



Eric Balken
Glen Canyon Institute
3090 East 3300 South, Suite 400
Salt Lake City, UT 84109

August 15th, 2023

Comments on Proposed Development of Post 2026 Colorado River Operational Strategies
Sent via email to crbpost2026@usbr.gov

Dear Bureau of Reclamation:

Thank you for the opportunity to comment on the scoping of the Post-2026 Colorado River Reservoir Operational Strategies for Lake Powell and Lake Mead.

1. Introduction

The fate of the entire Colorado River system is in a drastic state of uncertainty. While the circumstances we face as a basin are unprecedented, they are not unpredicted. The scientific and water user community has long acknowledged that the Colorado River is over allocated, and that consumption/demand has outstripped supply for most of the past two decades¹. Furthermore, the deleterious effects of climate change have compounded this supply/demand imbalance, with numerous studies expounding the impacts of a warming basin and modeling future scenarios². Every climate study that has been done on the Colorado River Basin predicts there will be less runoff in the years to come. Leading climate scientists Jonathan Overpeck and Brad Udall have stated that “Half of the flow of the Colorado River may be lost due to climate change by mid-century.”

Even after the biggest snowpack and runoff in over a decade, which yielded 170% average runoff into Lake Powell, the reservoir stands at a mere 40% full³. The combined storage of Powell and Mead this summer was 36% full or 17.5 million acre feet⁴—which isn't even enough

¹ <http://www.inkstain.net/fleck/2022/08/how-we-got-into-this-mess-on-the-colorado-river/>

² https://scholar.colorado.edu/concern/parent/8w32r663z/file_sets/ng451j49n

³ https://www.usbr.gov/uc/water/hydrodata/reservoir_data/site_map.html

⁴ Colorado River Post 2026 EIS Webinar, BOR, 2023

to fill Lake Mead to 70% full. It's clear that even after a historically wet year, the system's decline is far from averted. Now is the time for actively addressing alternatives that can provide options for water managers while protecting environmental resources.

Changing Hydrologic Conditions

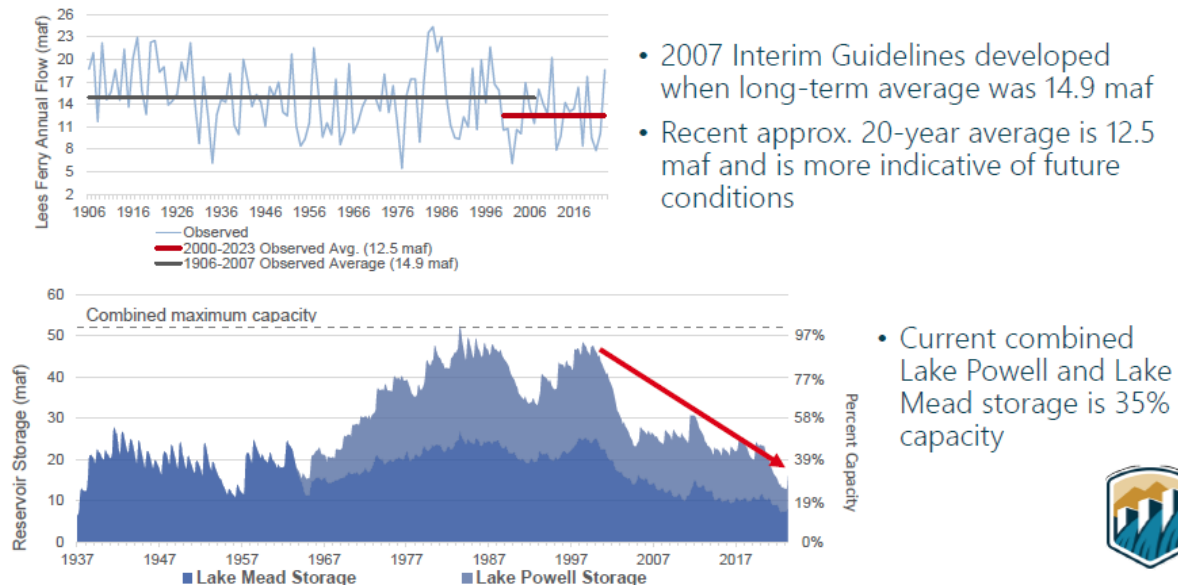


Figure from Colorado River Post-2026 Webinar, BOR 2023

In 2022, the prospect of Lake Powell dropping below minimum power pool within 1-2 years entered the realm of possibility, based on Reclamation's August 24-month study⁵, even with the extensive efforts to prop up the reservoir in 2021 and 2022⁶. While the tremendous water year of 2023 has boosted water storage at Powell by approximately 4.3 million acre feet⁷, we must not forget how close we came to reaching that threshold, and how likely it is to happen again given long-term climate models. The Post 2026 Operational Guidelines process provides an opportunity for Reclamation to lead the States forward with options that are based on science-based risk assessments.

The Post-2026 NOI states that the new guidelines, "must be capable of both withstanding a broad range of future hydrologic and operating conditions and minimizing system vulnerability." This requires all parties to look at both hydrologic and operational risk and to develop operational guidelines that provide both flexibility and a balancing of all demands on the system. No one-size-fits-all approach will work. What is needed is leadership in structuring an array of options that reflect the variability of hydrology and the abilities of the states and federal government to step forward with realistic approaches. The range of future hydrologic conditions should anticipate and plan for the worst-case scenario, i.e. the 40-50% reduction alluded to by

⁵ <https://www.usbr.gov/lc/region/g4000/24mo/2022/AUG22.pdf>

⁶ <https://www.kuer.org/health-science-environment/2022-05-03/feds-roll-out-extraordinary-actions-to-prop-up-lake-powell>

⁷ https://www.usbr.gov/uc/water/hydrodata/reservoir_data/site_map.html

Dr. Overpeck. But without structural modifications to river infrastructure, namely Glen Canyon Dam, the system will not be equipped to handle these scenarios.

An analysis⁸ released by Glen Canyon Institute, Utah Rivers Council, and Great Basin Water Network shows that if the Colorado River system experienced a series of water years like 2000-2004 or even 2017-2021, Lake Powell could drop within the range of deadpool elevation. The big water year of 2023 has avoided that outcome (for now), but the buffer could very well be temporary. Managing Lake Powell near deadpool comes with a host of challenges, many of which have been identified by Reclamation. These challenges include structural challenges of operating Glen Canyon Dam solely with the use of the river outlet works, managing recreation and safety at a wildly fluctuating reservoir, and serious impacts to the environmental resources, including endangered fish species in the Grand Canyon downstream. But the most important consideration is that at elevation 3,430 feet above sea level, Glen Canyon Dam cannot release enough water to meet its downstream delivery obligations to the Lower Basin⁹. Meeting that delivery obligation is one of the main reasons Glen Canyon Dam was built in the first place.

For these reasons, it's imperative that the Post-2026 Operational Guidelines EIS include an alternative where Glen Canyon dam is re-engineered so that it can be operated as a "run of river" facility, allowing for the full downstream release capabilities at any elevation. While this concept is controversial to some, it will provide the greatest flexibility with the lowest compact requirement risk option under future hydrologic circumstances. To not include such an alternative for analysis would be a major flaw in an EIS meant to carry the basin decades into a drier future and ignore potentially devastating impacts to the Grand Canyon National Park ecosystem and downstream resources.

The "run of river" alternative should include an in-depth analysis of the many considerations that that type of management regime would entail, including but not limited to:

- Engineering costs and timeline
- Policy framework options for Upper Basin water storage—including rethinking downstream delivery obligations past Lee Ferry and the ability of Upper Basin States' potential to store water in Lake Mead in the form of Intentionally Created Storage.
- Potential water savings from reduced ground seepage and evaporation
- Recreational opportunities and impacts in Glen Canyon and Grand Canyon
- Environmental impacts and benefits in Glen Canyon and Grand Canyon
- Use of Glen Canyon Dam facilities for flood protection
- Implications for the thirty Colorado River Basin Tribes
- Impacts and implications to meeting the requirements of the 1944 Treaty regarding the Colorado River supply to the Republic of Mexico.

- Cultural resources emerging in restoring sections of Glen Canyon that were once inundated by the reservoir.

⁸ <https://www.glencanyon.org/wp-content/uploads/2022/08/Final-Antique-Plumbing-at-Glen-Canyon-Dam.pdf>

⁹ https://qcnr.usu.edu/coloradoriver/files/CCRS_White_Paper_1.pdf, Page 10

It is imperative that the engineering costs and timeline allow for the retrofitting of the hydropower turbines via either full bypass or another engineering solution. The forthcoming water delivery crisis because of the outdated design inside Glen Canyon Dam will prevent the full delivery of Compact water downstream if/when Lake Powell levels drop in the future. The Department of Interior still has time to address this looming crisis, but time is quickly running out.

2. The hydrologic reality of the Colorado River, and the need to forecast for even lower flows

The impacts of climate change on the Colorado River have been widely studied for decades, with almost every study indicating that warming temperatures in the basin have already and will continue to reduce runoff¹⁰. The question isn't whether or not this trend will continue, but by how much. With a wide range of future impacts, scientists have concluded that we have not yet seen the worst, with the potential to see an additional 40% of flow reductions by mid-century¹¹.

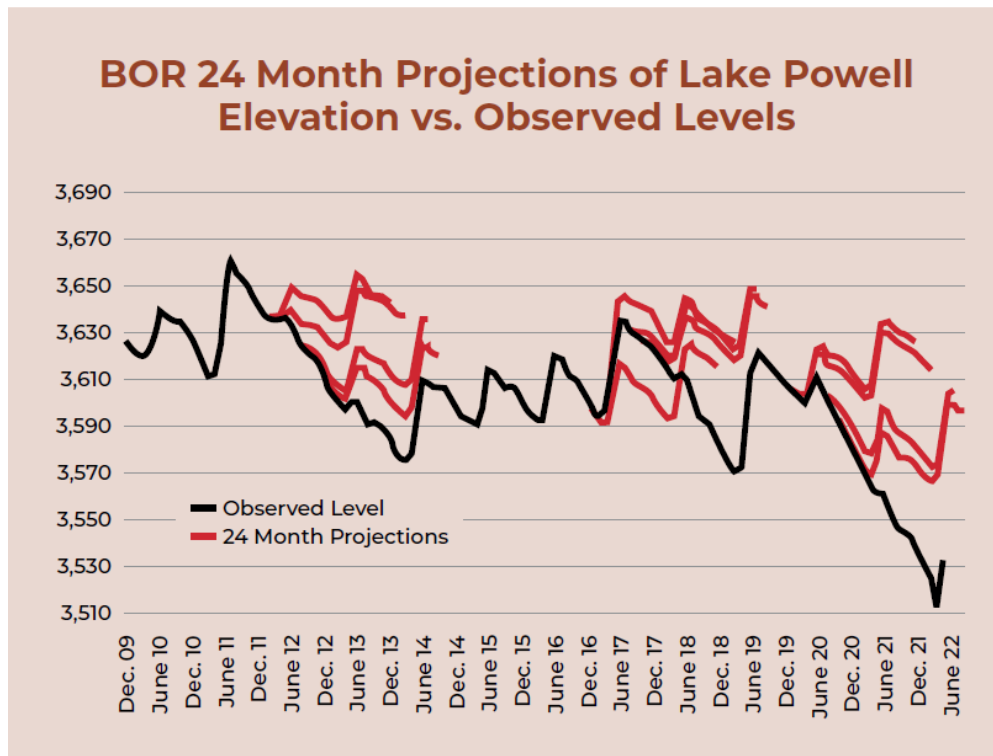
The impacts being experienced in the Colorado River are unlike anything that's been seen in this millennium, which is one of the reasons current modeling used by Reclamation, the Colorado River Mid-term Modeling System (CRMMS), informed by Colorado River Forecast Center, has proven to be overly optimistic for most of the past decade. A 2021 white paper The Futures of the Colorado Group evaluated Colorado River projections used by the Bureau and found that the agency has consistently underestimated the impacts of climate change and overestimated the amount of water projected to flow in the Colorado River, specifically into Lake Powell.

