

## Comment on the Draft Environmental Impact Statement for New Operations for Lake Powell and Lake Mead Post-2026

Utah State University College of Engineering

### CEE 6490: Integrated River Basin / Watershed Planning and Management

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### Introduction

We appreciate the Bureau of Reclamation's extensive effort in preparing the Post-2026 Draft Environmental Impact Statement (Draft EIS) for operational guidelines for Lake Powell, Lake Mead, and the Colorado River Basin. This commentary will address positives, questions, and concerns from the Draft EIS. We also share recommendations for consideration in the Final EIS.

### Positives

We found many strengths in the Draft EIS. We hope to see all these points remain in the Final EIS and in the preferred alternative:

1. Clear Performance Markers and Figures: We found the consistency of figures across each alternative in the Draft EIS helpful to quickly get up to speed. The clear performance markers in Table ES-5 were particularly insightful to see how the alternatives were being compared.
2. Use of Decision Making Under Deep Uncertainty (DMDU): Reclamation is using state-of-the-art science in using the DMDU approach. Given the current state of the Colorado River Basin with many possible futures, this framework is appropriate. There is an urgent need for response to the aridification of the basin and the uncertainties of the future.
3. Glen Canyon Dam Releases Lower than Current Operations: Several alternatives in the Draft EIS consider lower releases at Glen Canyon Dam than the current operations. This will help to protect Lake Powell and preserve water with declining supply.
4. Shortages Higher than Current Operations: Several alternatives consider higher shortages in the system than current operations. This is a realistic approach with declining supply and will help to bring water use to the available supply.
5. Including Tribal Water Management: There is a need to bring the Tribal Nations to the table for this conversation about post-2026 operations in the basin. We are happy to see Tribal Nation considerations noted in the alternatives, particularly the inclusion of mechanisms for tribal conserved or unused water to be stored, credited, and integrated into system operations.
6. Need for New Operation Alternatives: Looking across the performance markers of the alternatives, it is clear to see that a "No Action" alternative is not acceptable. The Colorado River Basin needs new operations to maintain utility of critical infrastructure.
7. Valuable Analytical Approach: As a class we have been introduced to the Colorado River Simulation System (CRSS). We can appreciate the effort put into the traces and ensembles for modeling. CRSS is a valuable tool to manage the complexity of the Colorado River Basin.

8. Shorter Interim Duration or Phased Implementation: Understanding the uncertainty of what future years will present, we support the idea of a shorter interim duration as well as phased implementation of operational guidelines.
9. Conservation Reserve: The Conservation Reserve allows the use of stored volumes in Lake Mead and Lake Powell to be coordinated to convert to system water and help bring the reservoirs above critically low levels. This provides additional operational flexibility to stabilize reservoir elevations and reduce the risk of drawdown to minimum power pool or dead pool elevations.
10. Comprehensive Resource Impact Analysis: We are happy to see that the Draft EIS considers the impact that each alternative may have on resources other than water resources such as native fish in the Grand Canyon, hydropower generation, and recreational access to Lake Mead and Lake Powell.
11. Recent Hydrology: The incorporation of 3- and 10-year prior river flows and allowing for run-of-the-river adjustments during extreme low storage conditions provides for a more realistic framework than relying on longer duration trends. Using 3- and 10-year river flows allows the system to adjust releases and shortage determinations based on recent hydrology rather than multi-decade historic data
12. Dynamic Storage: The option of the strategic coordination of multiple pools and reservoirs provides greater operational flexibility and resilience while enabling more adaptive storage management in rapidly changing conditions.
13. Credit Calculation: Adjusting the conservation credit calculations to exclude mandatory reductions strengthens program integrity and is more sustainable. It also removes gaming between the voluntary and mandatory conservation programs.
14. Forecasting Techniques: The science is state of the art in the implementation of scenario-based forecasting which is essential for planning in cases of deep uncertainty.
15. Acknowledgement of External Factors: It is clear that the EIS has taken into account the existence of external factors and adjusted alternatives to account for unknown and uncontrolled possibilities, such as prolonged drought beyond modeled scenarios and sudden infrastructure failures that limit operational flexibility.
16. Resilient System Planning: We appreciate that shortages being considered in the Draft EIS are higher than current operations—this will help make the post-2026 operations more resilient.
17. Environmental Impact Summaries: Table ES-8 and subsequent chapters effectively discuss the environmental impacts of the proposed alternatives as well as the hydrologic performance of each alternative.
18. Environmental Impact Statement Alternatives: The Draft EIS clearly presents multiple operational alternatives and outlines the tradeoffs associated with each option. At the same time, it maintains flexibility for the states, Tribes, and federal agencies responsible for managing the Colorado River to work collaboratively and determine the most balanced and sustainable path forward.
19. Alternative Formulation, Modeling, and Analysis. The Draft EIS and the modeling are truly amazing—state of the art science—and positively reflect the efforts the Reclamation Modeling Team made to sell Reclamation leadership that DMDU is the appropriate framework to develop new operations in a future of high uncertainty and risk.

