commission. Resolution. Consumptive Use Measurement in the Upper Colorado River Basin. June 14, 2022. http://www.ucrcommission.com/wp-content/uploads/2022/07/2022-06-14-Resolution-Consumptive-Use-Measurement.pdf
[20] Bureau of Reclamation, Boulder Canyon Operations Office. Implementation Effects of New Evaporation Coefficients for Lake Mead and Lake Mohave. February 2022.
https://www.usbr.gov/lc/riverops/evaporation/Mead-Mohave%20Evap%20Study.pdf
[21] Richter, B.D., Lamsal, G., Marston, L. et al. New water accounting reveals why the Colorado River no longer reaches the sea. Commun Earth Environ 5, 134. 2024. https://doi.org/10.1038/s43247-024-01291-0
[22] Lewis, Linsey. New tiered water rates approved for the Las Vegas valley affecting high water users. 8 News Now. October 4, 2022. https://www.8newsnow.com/news/local-news/new-tiered-water-rates-approved-for-the-las-vegas-valley-affecting-high-water-users/
[23] Southern Nevada Water Authority. Moratorium on Evaporative Cooling. Last Visited February 8, 2025.
https://www.snwa.com/conservation/understand-laws-ordinances/index.html
[24] Richter, B.D., Lamsal, G., Marston, L. et al. New water accounting reveals why the Colorado River no longer reaches the sea. Commun Earth Environ 5, 134. 2024. https://doi.org/10.1038/s43247-024-01291-0
[25] Eddington, Mark. This Southwestern Utah County Plans to Turn Wastewater Into Drinking Water. The Salt Lake Tribune. February 27, 2025. https://www.sltrib.com/news/2025/02/27/washington-countys-plan-turn/
[26] Stern, Charles V. Bureau of Reclamation FY2025 Budget and Appropriation. Congressional Research Services.
https://www.congress.gov/crs-product/IF12661
[27] Great Basin Water Network. Municipal Water Conservation Handbook. August 2023.
https://greatbasinwater.org/municipal-water-conservation-handbook/
[28] Veeder, William H. Winters Doctrine Rights Keystone of National Programs for Western Land and Water Conservation and Utilization, Montana Law Review. January 1965. https://scholarworks.umt.edu/mlr/vol26/iss2/1
[28] Veeder, William H. Winters Doctrine Rights Keystone of National Programs for Western Land and Water Conservation and Utilization, Montana Law Review. January 1965. https://scholarworks.umt.edu/mlr/vol26/iss2/1
[29] Colorado River Water and Tribes Initiative. About Us: Context. Last Visited February 8, 2025.
https://www.waterandtribes.org/about-us
[30] U.S. Fish and Wildlife Service. Reclassification of the Humpback Chub From Endangered to Threatened With a Section 4(d) Rule. 86 Fed Reg 57588. (Codified at 50 CFR Part 17).
[31] Schmidt, John C., Yackuic, Charles B., Kuhn, Eric. The Colorado River water crisis: Its origin and the future. WIREs Water. June 17, 2023.
[32] Glen Canyon Institute, Utah Rivers Council, Great Basin Water Network, et al. Antique Plumbing and Leadership Postponed: How the Glen Canyon Dam's Archaic Design Threatens The Colorado River Water Supply. August 2022. https://static1.squarespace.com/static/5a46b200bff2007bcca6fcf4/t/62e9d5e66e6ec602d2575e30/1659491822127/Antique+Plumbing+at+Glen+Canyon+Dam.pdf
[33] Bureau of Reclamation. Technical Decision Memorandum: Establishment of Interim Operating Guidelines For Glen Canyon Dam During Low-Reservoir Levels At Lake Powell. March 26, 2024. https://docs.google.com/viewerng/viewer?url=https://greatbasinwater.org/wp-content/uploads/2024/04/Glen-Canyon-Dam-outlet-tube-memo-BOR-report-April-24.pdf
[34] James, Ian. As the Colorado River Shrinks, Federal Officials Consider Overhauling Glen Canyon Dam. Los Angeles Times. February 18, 2023.
https://www.latimes.com/environment/story/2023-02-18/federal-officials-consider-overhauling-glen-canyon-dam
[35] Rumsey, C.A. et al. Regional Scale Estimates of Baseflow and Factors Influencing Baseflow in the Upper Colorado River Basin. Journal of Hydrology: Regional Studies. 2015.
https://water.usgs.gov/watercensus/file/Rumsey-et-al_2015.pdf
[36] Castle, Stephanie L., Thomas, Brian F. et al. Groundwater depletion during drought threatens future water security of the Colorado River Basin. Geophysical Research Letters. Aug 2014. https://pmc.ncbi.nlm.nih.gov/articles/PMC4373164/
[37] Supra at 4. See Figure 2 in report.
[38] See Nevada Supreme Court opinion in Sullivan v. Lincoln County Water District.
https://law.justia.com/cases/nevada/supreme-court/2024/84739.html