As described in the Futures of the Colorado River Project's White Paper #7¹², Reclamation's 24-month studies have **consistently overestimated runoff** of the studies' 2nd year "most probable" projection. The study found that the Bureau's "most probable projected inflows were higher than what actually occurred by as much as ~7 million acre feet (maf) in some years, and predicted reservoir elevations were also higher than what occurred in some years." This is most aptly demonstrated by White Paper #7's Figure 7, which has been reproduced below as a single graph.

¹⁰ https://www.usu.edu/colorado-river-research-group/files/crrg_reflections_on_two_decades.pdf

¹¹ Milly, P. C., & Dunne, K. A. (2020). Colorado River flow dwindles as warming-driven loss of reflective snow energizes evaporation. *Science*, 367(6483), 1252-1255. Bradley Udall & Jonathan Overpeck, The Twenty-first Century Colorado River Hot Drought and Implications for the Future, 53 WATER RESOURCES RES. 2404 (2017)

¹² https://qcnr.usu.edu/coloradoriver/files/WhitePaper_7.pdf



The above figure, showing levels of Lake Powell between December 2009 and June 2022, demonstrates how far Lake Powell water levels have declined over time, (shown in black). The red lines are Bureau of Reclamation 24 month “most probable” forecasts demonstrate a bias to overestimating the amount of water that will be in Lake Powell. Reproduced from White Paper #7, Figure 7.

The use of the 30-year statistical modeling is historically the standard for water managers, but in the Colorado River Basin it has proven to be outdated and leaves water managers and stakeholders unprepared when a series of dry years reduces the volume of supply to the reservoirs. We believe Reclamation should incorporate a wider set of data, like those used and suggested by the Futures of the Colorado Group¹³ and Western Water Assessment¹⁴, in 24-month and 60-month projections.

3. The likelihood of future declines at Lake Powell

Climate change has already reduced the Colorado River’s average annual flow roughly 20% over the past two decades, compared to the 20th Century average, resulting in dramatic water level declines at Lake Powell¹⁵.

¹³ <https://www.science.org/doi/10.1126/science.abo4452>

¹⁴ <https://scholar.colorado.edu/concern/reports/8w32r663z>

¹⁵ Bureau of Reclamation. Natural Flow and Salt Data. (2022).

Water Flow Scenario

Flow reduction of the Colorado River at Lee Ferry	Naturalized flow at Lee Ferry
20th Century Average (1906-1999)	15.2
5% Decrease	14.4
21st Century Average 19% Decrease	12.4
20% Decrease	12.2
40% Decrease	9.1

Table 3. From 2000 to 2018, the Colorado River flowed at an average 12.4 million acre-feet per year, a roughly 20% drop in flows from the 15.2 million acre-feet experienced for most of the 20th century.

The table above summarizes the range of Colorado River flow declines projected by multiple peer-reviewed scientific papers. This material is reproduced from *A Future on Borrowed Time*¹⁶, an analysis of Upper Colorado River Basin water budgets. Flow declines are shown as a percent decrease from the 20th Century Average of **15.2 million acre-feet**, and both the 20th and 21st Century. Under a 40% decrease, the flow of the river is a mere **9.1 million acre-feet**.

In 2022, Reclamation took drastic steps to increase the elevation of Lake Powell, by releasing an additional 500,000 acre feet of water from Flaming Gorge Reservoir and holding back 480,000 acre feet of water from being released to Lake Mead downstream¹⁷. Even with these efforts, Reclamation projected that, under its most probable scenario, Lake Powell's elevation could drop to approximately 3,508 fasl by April 2023, 14 feet lower than the reservoir's 2022 low point¹⁸. With the combined results of increased upstream dam releases, reduced downstream releases, and a 2023 snowpack that was 170% of average, the low reservoir level outcome was narrowly averted. But crucially It's important to take stock of how close Lake Powell came to hitting minimum power pool.

¹⁶

<https://static1.squarespace.com/static/5a46b200bff2007bcca6fcf4/t/620a935ebcb00a3f5258e71b/1644860263000/Future+on+Borrowed+Time.pdf>

¹⁷ Trujillo, Tanya. Letter to Colorado River Basin State Managers on Coordinated Actions & DROA. (May 2, 2022)

¹⁸ <https://www.usbr.gov/lc/region/g4000/24mo.pdf>

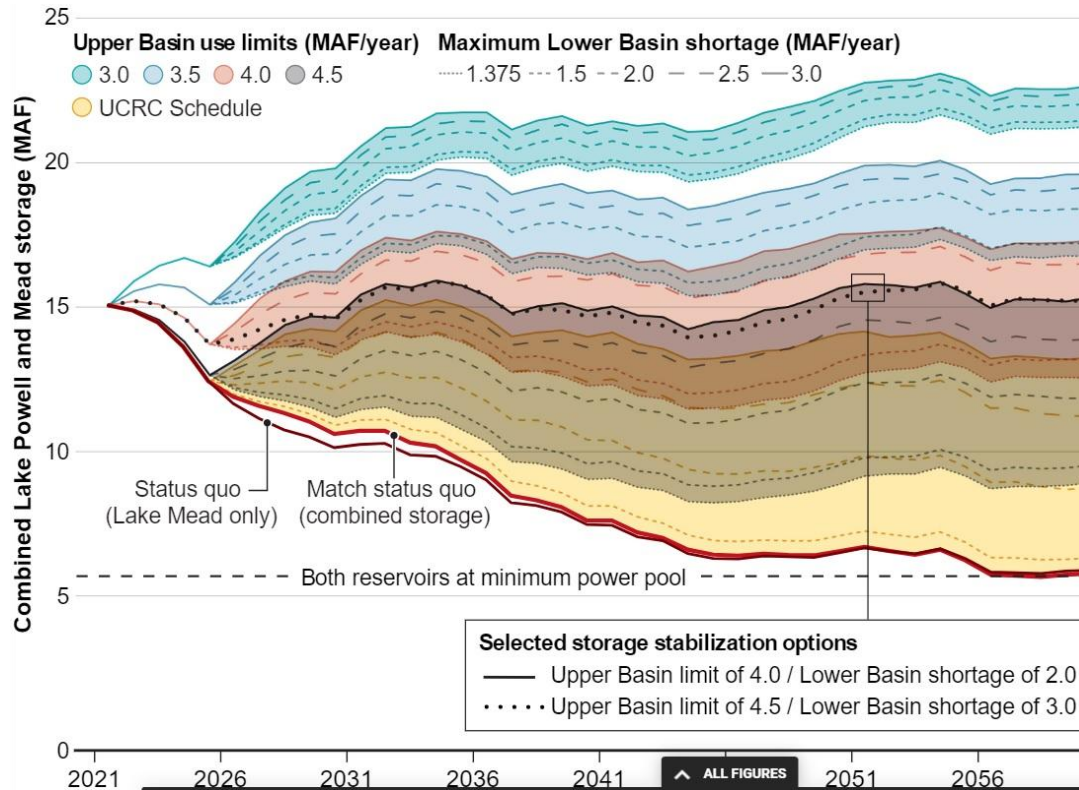


Figure from “What will it take to stabilize the Colorado River?”, *Science Magazine*

The figure above, from Wheeler et al. in *Science*¹⁹, shows an array of future possibilities of combined storage totals between Powell and Mead, based on existing shortage curtailment schedules and different Upper Basin depletion (demand/use) scenarios. The figure shows that with climate impacts not getting worse, and significant reductions implemented from the Upper and Lower Basin, system storage **will still only stabilize, not increase**.

Based on the Wheeler et al. projections, if Basin states cannot come to an agreement on widespread reductions of consumptive use and/or climate continues to reduce runoff, storage at Powell and Mead will drop precipitously in the near future. As stated earlier, climate science predicts that runoff will get worse. Whether Basin states can agree to widespread cuts remains to be seen. The recent agreement reached by California and Arizona was a step in the right direction, but relies on extensive federal funding—a model that likely won't be sustainable in the future²⁰.

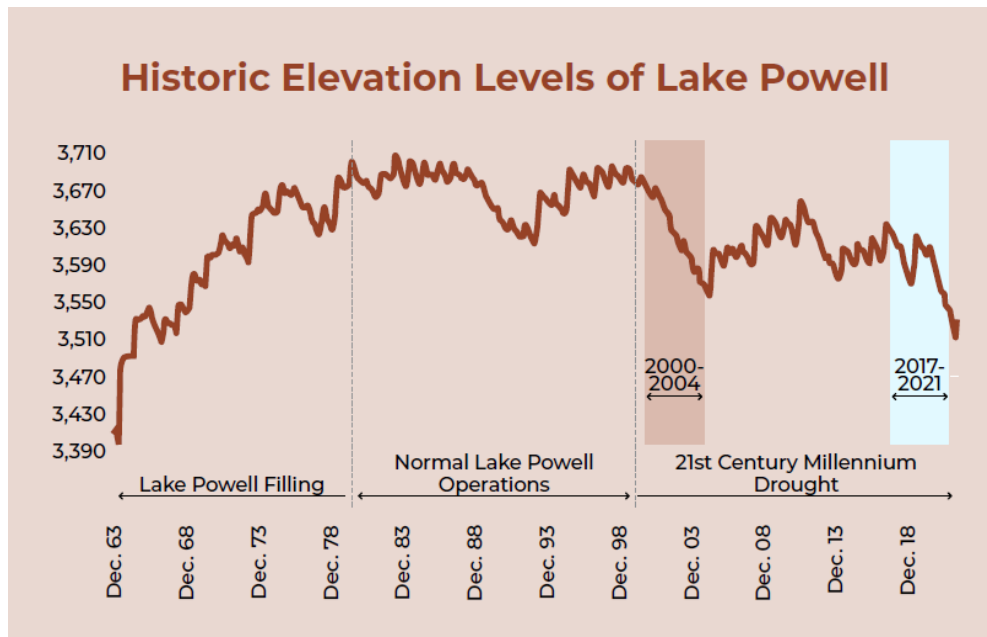
For another perspective of what the reservoir's future could look like and provide another possible prediction of what could happen in the years ahead, the analysis conducted by Utah Rivers Council, Glen Canyon Institute, and the Great Basin Water Network²¹ projected potential future Lake Powell water levels by simply using observed historical data. Two historical five-year periods were chosen and examined what Lake Powell's water level would be if future conditions

¹⁹ <https://www.science.org/doi/10.1126/science.abo4452#>

²⁰ <https://www.inkstain.net/2023/05/deadpool-diaries-nice-river-basin-ya-got-there/>

²¹ <https://www.glencanyon.org/wp-content/uploads/2022/08/Final-Antique-Plumbing-at-Glen-Canyon-Dam.pdf>

resembled those observed in either of these periods²² The figure below shows the entire history of Lake Powell’s water levels and illustrates the two color-coded periods used by the report to project future Lake Powell levels, from 2000-2004 and from 2017-2021.



