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In Reply Refer To:
FWS/R2/ES-ARD/080853
IMDO-RSS-EQ (1248)

Russell Callejo
Post-2026 NEPA Project Manager
Bureau of Reclamation
Mail Stop 84-55000
P.O. Box 25007
Denver, Colorado 80225

Dear Mr. Callejo:

The U.S. Fish and Wildlife Service (Service) and the National Park Service (NPS) appreciate this opportunity to comment on the Bureau of Reclamation's (Reclamation) Colorado River Basin Post-2026 Operations Exploration Tool (on-line modeling tool) regarding the Development of Post-2026 Operational Guidelines and Strategies for Lake Powell and Lake Mead. We have prepared our comments in consideration of the Endangered Species Act of 1973 (16 U.S.C. *et seq.*) (ESA) as amended, National Wildlife Refuge System Act (16 U.S.C. § 668dd), Fish and Wildlife Coordination Act (16 U.S.C. § 661-666(e), NPS Organic Act (16 U.S.C. 4.Aug.25, 1916, ch 408 §4, 39 Stat. 536) National Historic Preservation Act (NHPA) (16 U.S.C §470a-470w-6 et. seq) , and Grand Canyon Protection Act (GCPA) (title XVIII, secs. 1801-1809, of Public Law 102-575)

Reclamation has encouraged all Colorado River stakeholders to use the on-line modeling tool to develop operational strategies that could inform the development of viable alternatives for consideration under the Environmental Impact Statement (EIS). In a multiagency call on March 11, 2024, Reclamation specifically encouraged the Service and NPS to communicate metrics of shared interest that may be used to optimize all analyzed alternatives as well as to submit shared strategies for consideration. Reclamation expressed that it is important for the analysis and optimization process to have all possible strategies included in the draft EIS analysis. To that end the NPS and the Service respectfully submit the attached joint concepts and referenced operational strategies and priority metrics for Reclamation's consideration.

The Service and the NPS share several goals for evaluating alternatives and recognize the difficult task ahead to balance supply and demand in the face of climate change, increasing aridity, decreasing supply, and likely increasing demands on that limited water while still protecting our Nation's fish, wildlife, plants, habitats, National Wildlife Refuges, Lower Colorado River Multi-Species Conservation Plan (LCR MSCP) Conservation Areas, the 1944 Treaty with Mexico and associated minutes, and some of the most iconic National Parks. We recognize the Basin States and Tribal Nations will play a crucial role in proposing and applying operational strategies, negotiating water rights, and reducing Colorado River water consumption as supplies decline. The NPS and the Service also recognize that long term management of the limited water supply will likely involve shortages and reduced releases, as the best available science indicates natural flows at Lee Ferry are expected to continue to decline from about 12.5 maf on average to between 10-11 maf by 2050. The on-line modeling tool had some limitations on the assignment of shortages; any indication that shortages are being applied to the Lower Division States in the operational strategies we jointly developed is solely due to those on-line limitations.

The attached document describes priority concepts and includes example operational strategies developed from those concepts that appear to protect, or at least minimize negative impacts to, our shared conservation interests and resources of concern over the next 20 years. We are requesting that Reclamation consider the integration of these priority concepts into alternatives submitted by other stakeholders and partners. The NPS and the Service recognize the ultimate alternative(s) fully analyzed by Reclamation may be a conglomerate of ideas and concepts and the submission of our priority concepts and example operational strategies is the beginning step to full alternatives development that will occur over the next year. We also recognize that our ideas and concepts may have unintended consequences that we have not yet considered, and we look forward to continuing discussions as Cooperating Agencies in the EIS process.

The attached joint concepts focus on protecting ecological resources and water quality in all reservoirs, protecting riverine processes, creating conditions that support threatened and endangered species survival and recovery, and disadvantage nonnative warm water invasive fish, especially smallmouth bass below Glen Canyon Dam. Approximately 90% of all known federally listed humpback chub (*Gila cypha*) occur within the Grand Canyon reach of the Colorado River. Humpback chub were downlisted from "endangered" to "threatened" (86 FR 57588; November 17, 2021) because of four persistent populations in the upper basin and the large population in Grand Canyon which has had little predation pressure from nonnative species. Smallmouth bass (*Micropterus dolomieu)*, in particular, negatively impact native fish populations wherever introduced and establishment of this predatory nonnative invasive fish within the Grand Canyon reach would constitute a significant new threat to humpback chub.