## Questions

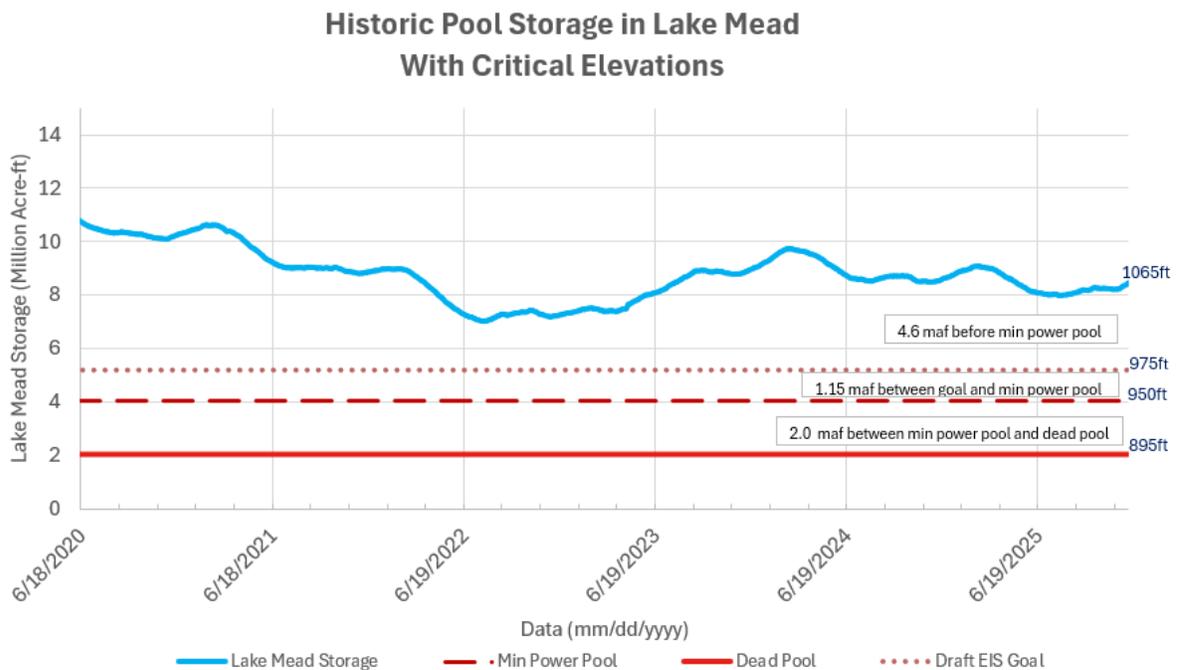
In our review and discussion of the Draft EIS, we came to several questions we would like to see answered in the final EIS and Record of Decision.