Historic elevations of Lake Powell and the two historic periods chosen to forecast possible future declines

	Average unregulated inflow to Lake Powell	Change in Lake Powell Storage	Change in Lake Powell Storage	Average Natural Flow at Lees Ferry	Decline in Natural flow from 20th Century Average
2000-2004	5.8 million ac-ft	-120 feet	-13.8 million ac-ft	9.4 million ac-ft	38%
2017-2021	7.8 million ac-ft	-65 feet	-5.5 million ac-ft	12.2 million ac-ft	20%

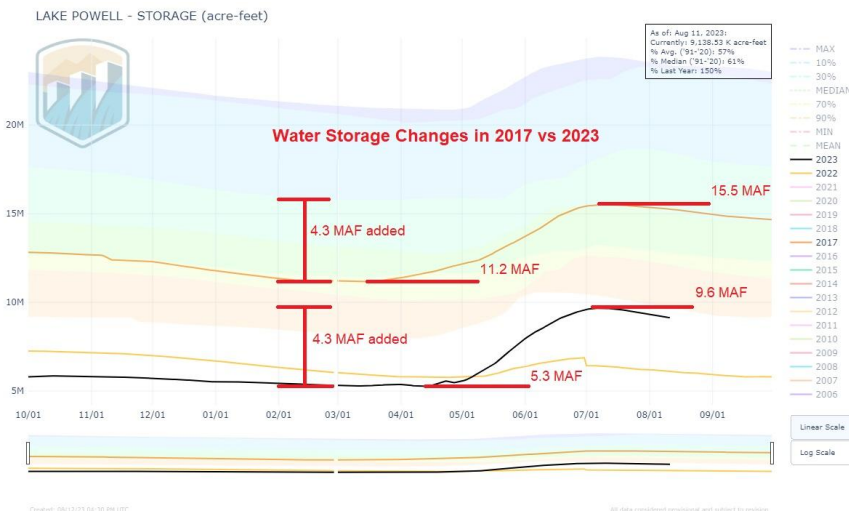
Summary statistics for two historical time periods used in analysis.

These two periods were chosen because they represent good ‘new normal’ and ‘low end’ projections for the Colorado River System. The 2000-04 period roughly conforms with the low-end projection of a 40% decline in Colorado River flows predicted by the current scientific

²² Bureau of Reclamation. Annual Operating Plan. (2021). <https://www.usbr.gov/uc/water/rsrvs/ops/aop/AOP21.pdf>. Bureau of Reclamation. Natural Flow and Salt Data. (2022). Bureau of Reclamation. 24 Month Study. (June 2022). https://www.usbr.gov/uc/water/crsp/studies/24Month_06.pdf

literature²³. The 2017-21 is similar to the 21st century average Colorado River flow of 12.3 million acre-feet and could be thought of as the recent new normal. The figure below shows Lake Powell's projected elevation level using these two historical periods.

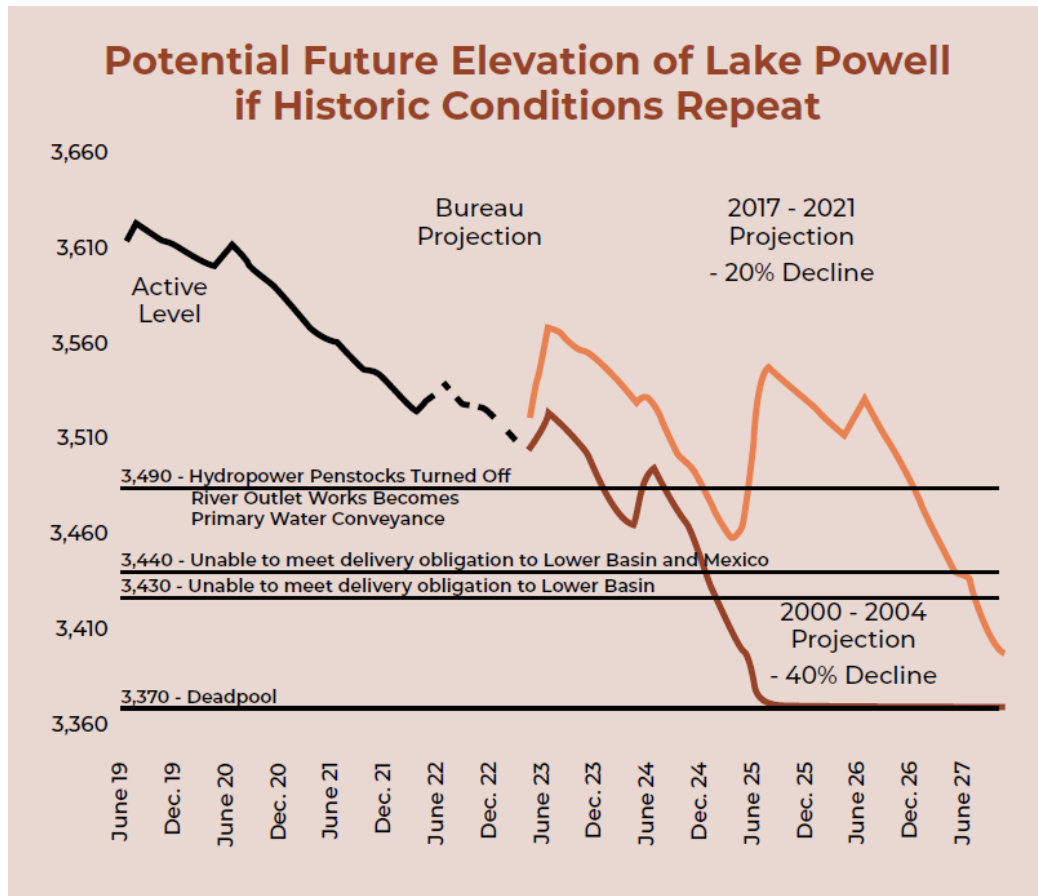
It must be noted that these projections do not include the historic water year of 2023. However, they are still relevant, especially when considering the 2017-2021 projection window. In 2017, Lake Powell experienced an increase of 4.3 million acre feet in storage volume, an almost exact match of storage in 2023. (See graph below).



USBR graph with overlay text by Glen Canyon Institute

The study forecasted into the future using the two historic periods of 2000-2004 and 2017-2021, and projected that Lake Powell quickly drops to levels well below the critical elevation thresholds of 3,440 and 3,430 feet above sea level. This exercise was not meant to be a prediction that Lake Powell will follow either of these paths over this time frame. Projecting Lake Powell's future water levels with a high degree of certainty is very difficult, especially without incorporating potential future curtailments. **This exercise demonstrates it is very possible that Lake Powell could drop to critical elevation thresholds in the near future.**

²³ Milly, P. C., & Dunne, K. A. (2020). Colorado River flow dwindles as warming-driven loss of reflective snow energizes evaporation. *Science*, 367(6483), 1252-1255. Bradley Udall & Jonathan Overpeck, The Twenty-first Century Colorado River Hot Drought and Implications for the Future, 53 WATER RESOURCES RES. 2404 (2017).



Projected elevation of Lake Powell reservoir levels into the future from WY 2022 forward, given observed historical hydrologic periods of both 2000–2004 and 2017–2021.

4. The need to study full bypass of Glen Canyon Dam and model operations with low and no reservoir scenarios at Lake Powell

As demonstrated by the charts above and acknowledging Reclamations’ own 5-year projections²⁴, there is a significant enough likelihood of Powell dropping below power pool and near deadpool that Reclamation should have every operational tool available to manage the system in low system hydrologic scenarios. Currently those tools are unavailable, because of infrastructure limitations at Glen Canyon Dam, and the lack of predictive modeling utilizing alternative scenarios where Lake Powell is hydrologically drawn down to low levels or run-of-river level.

In an announcement on August 16th, 2022²⁵, Reclamation outlined a number of actions it would take to address falling levels at Lake Powell. One of these actions states Reclamation will, “Take administrative actions needed to authorize a reduction of Glen Canyon Dam releases below 7 million acre-feet per year, if needed, to protect critical infrastructure at Glen Canyon Dam.”

²⁴ <https://www.usbr.gov/lc/region/g4000/riverops/crss-5year-projections.html>

²⁵ <https://www.usbr.gov/newsroom/news-release/4294?filterBy=year&year=2022>

This action highlights one of the structural limitations at Glen Canyon Dam, specifically its ability to operate and move water downstream to the Lower Basin States and Mexico solely through use of the river outlet works for months or years at a time. Tanya Trujillo, former Assistant Secretary for Water and Science, in an announcement stated, “Glen Canyon Dam was not envisioned to operate solely through the outlet works for an extended period of time and operating at this low lake level increases risks to water delivery and potential adverse impacts to downstream resources and infrastructure.” It’s unclear that the physical structure of the river outlet works are capable of safely operating at full capacity for long periods of time.

The recent strategy from Reclamation²⁶ is centered around propping up Lake Powell enough to meet legal requirements through increased releases from upstream reservoirs, and reduction of releases downstream. These efforts will only work in the short-term and don’t address the important structural problem of Glen Canyon Dam’s inability to meet legal delivery requirements downstream.

Even with the significant efforts to prop up Lake Powell, the Drought Response Operations Agreement (DROA) acknowledges that these efforts may not be enough to avoid dropping below minimum power pool. Line 453²⁷ of the DROA document states that “if dry conditions persist or worsen, available storage volumes for potential adjustments or releases may be insufficient to protect the Target Elevation at Lake Powell. As such, Drought Response Operations may be ineffective and therefore futile.”