A critical aspect of our joint concepts and example operational strategies is the use of combined storage of both reservoirs in determining annual releases and potential shortages. We believe utilizing a combined storage approach will help shape water releases to maximize benefits between Glen Canyon Dam and Lake Mead, while also recognizing and ensuring adequate water deliveries to LCR MSCP conservation areas as well as to National Wildlife Refuges.

Our concepts emphasize measures that are protective to Marble Canyon through Grand Canyon as these are the most natural reaches of the Colorado River. These reaches also harbor many significant natural and cultural resources that either do not exist in other reaches or are heavily impacted by nonnative species in other reaches. To this end we prioritize a higher elevation above powerpool at Lake Powell, pro-actively filling Lake Powell to a higher elevation early in the implementation period, and emphasize flows that mimic a more natural hydrograph for this reach with some interannual variability. We encourage utilizing storage at Lake Powell over storage at Lake Mead to help protect the Western Grand Canyon population of humpback chub habitat by maintaining a Lake Mead elevation below 1135' that protects Pearce Ferry rapid and maintains the additional 42 miles of re-emerged occupied river habitat below Separation Canyon. We recognize that Lake Mead elevations may have to raise above that elevation at times and would welcome opportunities to discuss this further.

Our concepts also emphasize the important role that Upper Basin Colorado River Storage Project reservoirs (i.e. Flaming Gorge, Aspinall Unit, Navajo) play in implementing recovery actions for federally listed fish species and the need to ensure that current management flexibilities as described in current RODs stay in place to utilize releases from those reservoirs to enhance native fish recovery and disadvantage nonnative fish. The on-line modeling tool does not currently have operational metrics to evaluate how different strategies may impact operations at those Upper Basin reservoirs and it will be important that such metrics be fully considered before finalizing alternative development and analysis.

We recommend that Reclamation consider the benefits of changing the date associated with the beginning of the water year at Lake Powell. We recommend considering revising the water year at Powell to begin on April 1 or revising to align with Lake Mead and begin on January 1. This may assist in meeting the objective of increasing water release variability from Glen Canyon Dam to benefit natural resources. Specifically, it could help with avoiding high sediment erosion in higher volume years by allowing more months in which to deliver the water; avoid higher late summer water releases that might distribute non-native fish downstream; improve natural hydrograph variability; and may also increase hydropower production in some scenarios.

The on-line modeling tool allows for many different ways to adjust operational strategies that can both subtly and greatly impact performance under the metrics we have identified. There are also many environmental considerations hat can't be modeled directly with the on-line modeling tool that will be important considerations in evaluating the different alternatives. These additional analyses may influence our recommendations as we move through the analysis process.

We look forward to continuing our partnership and working closely with Reclamation over the next several months to further refine our concepts to best address our resource priorities. One area that we want to emphasize continued close coordination is in thinking through how to shape water releases in the driest hydrological scenarios to best mimic natural hydrological patterns, interannual variability, and minimize impacts to NPS and Service resources. Thank you again for the opportunity to comment on this important issue. The NPS and the Service recognize the

breadth of challenges facing Reclamation as you work to balance water demand and water availability, federally listed species and habitat needs, and maintaining dam safety and integrity. We stand committed and ready to assist Reclamation with all phases of the EIS. Please include the NPS and the Service as early as possible so that we can provide input and be responsive to time intensive aspects of project requirements.

If we can be of further assistance, please contact Deborah Williams, Service Colorado River Special Assistant, at Deborah_williams@fws.gov or 575-517-6091 or Rob Billerbeck, NPS Colorado River Coordinator, at rob_p_billerbeck@nps.gov or 720-326-2628.