1. ICS Conversion after 2026: In the “No Action” and Basic Coordination Alternatives, there is no new storage and delivery mechanism for ICS while in the remaining alternatives—Enhanced Coordination, Maximum Operational Flexibility, and Supply Driven—ICS is noted to be converted immediately, in 5 years, and in 10 years, respectively. How will ICS convert into new storage/conservation pools under each alternative?
2. Shortage Sharing: With “first in time, first in right” water rights in place, how could a preferred alternative incorporate a minimum shortage-sharing standard to avoid situations where shortages fall disproportionately on certain basin states like Arizona?
3. Tribal Nation Co-Management: Is there an opportunity for Tribal Nations to participate in Colorado River storage and delivery programs? Our class also had the opportunity to attend several webinars by both Reclamation and Western Resource Advocates (WRA). With speakers noting a lack of tribal integration in decision-making, we wonder about the ability of the Tribal Nations to manage their own water rights.
4. Impacts on Tribal Nations: Additionally, the Draft EIS gives consideration for tribal water use and conservation in the Enhanced Coordination alternative, but other alternatives are unclear. How will other alternatives negatively impact or benefit the Tribal Nations?
5. Dead Pool Operations: What is meant by dead pool operations in several of the alternatives? At what Lake Powell elevation/storage do they initiate? At what Lake Mead elevation/storage do they cease? How long do dead pool operations stay in effect in each of the alternatives?
6. Critical Drawdown Limits: The Draft EIS establishes buffer elevations at Lake Powell (3,500 ft) and Lake Mead (975 ft), but what is the lowest elevation/storage that Reclamation will allow Lake Powell and Lake Mead to draw down to?
7. Conservation Pool Implementation: How will the different conservation pools, Lower Basin, Upper Basin, Tribal and system pool, be implemented, practiced, and coordinated?
8. Hydraulic Traces in CRSS: Which specific hydrology scenarios were used in the 400 CRSS traces used in the modeling for the Draft EIS?
9. Preferred Alternative Selection: How will Reclamation identify the preferred alternative in the Final EIS? What selection process and criteria will be used and how does Reclamation determine the order of priorities for that process?
10. Gap Water: What is meant by “gap water” in section 2.8.4.3? The section mentions injecting gap water into Lake Powell when sufficient water cannot be released due to low elevation infrastructure constraints. What is the source of the gap water? How much gap water is required in each alternative? How long is gap water required for each alternative?

## Concerns

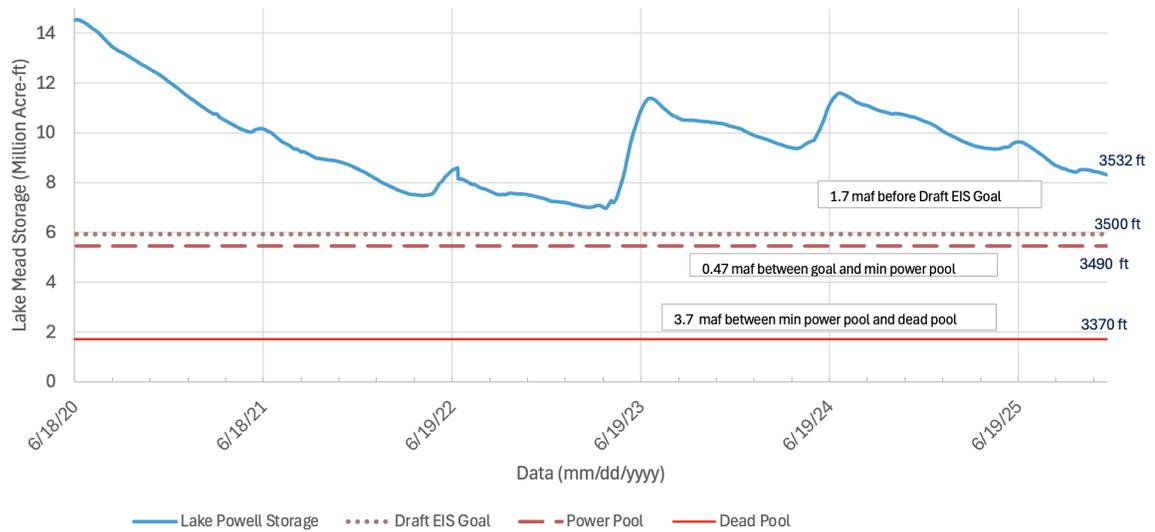
After reviewing the Draft EIS, we have six concerns:

1. Limited Margin of Error for Drawdown to Critical Elevations: The EIS outlines three predominant long-term hydrologic categories used for modeling: average, dry, and critically dry where average annual flows fall below 10 MAF. Current climate trends suggest that critically dry conditions are probable for the future, yet even the strongest alternatives struggle to keep Lake Mead and Lake Powell above the buffer water elevations under those conditions. The buffer elevations for Lake Mead (975 ft) and Lake Powell (3,500 ft) from Section ES.4.1 leave little room for drawdown of Lake Powell and Lake Mead to their power pool elevations (see Figures 1 and 2). For Lake Mead, the difference in the buffer elevation of 975 feet and the minimum power pool elevation of 950 feet is roughly 1.15 MAF, and approximately 2 MAF between the minimum power pool elevation and dead pool. For Lake Powell, the difference in the buffer elevation of 3,500 feet and the minimum power pool elevation is roughly 0.47 MAF, and approximately 3.7 MAF between the minimum power pool elevation and dead pool.



**Figure 1:** Historic Lake Mead Storage compared to Critical Elevations. There is only 1.2 MAF between the threshold of 975 feet and minimum power pool, leaving little margin of error.

### Historic Pool Storage in Lake Powell With Critical Elevations



**Figure 2:** Historic Pool Storage in Lake Powell with Critical Elevations. The storage values in MAF from 2020 to present are shown for Lake Powell. Included are the storage differences between the current storage and the Draft EIS goal, and the key elevations with their associated storage

2. **Large Number of Unacceptable Outcomes:** Even under the best performing alternative (Max Flexibility), the Draft EIS results still show unacceptable failure rates: 10% of modeled futures have Lake Powell below 3,500 ft, about 45% have Lake Mead below 975 ft, and around 20% trigger dead pool-related operations. Unfortunately, these are not unlikely scenarios; they represent a significant portion of probable futures in the dry and critically dry ranges (Figure ES-5 and Tables ES-4/ES-5). That level of risk is not acceptable without stronger safeguards and conservative operating rules.
3. **Lack of Basin State Consensus:** Given that the basin states did not come to a consensus for an alternative to implement, our concern is that the preferred alternative in the Final EIS will not adequately address aridification facing the Colorado River Basin due to political red tape. The Bureau of Reclamation may need to exercise more authority under the U.S. Department of the Interior to prevent insufficient alternatives being selected.
4. **Water Credit Storage and Recovery Calculation:** Water Credit Entitlements allow users to generate credits based on legal or administrative formulas rather than actual hydrologic conditions. This means the system can create credits for water that does not physically exist. Because managers cannot know future inflows, these credits implicitly assume that future flows will exceed current entitlements. In a declining system, this creates a growing gap between paper water and physical water, especially in Storage and Recovery accounting where recoverable volumes depend on future hydrologic conditions that may never materialize.
5. **Use of probabilistic metrics:** Many of the key performance metrics are framed in probabilities, percentages, averages, % Months Powell  $\geq$  3,500, % Months Mead  $\geq$  975, average shortage, average Glen Canyon water-year release, etc. These results are sensitive to the hydrology scenarios selected for inclusion in the analysis. If more dry or critically dry scenarios were included, then the probabilities would be lower.