In February of 2023, Reclamation hosted a webinar describing possible alternatives to re-engineer Glen Canyon Dam so that it may provide limited hydropower generation and continue delivering water at lower levels²⁸. The effort by Reclamation to have a discussion demonstrates there is an urgent need to begin the process of modifying Glen Canyon Dam. If the Colorado River is to survive the decades to come, we have to think about more than salvaging some hydropower at Glen Canyon Dam. **Reclamation’s ongoing efforts to study the structural modification of Glen Canyon Dam must be incorporated into the analysis and process of the Post-2026 Operational Guidelines.** The implications of structural modifications should be vetted thoroughly, especially in consideration to its effects on the environment. Both upstream of the dam in Glen Canyon and downstream in Grand Canyon National Park.

a. Engineering limitations of Glen Canyon Dam

When Reclamation designed Glen Canyon Dam, it prioritized two things: (1) water storage to allow the Upper Basin States to store their unused apportionment of Colorado River water while

²⁶ <https://www.usbr.gov/dcp/droa.html>

²⁷ [https://www.usbr.gov/uc/DocLibrary/Plans/20220103-Draft-2022DroughtResponseOperationsPlan-508-UCRO.pdf?ct=t\(October_Lotdown10_20_2016_COPY_01\)](https://www.usbr.gov/uc/DocLibrary/Plans/20220103-Draft-2022DroughtResponseOperationsPlan-508-UCRO.pdf?ct=t(October_Lotdown10_20_2016_COPY_01))

²⁸ <https://www.glencanyon.org/wp-content/uploads/2023/02/GCD-Low-Head-Hydropower-Modifications-alternatives-presentation.pdf>

meeting their delivery requirements, and (2) hydropower generation²⁹. The dam was not designed to run at the low reservoir levels we face in the era of aridification.

The eight hydropower penstocks collect reservoir water at elevation 3,470 feet above sea level are the primary means of moving water downstream. Once the reservoir dips below minimum power pool, elevation 3,490 feet above sea level, the only way for the dam to release water is through the river outlet works located at elevation 3,374. The outlet works have a much more limited structural ability to release water, with diminishing capacity as the reservoir drops closer to them, a function of reduced head pressure³⁰. The figure below, from *Futures of the Colorado White Paper #1*, breaks down the maximum release capacity of the outlet works, assuming they are run at full capacity.

Maximum rate of discharge through the river outlets as a function of Lake Powell elevation²⁰

Reservoir elevation, in feet above sea level	Maximum discharge through river outlets, in cubic feet per second	Maximum discharge rates through bypass tubes, in acre feet per year
3,500	15,000	10,900,000
3,490	14,650	10,600,000
3,450	12,600	9,090,000
3,440	11,400	8,280,000
3,430	10,200	7,410,000
3,420	8,800	6,370,000
3,400	4,800	3,470,000

Table from White Paper #1 demonstrating limited release capacity of river outlet works

b. Glen Canyon Dam is incapable of meeting delivery obligations at low levels

At elevation 3,430, the dam is physically incapable of releasing enough water annually to meet Upper Basin delivery obligations, based on current interpretations of the Law of the River³¹. Failure to deliver these agreed upon amounts could result in technical, legal, engineering, and environmental problems for all members of the Basin.

While the Upper Basin Delivery obligation of 7.5 million acre feet per year (and 75 million acre feet over ten years), is a cornerstone of the Law of the River, it should be noted that ongoing

²⁹ Bureau of Reclamation. Technical Record of Design and Construction: Glen Canyon Dam and Powerplant. (1966). <http://www.riversimulator.org/Resources/USBR/GCDtechnicalData.pdf>

³⁰ Bureau of Reclamation. Technical Record of Design and Construction: Glen Canyon Dam and Powerplant. (1966). <http://www.riversimulator.org/Resources/USBR/GCDtechnicalData.pdf>

³¹ Schmidt, John. White Paper #1: Fill Mead First – A Technical Assessment. (2016). https://qcnr.usu.edu/coloradoriver/files/CCRS_White_Paper_1.pdf

policy discussions around the Law of the River argue that this interpretation should be updated and that it is unrealistic for the “75 in 10” policy to continue as is³². Nevertheless, it is unclear what changes the Law of the River may undergo in the future, and it’s likely that Glen Canyon Dam’s structural limitations hinder the system’s ability to adapt to those changes.

c. Additional problems with operation of Lake Powell at or near deadpool

The river outlet works intakes are located nearly 240 above the bottom of the dam, meaning that a large pool of approximately 1.7 million acre-feet of water is effectively ‘stranded’ behind the dam³³. This large pool of water, commonly referred to as “deadpool”, could become a common occurrence in the near future at Lake Powell. In addition to the inability to access the 1.7 million acre-feet of water, operating near deadpool at Lake Powell would create a number of problems for the reservoir managers, Colorado River Basin water users, and other constituencies. Not the least would be a stagnant body of water sitting in a desert environment that would be conducive to stimulating harmful algal blooms and other water quality problems. Toxic algal blooms have already begun to emerge in Lake Mead, with one swimmer being killed by a brain-eating amoeba in 2022.³⁴

At deadpool, the reservoir is subject to rapid changes in elevation, due to the martini glass-like shape of Lake Powell’s vertical cross section. Nearly half of the reservoir’s capacity resides above 3,600 feet³⁵, meaning that when water levels drop to deadpool elevation ranges, even moderate inflows can cause water levels to rise over 100 feet in one season³⁶. This could create numerous problems for both reservoir visitors and the National Park Service recreation managers at Lake Powell.

These rapid elevation changes would force the National Park Service to move marinas and extend boat ramps, which is costly and increases safety risks. For most of 2021 and 2022, the majority of National Park Service and Tribally managed launch ramps were unusable. Current plans to adapt to declining reservoir levels include abandoning the current Bullfrog Marina site and moving those facilities into the main channel at an estimated cost of \$25 million dollars³⁷. With the significant cost of extending boat ramps, walking ramps and marina utility infrastructure, there may come a point of diminishing returns on increasingly large and frequent taxpayer investments. After such investments are made to adapt to deadpool elevations, a subsequent medium or large water runoff year could lead to significant damage to this new

³² <http://www.inkstain.net/fleck/2021/07/reverence-or-pragmatism-the-upper-colorado-river-basins-compact-dilemma/>

³³ Bureau of Reclamation. Technical Record of Design and Construction: Glen Canyon Dam and Powerplant. (1966). <http://www.riversimulator.org/Resources/USBR/GCDtechnicalData.pdf>

³⁴ USBR DSEIS, April 2023, Page 293

<https://www.usbr.gov/ColoradoRiverBasin/documents/NearTermColoradoRiverOperations/20230400-Near-termColoradoRiverOperations-DraftEIS-508.pdf>

³⁵ Root, J. C., & Jones, D. K. (2022). Elevation-area-capacity relationships of Lake Powell in 2018 and estimated loss of storage capacity since 1963 (No. 2022-5017). US Geological Survey

³⁶ Root, J. C., & Jones, D. K. (2022). Elevation-area-capacity relationships of Lake Powell in 2018 and estimated loss of storage capacity since 1963 (No. 2022-5017). US Geological Survey

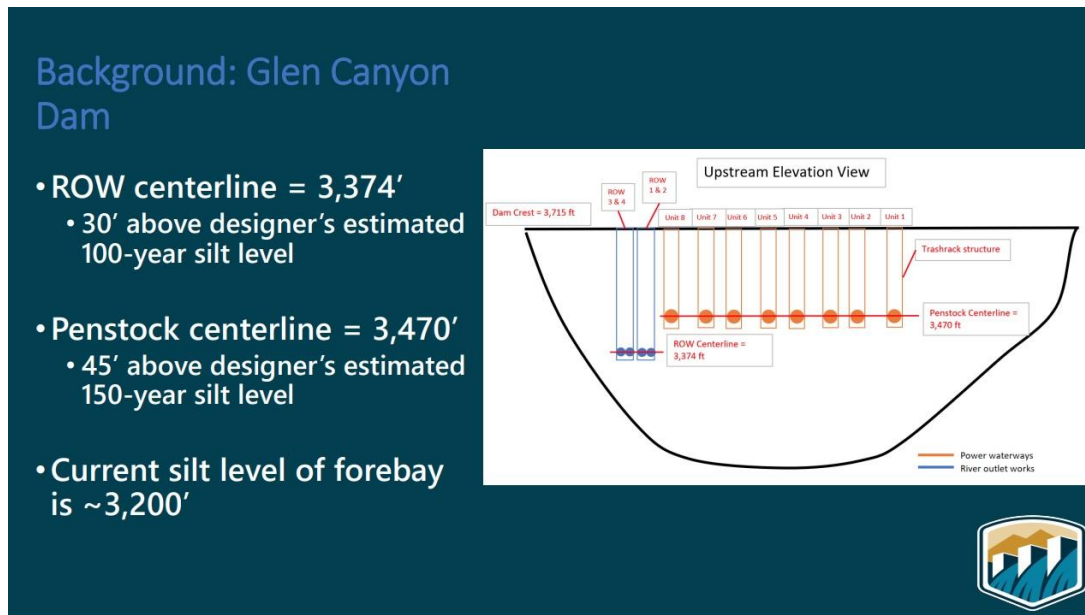
³⁷ Returning Rapids Project. Field Binder: The River Persists. (2022).

<https://www.glencanyon.org/product/2022-returning-rapids-field-binder-the-river-persists/>

infrastructure. This could create infrastructure challenges for the National Park Service, which is already suffering from a large backlog of maintenance projects.

In a scenario where the reservoir nears deadpool without subsequent engineering modifications to Glen Canyon Dam, its lifespan would dramatically decrease due to its storage volume being displaced with sediment. The Colorado River has the second largest natural sediment load of any large river in North America, moving an estimated 54-60 million metric tons of sediment per year into Lake Powell³⁸. When the reservoir is full, this amount of sediment displaces a relatively small portion of the reservoir. But when the reservoir is low, that proportion of sediment displacement will more quickly diminish the reservoir's smaller storage volume as sediment moves closer to the dam. According to the findings of Schmidt et al. (2016), if the reservoir were to remain at levels between power pool and deadpool, sedimentation will eventually reach the dam and directly affect flow into the River Outlet Works³⁹.

Sediment has been accumulating in the upper reaches of the reservoir for nearly 60 years, totaling a loss of 6.8% reservoir storage capacity since 1963⁴⁰. As the reservoir and its volume of stored water has declined, the rate of siltation has increased relative to its overall size.