Sincerely,

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Amy Lueders, Regional Director
FWS, Southwest Region

KATHARINE HAMMOND
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Kate Hammond, Regional Director
NPS Interior Regions 6, 7, & 8

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Attachment A

Post 2026 – NPS and USFWS Draft Concepts and Example Operational Strategies

The US Fish and Wildlife Service (USFWS) and the National Park Service (NPS) are cooperating agencies on the US Bureau of Reclamation (BOR) Development of Post-2026 Operational Guidelines and Strategies for Lake Powell and Lake Mead (Post 2026) Environmental Impact Statement (EIS). This EIS scope could have significant impacts along the full Colorado River corridor to the Mexico Delta, including within nine NPS park units and four USFWS Refuges below Hoover Dam. The project area includes habitat for at least 10 federally listed species, including four endangered and threatened fish species endemic to the Colorado River, and over 30 species for which the USFWS has regulatory responsibilities. Also impacted by this process, are effects to associated habitats for a number of birds, reptiles, amphibians, and invertebrates that use riparian trees, backwaters, and marshes as habitat. The Department of Interior (DOI) as a whole is responsible for complying with relevant laws such as the NPS Organic Act, the Endangered Species Act (ESA), National Historic Preservation Act (NHPA), and 1992 Grand Canyon Protection Act (GCPA), as alternatives are developed and selected.

The NPS and the USFWS requests consideration of the following concepts during the development of alternatives in the post-2026 EIS process. We used BOR's Colorado River Basin Post-2026 Operations Exploration Tool (on-line modeling tool) to highlight resources and parameters that are important to the mission of our two agencies. We are including example modeled operational strategies that demonstrate that development of strategies that generally perform well for these resources are not mutually exclusive to other alternatives and options that may be analyzed under this process. We hope BOR can use this information in evaluating and developing alternatives for the anticipated development of the December 2024 draft EIS. Both agencies to are open to discussions about how such parameters could be combined and included in future considered alternatives.

Our joint concepts and the example modeled operational strategies all meet BOR's purpose and need statement (US BOR 2023, 88 FR 72535). Our concepts include a proactive reduction and conservation approach that may, under a range of future hydrological conditions, protect focal resources dependent on the Colorado River, minimize the existing supply and demand imbalance, and improve the predictability and sustainable management of the large Colorado River reservoirs and system resources. The shared concepts outlined below also conform with the NPS Organic and General Authorities Acts, which mandate protection of park resources and values, and prevents the impairment of parks' scenery, natural and historic objects, and wildlife. These concepts prioritize protection of the resources related to, and in accordance with, the 1992 GCPA mandate to protect, mitigate adverse effects to, and improve the natural and cultural resources and recreation below the Glen Canyon Dam (GCD) on the Glen Canyon National Recreation Area and the Grand Canyon National Park. These concepts value all federal trust resources consistent with the USFWS mission and prioritize conservation of federally listed species consistent with section 7(a)(1) of the ESA. The central focus of section 7(a)(1) is on conservation of listed species by all federal agencies. As defined by the ESA "conservation" means "to use and the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary." Additionally, these concepts may form the basis for avoidance and minimization measures encouraged under ESA's consultation process (sections 7(a)(2) and 7(b)(4)(c)(ii)) and the Habitat Conservation Planning and Permitting process (sections 10(a)1(B) and 10(a)(2)(A)(ii)), once compared to future alternatives.

We request that BOR consider and evaluate the concepts outlined below within the Post-2026 EIS process. The BOR may want to develop these concepts into a full alternative for consideration or otherwise adopt these concepts into other options and alternatives submitted by other partners, cooperating agencies, or stakeholders. We note that the details of these concepts are based on preliminary modeling, and we request full analysis from BOR with more complete hydrology modeling from BOR and resource impact modeling from USGS (some aspects funded by NPS) to fully evaluate any implications. The NPS and USFWS may want to change some aspects of these concepts in response to the full analysis. The NPS can provide additional specifications on the modeling parameters and results for the example strategies mentioned in Appendix A.

The NPS and the USFWS support and appreciate the efforts of both the Upper Division States and the Lower Division States to identify reductions in water use to achieve a more sustainable river system. In this document we identify a total reduction amount based on the modeling that could create a sustainable river system; we are not recommending a position on the allocation of shortages for any particular, basin, sectors, or users. The BOR on-line modeling tool had some limitations on the assignment of shortages; any indication that shortages are being applied to the Lower Division States in the operational strategies we jointly developed is solely due to those on-line limitations. We recognize the current climatic projections indicate a high potential for declining average runoff in the foreseeable future, and that hard decisions regarding maintaining the best-case scenario for all resources under the NPS and USFWS purview is not likely feasible for all impacted geographic locations along the entirety of the Colorado River Corridor. We offer example strategies that manage at the level of discretionary annual operating decisions, while taking into account the long-term impacts of these actions over the course of a 20-year timeframe dictated by the modeling tool. We are open to incorporating our joint concepts into aspects of other strategies in ways that are consistent with the principles and priorities described in this letter.