6. Drought vs. Aridification Perspective: Many of the key management concepts in the Draft EIS reflect a “drought perspective”—that annual flows will return to higher amounts, while others reflect an “aridification perspective”—that the Colorado River Basin should prepare for drier climate. Our concern is that the preferred alternative may implement “drought perspective” concepts that fail to adequately adapt Colorado River operations to declining water supply.

## Recommendations

Overall, in our review and discussion of the Draft EIS for post-2026 operations in the Colorado River Basin, our class has determined the following recommendations for the Final EIS draft and preferred alternative:

1. Hybrid Preferred Alternative: Ultimately, from our review of the Draft EIS, we note that there are pros and cons across each given alternative. We recommend that the preferred alternative implement the strongest elements from each alternative for a “hybrid” alternative equitably tailored to the needs of water users in the Colorado River Basin:
  - Basic Coordination: Infrastructure protection to help Lake Powell if it falls under 3,490 feet and adjusting operations with states’ knowledge.
  - Enhanced Coordination: Having the ability to convert system water and making sure that the prescribed volume ratio to help balance shortages in the lower basin works well for all users. This is the strongest alternative for the Lake Powell release considering the pro rata distribution and to use system water in the 2 MAF pool.
  - Maximum Operational Flexibility: Targeting the three-year period gives the best estimate for shortages and monitoring total system effective storage to keep Powell and Mead at their desired elevations. This alternative is the strongest for determining Lower Basin shortages.
  - Supply Driven: Using gap water to make up for the shortfall and including gap water within the modeling assumptions and updating with carryover per water-year is a great addition and helps with future modeling efforts.
2. Shortage Sharing: As noted in the questions above, we recommend that the Final EIS identify definitive guidelines for shortage sharing in order to avoid disproportionate shortages. The preferred alternative should be equitable while honoring water rights.
3. Tribal Water Clarifications: With Enhanced Coordination being the only alternative to substantially flesh out provisions for tribal water, we recommend that the Final EIS further detail tribal nation implementation in the preferred alternative and consider co-management of tribal storage and delivery.
4. Improving the Storage and Delivery Program: Each alternative in the Draft EIS contains a different approach to storage and delivery of conserved water as noted in the 2.10 Summary table of chapter 2. These approaches lead to uncertainty around which entities will store water, what volume will be stored, and when the contributions will occur. Because the system is voluntary and socially driven, it may lead to inaction and reduce the sustainability of conserved water. To improve the sustainability of these programs, we recommend that the preferred alternative consider implementing a new “Conservation Payout Incentive” for conserved water storage and delivery determined by hydrologic conditions in the basin, and additionally implement an “elevation-based access rule”. Overall, hydrology determines how much conservation is rewarded, while elevation determines when conserved water can be withdrawn responsibly.
  - Financial Incentive: This approach works to incentivize water conservation in times when the Colorado River needs it most. With this approach, the Federal Government, through the Bureau of Reclamation, would fund voluntary conservation through existing or expanded programs. Entities that hold and manage Colorado River water such as municipal providers, irrigation districts, and tribes would qualify for the incentive through documented, verifiable reductions in consumptive use. Qualified reductions

might include temporary or permanent savings, efficiency improvements, or tribal conservation and/or water leasing (additional qualifying conservation actions could be defined). Actions that do not demonstrate clear water savings would not qualify for compensation. The incentive amount corresponds with the hydrologic conditions used in the Draft EIS, as shown in Table 1, with higher incentives for periods of higher water stress.

- **Elevation-Based Water Access:** Along with the Conservation Payout Incentive is a potential “elevation-based access rule” that limits when participating entities can withdraw conserved water credits while preserving their ownership of those credits. With this approach, access to conserved water would be determined by physically available water in the reservoirs, using Powell and Mead elevation levels to determine what percentage of a participant’s stored credits can be accessed at a given time as detailed in Table 2. This annual access percentage could be determined independently for Powell and Mead. This elevation-based access rule prevents rapid drawdowns when the reservoirs are under high stress and protects system stability of Glen Canyon and Hoover Dam operations. This approach addresses the concern of total water entitlement exceeding water in the system.