Slide from USBR webinar on Glen Canyon Dam modifications, Feb 2023⁴¹

³⁸ Schmidt, John. White Paper #1: Fill Mead First – A Technical Assessment. (2016). https://qcnr.usu.edu/coloradoriver/files/CCRS_White_Paper_1.pdf

³⁹ Schmidt, John. White Paper #1: Fill Mead First – A Technical Assessment. (2016). https://qcnr.usu.edu/coloradoriver/files/CCRS_White_Paper_1.pdf

⁴⁰ Root, J. C., & Jones, D. K. (2022). Elevation-area-capacity relationships of Lake Powell in 2018 and estimated loss of storage capacity since 1963 (No. 2022-5017). US Geological Survey

⁴¹ <https://www.glencanyon.org/wp-content/uploads/2023/02/GCD-Low-Head-Hydropower-Modifications-alternatives-presentation.pdf>

Even without the depleted storage of Lake Powell, the dam was designed with an operational end date, exemplified by the estimated silt levels highlighted in the slide above. The slide shows that the original design of Glen Canyon Dam anticipated a silt level of ~3,344 ft by the year 2063. Currently, there is approximately 70 feet of silt behind the dam, which will continue to accumulate over time. As the reservoir has dropped, sediment has encroached farther downstream toward the dam⁴². **The above graphic highlights the reality that Glen Canyon Dam will have to be modified eventually, or become clogged with sediment.**

Should Lake Powell water levels drop down toward deadpool, the maximum water flow release capacity out of Glen Canyon Dam drops from 15,000 cfs to below 5,000 cfs. The reduction in water release capacity could have adverse effects on the Grand Canyon ecosystem. Below elevation 3,440 ft, downstream releases would likely need to be maximized to get water to the Lower Basin, meaning flows in the Grand Canyon could be constant over long periods of time—a flow scenario that would be damaging to the Grand Canyon’s ecosystem and beaches. These reduced flow capacities would limit the ability to conduct High Flow Experiments downstream and aggravate restoration efforts to improve sediment deficits in Grand Canyon National Park. Under these flow conditions, the fate of the Grand Canyon’s ecosystem would be in jeopardy, and would likely violate key provisions of the Grand Canyon Protection Act⁴³.

d. The need to model alternative scenarios where Lake Powell operating at low or run-of-river levels, including environmental benefits and costs

In addition to examining physical modifications at Glen Canyon Dam to allow water releases from low or run-of-river levels, there is a need to use CRSS or similar modeling tools to test how the entire Colorado River system would operate under such scenarios. The primary method of modeling Colorado River reservoirs is the Colorado River Simulation System (CRSS) system, which by design, only models reservoir storage scenarios conceptualized under existing operating criteria of the 2007 Interim Guidelines, 2019 Drought Contingency Plans, and DROA operations. **As stakeholders of the Basin develop operational strategies for Lake Powell and Lake Mead beyond 2026, it’s imperative that Reclamation model a wide range of scenarios, including ones in which Lake Powell is at low or run-of-river levels.**

The Futures of the Colorado Group has taken steps in this direction by modeling an array of scenarios⁴⁴ outside the limitations of existing operating criteria, but even this selection of scenarios do not represent a wide enough range to explore every storage regime available on the Colorado River. Using the CRSS tool to model alternatives outside of the current reservoir operating criteria, White paper #6 models and analyzed several different scenarios including variations of prioritizing storage Lake Mead over Lake Powell and vice versa. These analyses were an important step in the right direction building the data around informed discussions of new alternatives, but they didn’t go far enough, as they did not model the full drawdown of Lake Powell—a scenario which was once incomprehensible, but is now increasingly possible within a

⁴² <https://www.sltrib.com/news/2022/04/28/it-feels-like-dying/>

⁴³ Grand Canyon Protection Act of 1992, P.L. 102-575, Sec. 1802(a).

⁴⁴<https://qcnr.usu.edu/coloradoriver/files/news/white-paper-6.pdf>

scale of years as a function of reduced snowpack and a consistent supply/demand deficit. The focus of White Paper #6 was stabilization of the broader system, not averting the impending problems at Glen Canyon Dam.

A 2023 paper by Schmidt, Yackulic, and Kuhn⁴⁵ **highlights the potential benefits of fully bypassing Glen Canyon Dam**, stating:

”Another option for reservoir management is to entirely abandon reservoir storage in Lake Powell by drilling river-level diversion tunnels around Glen Canyon Dam. Diversion tunnels could be designed with emergency valves that could be closed in the unlikely event that large runoff filled Lake Mead and storage in Lake Powell was needed. Such an action would restore a natural stream flow and sediment regime to the Grand Canyon and might benefit some pre-dam elements of the Colorado River ecosystem, although there would likely be a multi-decadal period of ecosystem adjustment to the new flow and sediment conditions.”

The paper highlights the **potential benefits to native fish species**, several of which are endangered, as well as **a possible solution to the growing threat of nonnative fish** in the Grand Canyon.

“This management option would also lead to increases in water temperature and changes in the fish community, including elimination of the nonnative, tailwater trout fishery. Such a strategy would increase turbidity and favor some nonnative fish species like carp and channel catfish over other nonnative fish species such as smallmouth bass. Carp and channel catfish coexisted with native fish species in the Grand Canyon for decades prior to construction of Glen Canyon Dam (Mueller & Marsh, [2002](#)) and may represent a lesser threat to the continued persistence of native fish species than do smallmouth bass.”

In order to have an informed discussion among Basin stakeholders, it’s imperative to understand the benefits and tradeoffs of potentially phasing out Lake Powell entirely. As such, discussions around Post-2026 Operating Guidelines must utilize CRSS modeling of scenarios that includes Glen Canyon Dam being operated at levels below what the dam is physically capable of currently.

5. The need to include an assessment of emerging ecological, cultural, and recreational resources in Glen Canyon, Cataract Canyon, Narrow Canyon, and the San Juan River.

Since the 2007 Interim Shortage Guidelines, new resources have emerged in Glen Canyon that were not accounted for in the previous NEPA analysis. Given the significance of these resources under NPS responsibilities and the mandates of the Grand Canyon Protection Act,

⁴⁵ <https://wires.onlinelibrary.wiley.com/doi/10.1002/wat2.1672>

the Post-2026 Operational Guidelines NEPA analysis must recognize and include an analysis of the importance of the emerging recreational resources in the tributary rivers and canyons, including rafting and hiking in Glen Canyon, and recognize the impact that operational strategies will impact environmental resources including vegetation, wildlife, and archeological/cultural sites in Glen Canyon. Many of these resources were unaccounted for when Glen Canyon Dam was constructed and today require a different perspective on their management and protection.

a. NPS Mandates, Grand Canyon Protection Act, and Endangered Species Act

Similar to the 2007 Interim Shortage Guidelines, the Post-2026 Guidelines will require extensive cooperation with the National Park Service (NPS). With ten national park units directly affected by Colorado River operations, NPS should be an official cooperating agency in developing and assessing operational strategies. They were in the Glen Canyon Environmental Studies (1982-1996) and should be afforded the same level of engagement now. The decisions made around how Glen Canyon Dam is operated will have widespread effects on areas and resources that fall under the jurisdiction of NPS. As NPS is responsible for “conservation of natural and cultural resources and administers visitor use”⁴⁶, it is essential that decisions around how to manage Lake Powell, Glen Canyon, Grand Canyon, and Canyonlands incorporate up-to-date information on changing and emerging resources in those park units.

Additionally, Public Law 102-575, which includes the Grand Canyon Protection Act requires that Glen Canyon Dam be managed “in such a way as to protect, mitigate adverse impacts to and improve the values for which Grand Canyon National Park and Glen Canyon National Recreation Area were established, including, but not limited to natural and cultural resources and visitor use⁴⁷.” Public Law 102-575 has not been repealed and as such has to be acknowledged and used to establish the parameters of the Post-2026 analysis.

Reclamation must plan and manage for Endangered Species Act compliance not just in Grand Canyon national park, but for Glen Canyon National Recreation Area. With thus far minimal species monitoring in the “restoration zone” of GCNRA (above reservoir level and below 3,700), **the extensive emerging ecosystems could provide habitat for threatened and endangered species**, something that was highlighted in the Draft SEIS⁴⁸, which stated, “Declining lake levels would likely expand or increase habitat for Colorado pikeminnow, razorback sucker, flannelmouth sucker, and bluehead sucker in the inflows to Lake Powell as riverine habitat would increase in the San Juan River and Colorado River inflows.” Additionally, a Mexican Spotted Owl (threatened species) was seen in an emerged side canyon in GCNRA in 2022.⁴⁹

⁴⁶ <https://www.usbr.gov/lc/region/programs/strategies/RecordofDecision.pdf>, page 3

⁴⁷ Grand Canyon Protection Act of 1992, P.L. 102-575, Sec. 1802(a).

⁴⁸

<https://www.usbr.gov/ColoradoRiverBasin/documents/NearTermColoradoRiverOperations/20230400-Near-termColoradoRiverOperations-DraftEIS-508.pdf>

⁴⁹ <https://www.sltrib.com/news/environment/2022/08/28/glen-canyons-side-canyons-spring/>

b. Emerging Resources in Glen Canyon tributary canyons

Geologic Wonders

Glen Canyon National Recreation Area has experienced extreme changes in the past 20 years as Lake Powell water levels have receded. As of spring 2023, over 100,000 acres of land that were once inundated under Lake Powell had emerged⁵⁰. Unique geologic and natural features like Cathedral in the Desert, Gregory Bridge, La Gorce Arch, and countless waterfalls, grottos, alcoves, and other natural wonders once again became highlight features of the park unit.

These one-of-a-kind features are what inspired former Interior Secretary Harold Ickes to propose making Glen Canyon the central part of a larger Escalante National Monument in the 1930's, and what inspired countless western writers like Wallace Stegner, who said Glen Canyon would have made a "superb national park". The emergence of these emerging treasures have garnered attention from national⁵¹ and international media outlets, and have even been used for tourism promotions by GCNRA concessionaires⁵². When the level of Lake Powell rises, these features are submerged by the reservoir, and are effectively lost to visitors.

The Post-2026 Guidelines must acknowledge the negative impacts the reservoir has on these unique geologic features and the intrinsic value that they have to both American and global citizens alike.

Reestablishing Vegetation

As the reservoir levels have dropped, a large-scale ecological succession is taking place in Glen Canyon and its side canyons, tributary rivers, and streams. In Spring of 2023, with over 40 new miles of the Colorado River flowing once again in what used to be the northern reach of Lake Powell, 40 miles on the San Juan River, 13 miles flowing on the Escalante River, 10 Miles on the Dirty Devil River, and hundreds of linear miles of creeks and stream flowing in the 100-plus side canyons of Glen Canyon, the ecosystems surrounding Glen Canyon are rebounding⁵³.

In many once-drowned tributary canyons of Glen Canyon, well-established groves of native species like Goodings Willow, Coyote Willow, and Fremont Cottonwoods are thriving⁵⁴. These riparian forests are of great significance in many places throughout the Colorado River Basin, with resource managers going to great lengths to restore and protect them. Recent research has documented the return of plant life in the emerged canyons, which in many places has an abundance of native plant species such as globemallow, wirelettuce, scorpion weed, sacred datura, four wing salt bush, matted crinkle mat, wooly plantain, Jone's blue star, woody aster, desert trumpet, milkvetch, sticky brittle bush, purple three awn, common pepperweed, threadleaf sunflower, Indian rice grass, sand sage, and prickly pear cactus⁵⁵.

⁵⁰ Root, J. C., & Jones, D. K. (2022). Elevation-area-capacity relationships of Lake Powell in 2018 and estimated loss of storage capacity since 1963 (No. 2022-5017). US Geological Survey.