Principles for these concepts:

The over-arching goal of the NPS and USFWS in submitting these concepts and the example operational strategies from the on-line modeling tool is to demonstrate the most important aspects of alternatives that best-protect NPS and USFWS resource interests and balance conservation of federally listed species while minimizing impacts to federal trust resources along the entirety of the Colorado River. The following goals are central to developing sustainable guidelines for operations at Lake Mead and Lake Powell over the 20-year timeframe:

- Maintain healthy riverine processes, striving for a natural level of variability and protecting water quality in rivers and reservoirs.
    - Maintain a higher Lake Powell level to retain more natural riverine processes and maintain native species between GCD and Hoover Dam. Modeling shows that maintaining Lake Powell levels higher than 3570' (October 1 elevation) minimizes propagule pressure (expansion) of smallmouth bass (*Micropterus dolomieu;* SMB) and other warm-water invasive species (Eppehimer et al. 2024). This elevation is likely to result in conditions needed to protect federally threatened humpback chub (HBC) and other native fish by way of reduced predation pressure. Maintaining Lake Powell over 3570' (October 1 elevation) also provides sufficient volumes for more frequent high flow events.
    - Scientific studies show the more we retain natural and dynamic riverine processes approximating natural flow regimes, the more likely we will maintain the food base for aquatic ecosystems, native fish populations, and riparian vegetation and wildlife habitat (Poff et al 1997, Poff and Matthews 2013), including endangered and threatened species in this stretch of the Colorado River.
- Acknowledge climate change induced aridification and lower-runoff conditions.
    - Based on the best available science, natural flows at Lee Ferry are expected to decline from the current level of ~12.5-13 maf (as a 10-year average) to ~10-11 maf by 2050 (Udall & Overpeck, 2017, Whitney et al. 2023, Lukas et al. 2014). This concept was developed assuming reduced runoff levels of this magnitude.
    - The example operational strategies use proactive water conservation and efficiency improvements to reduce consumptive use to provide robust, flexible, and predictable management of the Colorado River system under a broad range of potential future hydrologic conditions by storing water for long-term use. Our concepts suggest utilizing a combined storage approach in determining annual releases and shortages, maintaining both Lake Powell and Lake Mead above powerpool and prioritize storing of water in Powell over Mead when possible (the reasoning for this approach is described further below). Proactively conserving water to increase Lake Powell levels reduces the chance of an extreme shortage lower in the river system when hydrologic conditions are drier for multiple years.
    - We note that proactively rebuilding Lake Powell storage in the first few years of Post 2026 operations to reach an October 1 elevation of 3570' appears to have long term effects in reducing the magnitude of shortages under the worst hydrological scenarios in the model. Generally, utilization of higher average