**Table 1:** Water Conservation Payout Incentive dependent on long-term hydrologic category. The payout amounts (\$/AF) given are only examples but demonstrate higher incentives for higher water stress conditions.

Long-Term Hydrologic Category	Average Annual Simulated Lees Ferry Flow, 2027-2046 (MAF)	Example \$/AF Incentive
Average	12-14	\$150/AF
Dry	10-12	\$300/AF
Critically Dry	<10	\$600/AF

**Table 2:** Elevation-based rules to access stored water. The percentages and elevation thresholds given are only examples but demonstrate that access to water credits decreases as water levels decrease to address the water credit entitlement concern.

Access to Stored Water	Lake Powell Elevation (ft) (Example)	Lake Mead Elevation (ft) (Example)
100%	≥ 3,600	≥ 1,145
75%	3,575–3,599	1,075–1,144
50%	3,550–3,574	1,050–1,074
25%	3,500–3,549	1,025–1,049
0% (no access)	< 3,500	< 975

5. **Bind Annual Credits to the Water that is Physically Available:** Another potential approach to improve the sustainability of the storage and recovery program is to tie credits to the physical water available rather than reductions from historical entitlements. Never allow total annual assigned credits and consumptive use to exceed total annual physical water available. The current credit creation equation listed in Appendix B (Modeling Assumptions: Lake Powell and Lake Mead Storage and Delivery of Conserved Water) is:

$$A_i = \max(E_i - C_i - D_i, 0)$$

Where,  $A_i$  = state  $i$ 's Annual credits,  $E_i$  = state  $i$ 's legal entitlement,  $C_i$  = mandatory cuts for state  $i$ , and  $D_i$  = state  $i$ 's annual consumption.

Summing over all users gives:

$$A_{\text{Total}} = \max(E_{\text{Total}} - C_{\text{Total}} - D_{\text{Total}}, 0)$$

The system is solvent and the formula is correct when the annual Physical Water Available for allocation (annual physical inflow to Lake Mead minus annual reservoir evaporation;  $Q_{\text{phys}}$ ) is greater than Total Legal Entitlements minus Total Mandatory Cuts ( $Q_{\text{phys}} \geq E_{\text{Total}} - C_{\text{Total}}$ ). In this case  $[E_{\text{Total}} - C_{\text{Total}} - D_{\text{Total}}]$  is positive and  $\max([a \text{ positive number}], 0)$  is that positive number and the credit awarded (Figure 3, Case #1).

However, when the annual Physical Water Available is less than the Total Legal Entitlements minus Total Mandatory Cuts ( $Q_{\text{phys}} < E_{\text{Total}} - C_{\text{Total}}$ ), there is a gap between the Total Legal Entitlements and Physical Water Available that the Total Mandatory Cuts does not fill (Figure 3, Case #2). In this case, the proposed storage and recovery program formula will award a credit  $A_{\text{Total}}$  even though some or all of that water did not flow into the reservoir. Case #2 ( $Q_{\text{phys}} < E_{\text{Total}} - C_{\text{Total}}$ ) will increasingly occur as future flows become more volatile and/or decline. For sustainability in Case #2, we should only credit water that physically flowed into the reservoir and can be stored for later release. Thus, we need to further constrain Total Consumptive Use and Total Credits to be less than the Physical Water Available.