⁵¹ <https://www.newyorker.com/magazine/2021/08/16/the-lost-canyon-under-lake-powell>

⁵² <https://marketing.revinate.com/public/promotion/view-in-browser/message-log/97e341cc-9266-4408-9b84-e434c4f437c8>

⁵³ <https://www.sltrib.com/news/environment/2022/08/28/glen-canyons-side-canyons-spring/>

⁵⁴ <https://content.jwplatform.com/previews/6H3H1RhH>

⁵⁵ Babtiz, Kendra, MPP. The Botanical Recovery of 50-Mile Canyon, *Hidden Passage: The Journal of Glen Canyon Institute*, issue XXV, Fall 2019 <https://www.glencanyon.org/wp-content/uploads/2020/02/Hidden-Passage-25.pdf>

Functional groups - all 2022 sites

- 40 sites
 - 14 above 3,700', 26 below 3,700'
- Above 3,700'
 - Greater plant cover
 - Greater cover of cactus, crust, trees
- Below 3,700'
 - More forbs, but no difference between annual and perennial
 - More bare ground



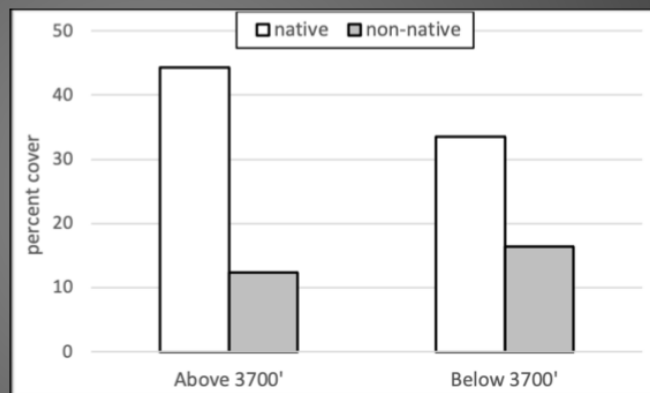
* Significant difference at $p < 0.1$
 ** Significant difference at $p < 0.05$

Graph by Seth Arens, WWA 2023⁵⁶

A new and ongoing vegetation survey⁵⁷ led by researcher Seth Arens of Western Water Assessment is looking at the vegetation composition in emerged areas in Glen Canyon, and has found that areas that have been out of water for more than 2-3 years are generally dominated by native plant species like willow and cottonwoods⁵⁸. As of summer 2023, the survey has established 89 transects in 20 locations throughout Glen Canyon.

Native vs. non-native - all sites

- Sites that have been exposed for longer periods trend toward more native coverage
- Most abundant non-native species:
 - Tamarisk (*Tamarix ramosissima*)
 - Russian Thistle (*Salsola tragus*)
 - Cheat Grass (*Bromus tectorum*)
 - Awned Barnyard Grass (*Echinochloa crus-galli*)
 - Ravenna Grass (*Saccharum ravannae*)



Graph by Seth Arens, WWA 2023⁵⁹

⁵⁶ <https://www.youtube.com/watch?v=Yfyb6dNLsx0>

⁵⁷ https://www.colorado.edu/sites/default/files/2023-06/CataractCanyonPoster_051123.pdf

⁵⁸ <https://www.youtube.com/watch?v=Yfyb6dNLsx0>

⁵⁹ <https://www.youtube.com/watch?v=Yfyb6dNLsx0>

It should be noted that the findings of this vegetation survey are a stark contrast to the descriptions of emerging ecosystems in the 2023 DSEIS. The impact analysis of that EIS acknowledges on page 233 that **the agencies lack any reliable data on new vegetation in Glen Canyon**, stating, "Vegetation monitoring does occur in the upland areas of the recreation area, but no studies have been conducted on the riparian habitat along the lakeshore."⁶⁰ Then it contradictingly claims, "currently, tamarisk and Russian thistle are the dominant vegetation type along the shores of Lake Powell. Dense stands of tamarisk displace native plants, degrade wildlife habitat, reduce livestock forage, limit human access, interfere with the natural fluvial process, and increase the risk of severe wildfires."

This description of new vegetation and ecological succession in Glen Canyon is woefully inaccurate, and based on outdated, anecdotal, or non-existent data. In order for decision makers to accurately weigh the impacts of water operations on the ecosystems in Glen Canyon, a thorough study of its ecosystems must be incorporated into the decision making assessment and process.

New Wildlife Habitat

The DSEIS also erroneously claims the emerging vegetation is harming wildlife. This couldn't be further from the truth. Abundant wildlife has been documented in emerged canyons of Glen Canyon including bighorn sheep, mule deer, coyote, bobcat, beaver, river otter, numerous birds, lizards and snakes⁶¹. Dozens of invertebrate species such as bees, beetles, and dragonflies have also been documented in the emerged areas⁶². These emerging landscapes provide native species the ability to compete with non-native species and to add to the ecological integrity of the Colorado River system. They may also be providing streamside habitat for threatened or endangered species such as the Willow Flycatcher or Yellow Billed Cuckoo. The western United States has lost thousands of acres of habitat for native species due to various forms of development and use. Recognizing Glen Canyon's unique place in the landscape for both human and non-human species must be considered in the analysis of the new operational guidelines.

Archeology

Glen Canyon is home to thousands of archeological sites that have been inundated by the water behind Glen Canyon Dam. Many of these culturally significant archaeological sites, including structures and rock art, have emerged along with other resources^{63,64}. The Post-2026 Guidelines must recognize impacts of reservoir operations on these socially and culturally important resources. With the 65 foot rise of Lake Powell in Summer 2023, 30,000 acres⁶⁵ of lake shore

⁶⁰

<https://www.usbr.gov/ColoradoRiverBasin/documents/NearTermColoradoRiverOperations/20230400-Near-termColoradoRiverOperations-DraftEIS-508.pdf>

⁶¹ McGivney, Annette, *Resurrection: Glen Canyon and a New Vision for the American West*, 2009, Braided River Publishing

⁶² <https://www.glencanyon.org/13220-2/>

⁶³ <https://www.sltrib.com/news/2022/10/24/cultural-sites-are-being/>

⁶⁴ <https://www.knau.org/knau-and-arizona-news/2022-05-12/archaeological-sites-once-thought-lost-under-lake-powell-reappear-as-water-drops>

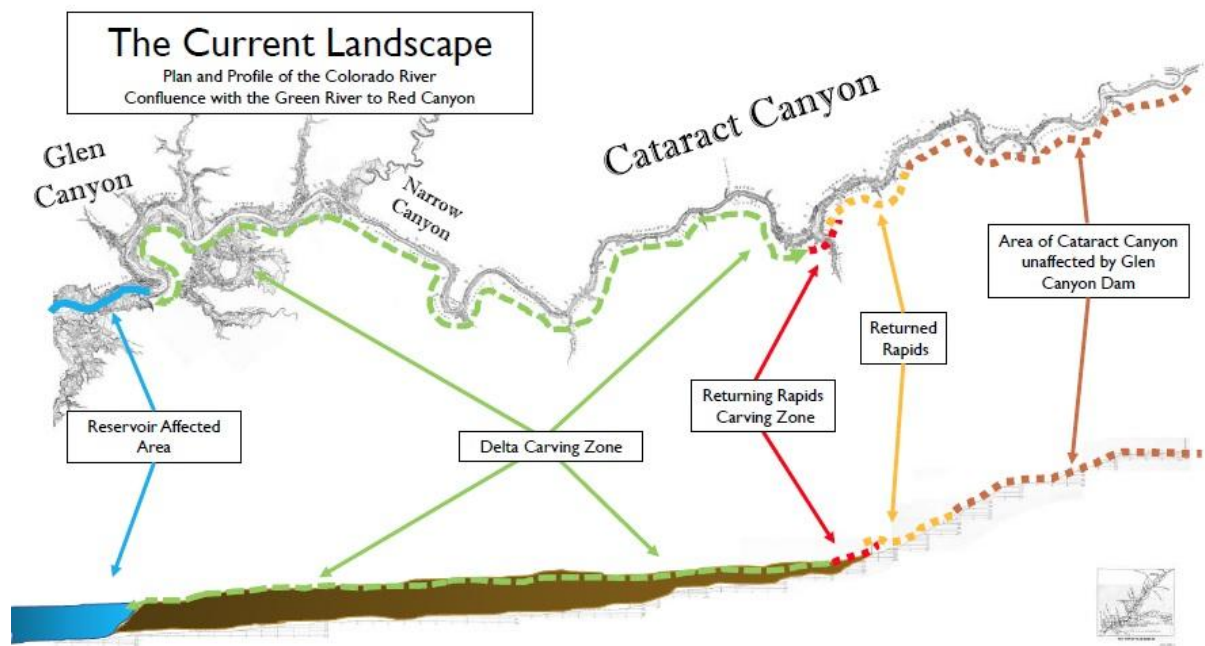
⁶⁵ Root, J. C., & Jones, D. K. (2022). Elevation-area-capacity relationships of Lake Powell in 2018 and estimated loss of storage capacity since 1963 (No. 2022-5017). US Geological Survey.

and tributary canyon were once again submerged, which re-drowned exposed archaeological sites, likely causing additional damage beyond what occurred when the reservoir first filled.

The Glen Canyon landscape has cultural, social, and historical significance to multiple Colorado River Basin indigenous tribes, early Mormon settlers, and to many early explorers and river runners. The future management of these resources should include a different approach than was used in the late 1950's and early 1960's when the Department of the Interior only focused on 'recovery of artifacts'. The Post-2026 Guidelines need to include active and consistent tribal input on the management of reservoir operations to protect all resources, not just the water.

c. Emerging resources in Colorado and San Juan Rivers

Cataract Canyon, located below the confluence of the Green and Colorado Rivers, is home to some of the most notorious whitewater in North America. It is known by many river rafters and guide companies as "Utah's Grand Canyon". When Lake Powell was full, the flowing river and whitewater rapids of Cataract Canyon ended below Big Drop 3 Rapid, which is also the boundary between Canyonlands National Park and Glen Canyon National Recreation Area. Since Lake Powell's decline from its most recent peak in 1999, the Colorado River in Cataract Canyon has reestablished itself in what used to be a reservoir.



Map and cross section of emergent sections of Colorado River entering Glen Canyon. Returning Rapids 2022 Field Binder.

What was left behind from Lake Powell's retreat are massive sediment deposits in the Cataract, Narrow Canyon (just downstream), and upper Glen Canyon. Over the years, a large amount of reservoir sediment in Cataract has been scoured away, and the natural characteristics of the Colorado have begun to reestablish. This transformation has been documented extensively by

The Returning Rapids Project⁶⁶, which has conducted numerous research trips in the reemergence area with coordination from NPS, USGS, GCMRC, and multiple researchers from the University of Utah and Utah State University.

Cataract Canyon is 41 miles long and historically had 49+ rapids in its approximately 400 feet of gradient. Out of those 41 miles, 24 were affected by the reservoir and its resulting sediment delta. Out of the 49+ rapids, all but 23 were impacted by the reservoir and then covered by the sediment delta. Since the retreat of the reservoir beginning in the mid 2000s, 7 major rapids have since reemerged. In spring of 2023, there were approximately 44 miles of flowing river in the mainstem Colorado River that were once inundated⁶⁷.

In Cataract Canyon, the return of the river and its whitewater rapids have created a recreational experience that hasn't been available since the reservoir first drowned the canyon. **3,000 to 4,000 visitors to the park unit raft down this section of river every year**⁶⁸. The prospect of a returning river rafting economy to Glen Canyon has been discussed publicly by former GCNRA superintendent Billy Shott⁶⁹. The rapids that have returned in lower Cataract Canyon add a significant experiential value to a Cataract Canyon trip — one of Utah's most popular rafting destinations and most popular expeditions from outfitting companies around the region. For most of the past 5 years, there has been river current all the way to the Hite area, and parties can run Cataract without the use of motors — which reduces the overall carbon footprint of this recreational activity.