levels of shortage earlier in the hydrological model would help ensure that Lake Powell and Lake Mead are less likely to drop below critical levels and ensure lower maximum reductions. Avoiding dropping below critical reservoir levels at both lakes protects the flexibility for functional dam releases that protect park resources and federally listed species.
    - The example operational strategies as modeled in the on-line tool do not result in lower storage at other Upper Basin Colorado River Storage Projects while maintaining Powell at an elevation of 3570'. As discussed more below, depleting storage in the other Upper Basin Colorado River Storage Projects could have detrimental effects to federally listed species and park units.
- Maintain long-term compliance with environmental laws and Department of Interior responsibilities.
    - The concepts and example operational strategies prioritize conservation of federally listed fish species consistent with section 7(a)(1) of the ESA by maintaining recovery actions at upper basin reservoirs that result in long-term water availability for lower river reaches and by maintaining sufficient Lake Powell elevations for operations to benefit the significant population of humpback chub (*Gila cypha*) relatively free of warm water nonnative invasive fish. This acknowledges the recent recovery success and downlisting of this species. The example strategies achieve this by maintaining Lake Powell surface elevations that minimize nonnative fish entrainment and maintain cooler river temperatures to inhibit their reproduction (Dibble et al. 2020, Bruckerhoff et al. 2022), reducing the imminent threat of predation from warm-water, nonnative fish (e.g. SMB). This approach also suggests reductions in such a way as to maintain Lake Mead elevation and outflows from Hoover at levels for long-term sustainability to avoid larger shortages. Any strategy that increases the likelihood of consistent releases from Hoover Dam will benefit 10 federally listed species and 20 sensitive species that are reliant on the Colorado River from Lake Mead down through the Delta in Mexico.
    - A critical aspect of all concepts and example operational strategies is the use of combined storage of both reservoirs in determining annual releases and potential shortages. This is a critical approach to recognize and ensure adequate water deliveries to the Lower Colorado River Multi-Species Conservation Program's current and future conservation areas as a water right holder to maintain compliance with permit conditions and conservation values for federal and state trust resources. This also helps ensure adequate water deliveries to National Wildlife Refuges.
    - The concepts and example operational strategies comply with the 1992 GCPA by focusing on protecting, mitigating adverse impacts to, and improving, the resources and recreation below the GCD in Glen Canyon NRA and Grand Canyon NP. This is accomplished by maintaining Lake Powell sufficiently high to reduce nonnative fish entrainment, protecting native fish, and maintaining sufficient water volume for frequent High Flow Experiments (HFEs).
    - NHPA, 1979 Archaeological Resources Protection Act (ARPA), and the 2009 Paleontological Resources Preservation (PRPA) compliance will be achieved through proper consultation with the Tribes on sacred areas or traditional cultural properties (TCPs), the proper State Historic Preservation Officers, and by minimizing extreme reservoir elevations changes to protect archeological and paleontological resources on reservoir shorelines.
    - Although impacts to the Colorado River below Hoover are anticipated, these example strategies minimize the possibility of Hoover Dam reaching powerpool or deadpool over the long-term, which ensures water releases will continue over the 20-year timeframe. Strategies that result in the cessation of water releases from Hoover dam would result in less water delivered to the Lower Colorado River Multi-Species Conservation Program's action area and USFWS' four river front Refuges. These approaches seek to minimize this possibility.
- Provide more flexibility and predictability of water delivery for Basin Tribes by maintaining reservoir levels and average flows over the long-term.
    - One component of protecting and recognizing the rights of Tribes is ensuring that the Colorado River system is sustainable. To accomplish that, this concept provides proactive conservation and reductions in use that minimize the risk of future critical shortages that could affect Tribal water delivery.

NPS and USFWS Highest priority features and performance goals:

We consider these features/ranges of performance metrics essential to any viable alternatives.