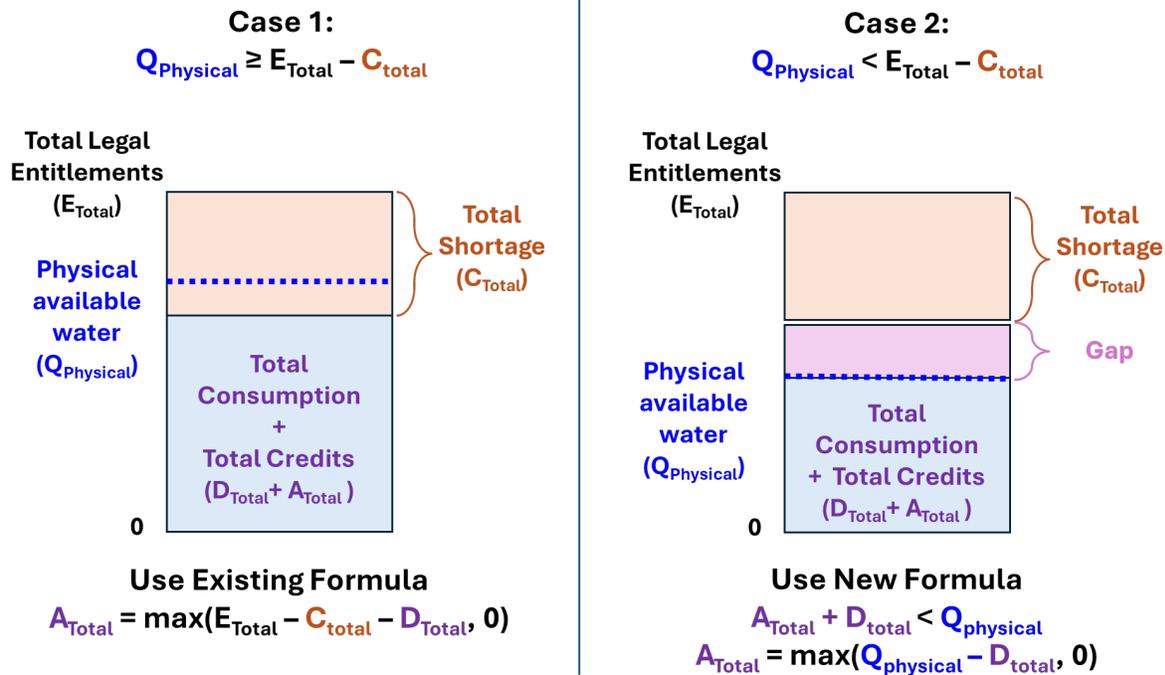
$$\sum_j D_j + A_j \leq Q_{\text{phys}}$$

Or alternatively,  $A_{\text{Total}} = \max(Q_{\text{phys}} - D_{\text{Total}}, 0)$ . Where again,  $Q_{\text{phys}}$  is the annual Physical Water Available.

One way to potentially address sustainability is to use a proportional scaling method to assign credits within the physically available water. For example:

$$A_i = \max(E_i - C_i - D_i, 0) \times \min\left(1, \frac{Q_{\text{phys}}}{\sum_j D_j + A_j}\right)$$

If total claims  $\sum_j (D_j + A_j) \leq Q_{\text{phys}}$ , then the multiplier is 1 and everyone receives their full calculated credit. If total claims exceed physical water, the multiplier is  $Q / \sum_j (D_j + A_j) < 1$ , proportionally scaling all credits.



**Figure 3.** Conceptual models showing when the existing formula to calculate credits for the Storage and Recovery program is correct (Case 1, left) and incorrect (Case 2, right). In Case #2, there is a gap between Total Legal Entitlements and the Physical Available Water that the Total Shortage does not fill. In Case #2, for program sustainability, we should only credit water that physically flowed into the reservoir and can be stored for later release. Thus, we need to further constrain Total Consumptive Use and Total Credits to be less than the Physically Available Water.

## Conclusion

Thank you for your time and consideration of our commentary on the Draft EIS. We hope that these positives, questions, concerns, and suggestions will improve the final EIS and help contribute to the overall effort to address the needs of the Colorado River Basin and the people it serves.

## Additional Notes

### Use of Generative AI

No AI was used to generate this public commentary.

### Data Availability

Data used for this commentary are available at

<http://www.hydroshare.org/resource/e4eeb5e9eafd44549ba7c828bb40807b>