There has also been significant ecological succession on the mainstem Colorado River in Cataract Canyon below full pool elevation. Vegetation surveys by Seth Arens of Western Water Assessment⁷⁰ have shown a snapshot of what those plant assemblages look like from survey work at several sites at tributary canyons within Cataract. A summary of the study states:

“Across all sites and years, 44 vascular plant species were observed in belt transects. At sites above 3,700 feet and not flooded by Lake Powell, 41 plant species were observed; at sites below 3,700 feet, 28 plant species were observed. Plant species present in transects were generally typical to Colorado Plateau upland desert and riparian ecosystems. Several previously flooded sites were dominated by native shrub species (coyote willow and seep willow), had lower abundance of non-native plants and native shrubs were generally more abundant than the non-native tamarisk.”

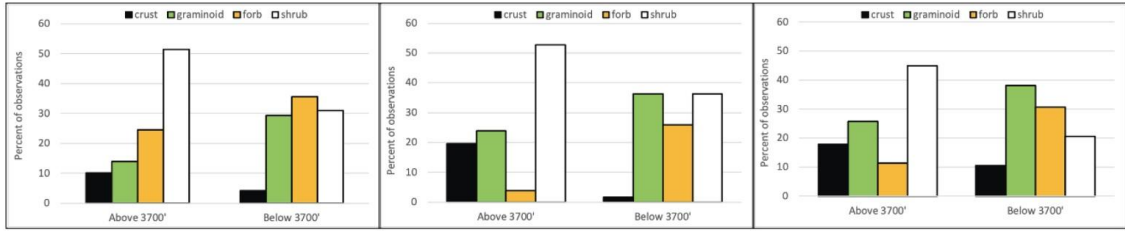
⁶⁶ <https://www.returningrapids.com/>

⁶⁷ Returning Rapids 2023 Field Binder

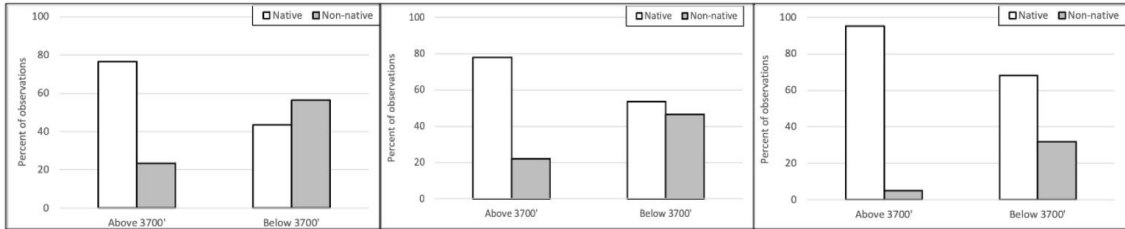
⁶⁸ Returning Rapids 2023 Field Binder

⁶⁹ <https://lakepowellchronicle.com/article/the-future-of-gcnra-lake-powell>

⁷⁰ https://www.colorado.edu/sites/default/files/2023-06/CataractCanyonPoster_051123.pdf



Percent of plant species observations by plant functional group, including a category for cryptobiotic crust and site elevation from belt transects at all sites in 2019 (left), 2020 (center) and 2021 (right).



Percent of native and non-native plant species observations grouped by site, above (not flooded) or below (flooded) 3,700 feet, from belt transects at all sites in 2019 (left), 2020 (center) and 2021 (right).

Charts on Cataract Canyon vegetation above and below elevation 3700 ft. Seth Ares, WWA.

On the San Juan River, a similar emergence of the river corridor has taken place with the retreat of Lake Powell. In Spring of 2023, there were approximately 45 miles of flowing river into areas once submerged by Lake Powell. The geographic characteristics of the San Juan River are different from the mainstem Colorado: the river gradient is less steep, and the pre-dam river channel was much wider with areas where the river braided through wide shallow reaches.



A group of river boaters camped at the mouth of Nokai Canyon on the San Juan River in April 2023 - an area that used to be submerged by Lake Powell. Returning Rapids 2023 Field Binder. Elliot Ross Photo.

At full pool in the 1980s-2000, the reservoir backed the river up all the way to Grand Gulch. As the reservoir level receded in the 2000s, the aggradation of sediment did not. It's possible that the full pool level being near Paiute Farms greatly amplified the area's ability to trap sediment. The continued backfill traveled upstream several more miles, covering the river corridor and rapids with sediment up to 40 feet **above Lake Powell's full pool line**⁷¹.

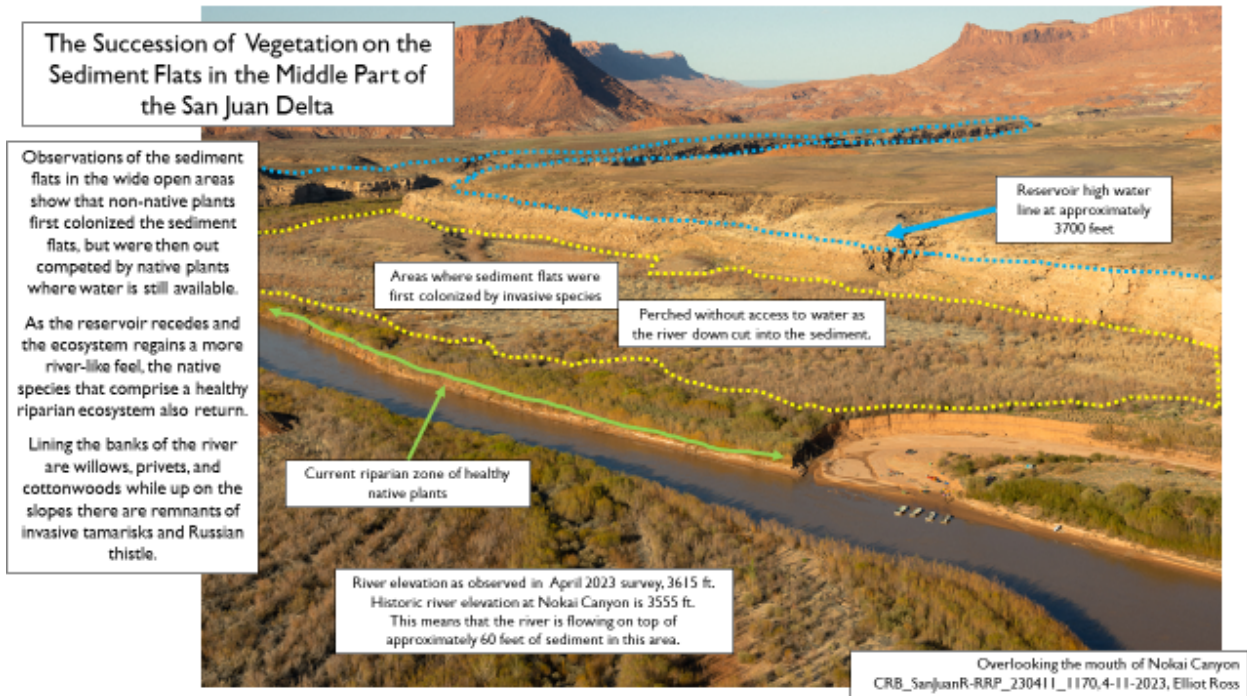


Image highlighting new vegetation on the emerged riparian corridor of the San Juan River near Nokai Canyon. Returning Rapids 2023 Field Guide. Elliot Ross Photo.



Rafter floats next to a large grove of cottonwood trees on the San Juan River at elevation ~3,630 ft.

⁷¹ Returning Rapids 2023 Field Binder

The rapidly changing river corridors of the Colorado and San Juan Rivers are providing new recreational opportunities in GCNRA that didn't exist in the 2007 Interim Guidelines, as well as large-scale ecological succession. These emerging areas are enhancing the ecosystem and helping to provide habitats for listed and endangered species.

On page 296 of the Draft SEIS released by Reclamation in 2023, the document states, "Whitewater boating is the key recreational activity in the Grand Canyon from Lees Ferry to the Diamond Creek or Pearce Ferry take-outs. Other reaches are not predominantly whitewater localities; therefore, they will not be discussed in this section." It fails to list anything about the returned river corridor in Cataract Canyon and flowing river on the San Juan. Referring to this area solely as "Lake Powell" and not Glen Canyon demonstrates that reservoir recreation is favored over river ecosystems. This section solely discusses the potential impacts to reservoir and reservoir-based recreation. There is no mention of how to manage both the rivers *and* the reservoir. **In order to fully understand the environmental and recreational impacts of reservoir operations on these sections of river, these significant resources must be taken into consideration in the Post-2026 EIS. The American public deserves to get an accurate assessment of the recreational resource values that Glen Canyon can and does supply.**

6. The need to consult tribes on impacts to Glen Canyon Resources

According to the National Park Service, 19 American Indian tribes and bands have an association and cultural affiliation with Glen Canyon — including contemporary descendants of the people who left behind the thousands of archeological sites in the canyon⁷². The Navajo, Hopi, Ute, Southern Paiute, Zuni and Puebloan tribes all have deep connections to Glen Canyon, and consider it to be part of their ancestral homelands. When the canyon was flooded, hundreds of tribal members were displaced⁷³ — their homes, farms and sacred sites drowned⁷⁴. As more ancestral lands emerge from the reservoir, there is an opportunity for the federal government to develop cooperative tribal management associated with their historical use of the area. There could be recreational economic opportunities for guiding, like the Hualapai tribe does in the Grand Canyon, or the Navajo Nation does in Antelope Canyon. The Post-2026 EIS should consult tribal leadership on management of Glen Canyon's emerging archeological, ecological, and recreational resources.

7. The need to for a sediment management plan in Glen and Grand Canyon

With the combination of Lake Powell's retreat and the massive amounts of sediment accumulating in Glen Canyon every year, massive sediment deltas are emerging and consistently moving in Glen Canyon, and deserve careful consideration in operational strategies under the Post-2026 NEPA process.

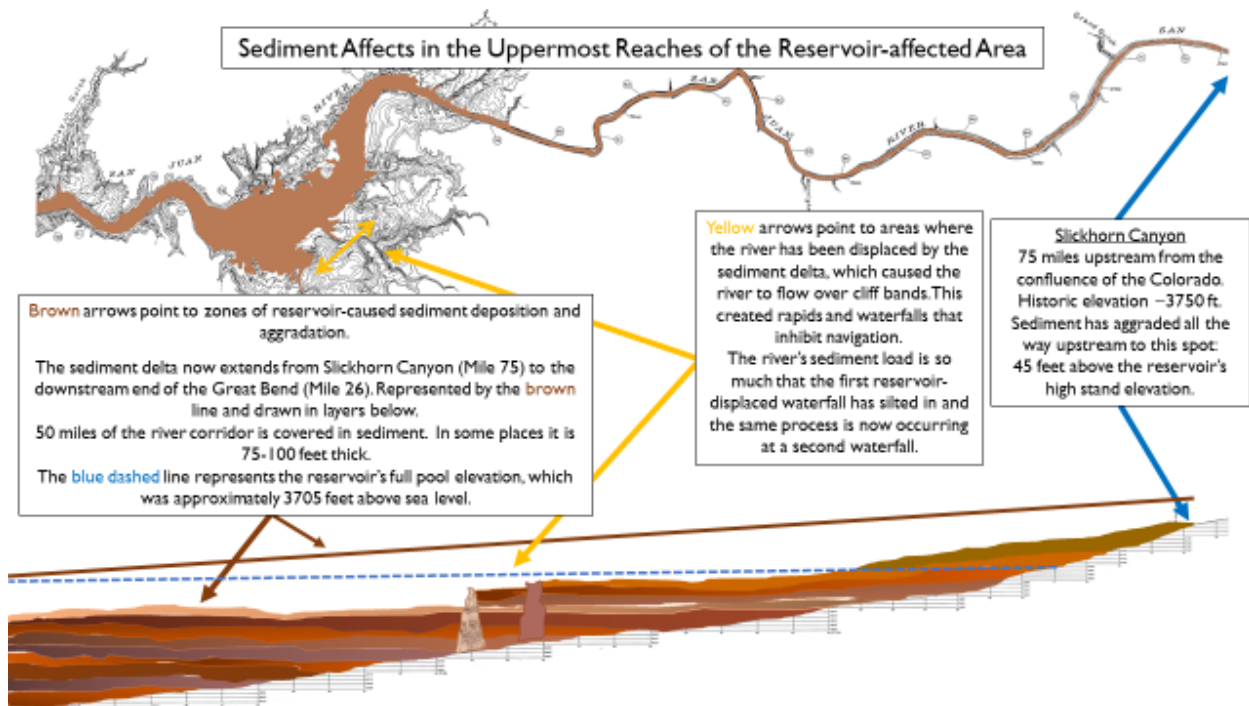
⁷² <https://www.nps.gov/glca/learn/management/foundation-document.htm>

⁷³ https://digitalrepository.unm.edu/hist_etds/21/

⁷⁴ Graham, Taylor. Oral Histories: Charley Bullets on Glen and Grand Canyon, *Hidden Passage: The Journal of Glen Canyon Institute*, issue XXVI, Fall 2020 <https://www.glencanyon.org/wp-content/uploads/2021/02/Hidden-Passage-Final-Version-2021.pdf>

These deltas are moving down through the mainstem river canyons. In the coming 20-50 years these “mud glaciers”⁷⁵ will greatly affect the viability of the reservoir’s storage capacity. In areas where the reservoir once was, mitigation efforts need to be taken where the sediment is damaging resources.

On the San Juan River, the original river channel has been displaced causing a waterfall at Paiute Farms, which will create challenges for future rafting recreation and ecological challenges. The lack of riverine ecosystem connectivity at the falls has impacts on native fish populations. The waterfall has blocked upstream sediment from the San Juan, impacting not just the newly flowing sections of river below Lake Powell’s full pool level, but even causing river sediment to back up farther upstream⁷⁶. A sediment management plan should include some monitoring of the Paiute Farms waterfall and how it is impacting resources above the 3,700 elevation level.



Graphic showing sediment cross sections and waterfall formations on the San Juan River. Returning Rapids 2023 Field Binder.

It’s believed a similar waterfall may soon develop near Hite at the end of Narrow Canyon⁷⁷. The emergence of such a waterfall would create a significant safety hazard and impact the recreation opportunities for private boaters and outfitters who utilize that section of river. If a

⁷⁵<https://www.kunc.org/environment/2022-08-04/a-mud-caked-terra-incognita-emerges-in-glen-canyon-as-lake-powell-declines-to-historic-low>

⁷⁶ Gene Stevenson, March 2000

⁷⁷ <https://www.sltrib.com/news/2022/04/03/waterfall-could-soon-form/>

reservoir-caused waterfall forms near the Hite area, Reclamation must assess the feasibility of dredging or directing the river back in its original channel.

Any long term operation plans must include development of a comprehensive sediment plan in Glen Canyon. This plan should address issues related to waterway access (river or reservoir), resource impacts, and resource remediation above areas where the reservoir will likely not be anymore. Understanding the sediment dynamics will allow the National Park Service, the Bureau of Reclamation and the State of Utah to actively manage infrastructure and public safety programs within Glen Canyon National Recreation Area. The recently completed USGS sediment survey of Lake Powell should form one of the elements of this assessment.

8. The need to assist NPS in planning for a Glen Canyon in the 21st century

With conditions changing so rapidly on the ground in Glen Canyon National Recreation Area, it will be vital for the Post-2026 NEPA process to provide the resources to assist NPS in planning for adapting to new physical realities at the park. GCNRA's management plan has not been updated since 1979⁷⁸. GCNRA develops its facilities planning based on projections and guidance from Reclamation⁷⁹. The recreation landscape at the park is changing at speeds that are almost impossible for the park to keep up with. Last year, there was a two month period where nearly every boat ramp at the reservoir was non-operational, with boat ramps being extended and marinas being moved as quickly as possible. Hite and Dangling rope marinas have closed indefinitely.

GCNRA has stated recreational use on the emerged Colorado River in Cataract Canyon/North Glen Canyon has increased dramatically, as has land based recreation around the park⁸⁰. Yet, the takeout ramp for Cataract Canyon rafting trips near Hite, UT has repeatedly degraded in recent years, creating a safety hazard as well as deterring recreational visitation to the area. Recent communications from GCNRA have indicated possible plans for this access point, but with no timeline, which could mean this serious safety issue could persist for years. Public safety in a National Park cannot be left unattended or ignored.

If Lake Powell is to be managed at low levels moving forward, the Post-2026 NEPA analyses must include planning for a permanent solution for the Hite boat ramp and the broader recreation area. Without a more comprehensive approach to the evolving recreation characteristics in the park, GCNRA will be forced to simply react to problems or ignore them as they come. While the disappearance of Lake Powell creates big challenges for many stakeholders, it has nonetheless created significant recreation opportunities in the park. The Post-2026 analyses and resource planning need to optimize management for this reality, pursuant to the mission of the NPS and Grand Canyon Protection Act.

⁷⁸ <https://parkplanning.nps.gov/parkHome.cfm?parkID=62>

⁷⁹ <https://www.nps.gov/glca/learn/changing-lake-levels.htm>

⁸⁰ Glen Canyon Gazette, volume 2, issue 1, August 5th, 2022

9. The need to study operational alternatives that include reservoir consolidation and prioritization of Lake Mead

Many leading scientists and policy experts along the Colorado River have advocated for a management approach where Lake Powell and Mead are viewed as one unit of water storage, rather than two separate storage facilities⁸¹. Some experts have even made the point that since Upper Basin users don't actually pull water from the reservoir, it is effectively a Lower Basin reservoir. Given the reality that Lake Powell narrowly avoided dipping below minimum power pool last year, and Reclamation is currently assessing re-engineering the dam to operate below deadpool, and a tremendous amount of emerged resources exist in Glen Canyon below its full pool elevation, the Post-2026 EIS should model alternatives where Lake Powell is operated at low or even run-of-river levels. **These alternatives should include reservoir consolidation, and prioritization of Lake Mead as the Colorado River's primary storage facility.** The scenarios modeled should include a rule that utilizes Lake Powell as a backup facility, not to be filled past 3,550 except for emergency situations.

From a perspective of maximizing water supply, the two-reservoir concept might have made sense in the 1956 Colorado River Storage Project Act and again in the 1968 Colorado River Basin Act. The underlying assumption was that the system would be operated and managed at a near full level. The realities of climate change and the impacts it is having on basin hydrology now requires us to assess those assumptions of the original basin development and determine if they are still valid for looking forward. The Federal government is supposed to be forward looking for its citizens and this is an opportunity to do that.

A 2013 legal analysis by Larry McDonnell explored the concept, stating "There may be opportunities to put in place measures that would reduce the likelihood of a 75/10 shortfall such as using an accounting system to smooth out the annual variability of flows and even a relaxation of the requirement under certain circumstances⁸²." Additionally, it's crucial that the Post-2026 NEPA analysis assess options for Upper Basin states to store water in Lake Mead in the form of an Intentionally Created Surplus (ICS). Similar ICS tools were essential in the 2007 Interim Guidelines and provided a framework and incentive for water users to conserve⁸³.

Some policy experts have recently argued that the Upper Basin's delivery obligation is unsustainable in a dwindling river system. If the delivery obligation is changed, the primary purpose of Glen Canyon Dam will change as well. As Eric Kuhn, former Director of the Colorado River Water Conservation District, said at the Getches Wilkinson Annual Summer Conference in 2023⁸⁴, "If the risk of a curtailment on the Upper Basin... is off the table, then the purpose of Lake Powell becomes very different". In an operational scenario where the Upper Basin is no longer required to release 75 million acre feet every ten years at Lee Ferry, the Upper Basin

⁸¹ <https://qcnr.usu.edu/coloradoriver/files/news/fs-white-paper-6.pdf>

⁸² McDonnell, Larry, Potential Legal Issues under the Law of the River Associated with the Fill Mead First Proposal, *The Water Report*, Issue 112: June 15, 2013

⁸³ <https://www.usbr.gov/lc/region/programs/strategies/RecordofDecision.pdf>

⁸⁴ <https://www.youtube.com/watch?v=OLXX8vyMf50>, minute 1:21:00

could then be allowed to count its delivery further downstream at Lake Mead. Even in amounts lower than 7.5 million acre feet, the omission of the delivery obligation would open up more flexibility to consolidate storage in one reservoir versus the other in an effort to minimize evaporative and seepage losses, and optimize environmental conditions in Glen Canyon and Grand Canyon.

An accounting approach that prioritizes water storage in Lake Mead could offer flexibility to the system, encourage conservation in the Upper Basin, and may save 30,000-50,000 acre feet a year by avoiding higher ground-seepage rates in Glen Canyon⁸⁵. Though such an idea was considered outside the scope of previous NEPA analyses, it is now essential to look at as one of the potential options considering the current and anticipated hydrology of the Colorado River. Analyzing options for Upper Basin storage in Lake Mead in the Post-2026 NEPA process will provide all stakeholders in the Basin the information needed to assess the best approach to water storage in the decades ahead.

Glen Canyon Institute and other signers to this letter support a scientific approach to assessing the impacts of Glen Canyon Dam on the resources of Glen Canyon and the Grand Canyon. We stand ready to support a scientifically based, transparent, and forward looking approach to future operations of the Colorado River. We encourage the Bureau of Reclamation to meaningfully include Colorado River Tribes in ensuring that in the process all aspects are considered equally and without bias.

Thank you for taking the time to consider our comments.

Sincerely,

Eric Balken, Glen Canyon Institute
Zach Frankel, Utah Rivers Council
Mike DeHoff, Returning Rapids Project
Kyle Roerink, Great Basin Water Network
John Weisheit, Living Rivers
Erika Pollard, National Parks Conservation Association

⁸⁵ <https://qcnr.usu.edu/coloradoriver/news/wp1>