- Balance supply and demand for system sustainability on a multiyear basis
    - Operations should balance reservoir inflows to outflows on a multiyear basis for management of water quality. Balancing inflows and outflows are likely to result in maintenance of both Lake Powell and Lake Mead elevations with sufficient buffers above powerpool to avoid extreme water quality conditions that impact resources and avoid extreme low flows.
        - Lower reservoir levels may increase water quality risks. Dropping Lake Powell levels have been associated with increased temperatures and decreased dissolved oxygen below GCD.
        - Failure to account for multi-year balancing of inflows and outflows could have largescale and long-lasting impacts to federally listed species and the habitats on which they rely downstream of Hoover Dam.
    - Utilize a combined storage approach to determine annual releases and trigger potential shortages instead of forecast models. Consider revising the beginning of the water accounting period at Lake Powell to be either January 1 or April 1.
        - Combined storage has more certainty to determining water availability and better ability to balance supply and demand than uncertain forecast models.
        - Allows for the most flexibility and certainty in shaping water deliveries from Powell and Mead to minimize environmental impacts, best mimic a natural hydrograph, and provide certainty to water users.
        - Water forecasts are most accurate in April.
- Prioritize storage of water in Lake Powell to maintain a higher Powell level while ensuring both reservoirs stay above powerpool
    - We propose maintaining Lake Powell at a higher elevation, specifically maintaining Powell above 3570’ on October 1, could provide many benefits and fewer conflicts at GCD. Including protecting native fish (discussed in detail above), having frequent HFEs, producing hydropower, and delivering water. We realize this may not be achievable under all hydrologic conditions, but we offer example operational strategies which also kept Mead levels above 1000'.
        - We recommend proactively conserving water in Lake Powell to achieve an elevation of 3570’ (October 1). In our example operational strategies we noted that a higher starting point of 3570’ at Powell is necessary because strategies are tied to average inflows and lower starting elevations at Lake Powell led to fluctuations in the model that dropped reservoir elevations below critical levels in the early years of the strategy. If Lake Powell elevations are above 3570’ on October 1, 2026, then no proactive conservation would be needed.
        - Maintaining higher elevations at Lake Powell increases high magnitude and long duration HFEs. We prefer HFEs to occur with a frequency of at least once every other year in spring to meet the goal of maintaining natural riverine processes and variably below GCD. We are most concerned about maintaining these levels under drier hydrologic conditions.
        - As discussed previously, maintain higher elevations at Lake Powell helps protect humpback chub from declines related to predation from warm water nonnative fish associated with low Lake Powel elevations. Ideally, maintaining the SMB lambda and fish entrainment through the dam at levels that would prevent establishment and expansion. If Lake Powell’s elevation can’t be maintained at an elevation that would minimize SMB entrainment and reproduction (Eppehimer et al. 2024) we strongly encourage BOR and partners to use other tools to minimize the risk from entrainment, high temperature releases, and lower dissolved oxygen below GCD.
        - Additional benefits from prioritizing storage of water in Lake Powell to maintain higher Powell Levels (that are lower priorities from the resource perspective for USFWS) include:

- Protect NPS infrastructure investments and the regional economic benefits that result from large watercraft recreation on Lake Powell and Lake Mead.
- Protect the NPS recreational fishery of rainbow trout below GCD through the above metrics related to dissolved oxygen, temperature, and SMB population growth and entrainment metrics (Yard et al. 2023). Dissolved oxygen levels < 5 mg/L have documented negative impacts to fish (Saari et al. 2018).
- Avoid dam engineering constraints and maintain hydropower generation at a reasonable level to avoid conflicts with environmental flows.

  - Maintaining Mead elevation above 1000' and below 1135' as much as possible.
    - To the extent that storage at Lake Mead isn't needed for flood control in any given year, and assuming a combined storage approach is used for determining annual releases and setting any potential shortages, maintaining Lake Mead elevation below 1135' will keep the reservoir elevation from overtopping Pearce Ferry rapid.
      - Pearce Ferry rapid is believed to be serving as a natural fish barrier preventing the upstream movement of nonnative warm water fish upstream from Lake Mead. This would also protect the riverine habitat that has re-emerged below Separation Canyon, which could be inundated at full pool elevations of Lake Mead. Those river miles provide habitat for a proportion of the humpback chub population in western Grand Canyon.
      - At the time of drafting the on-line tool did not offer a way to fully model the performance of this concept and we look forward to having more dialogue on this topic.
    - This would protect razorback sucker spawning and rearing habitat in Lake Mead that might be at risk below 1000' in finer sediments by maintaining Lake Mead > 1000' in drier years. It is also important that lake levels in Lake Mead do not drop too quickly and maintaining buffers may prevent this.
  - Maintaining elevation buffers/appropriate reservoir levels would provide predictability and sustainability of water delivery and avoid critical water shortages or crises from several years of poor hydrology.
  - Promoting and creating conditions that favor high magnitude and long duration HFEs, preferably occurring with a frequency of at least once every other year in spring. Our goal is to achieve and best mimic natural riverine processes and variably below GCD. We are most concerned about maintaining these levels under drier hydrologic conditions.
  - Maintaining elevation buffers/appropriate reservoir levels should protect water quality in Lake Powell and Lake Mead and in the river below GCD by minimizing the probability of dissolved oxygen <5 mg/L most of the time (in modeling keep probability of <3mg/L to 0.2 or less)
  - Maintaining Hoover Dam above powerpool ensures that water will still reach important conservation areas for ESA listed species and maintain the conservation work occurring in the Colorado River Delta in Mexico, although annual impacts are anticipated. It is our expectation that this 20-year management framework will not result in reductions in water delivered to the conservation areas associated with the Lower Colorado River Multi-Species Conservation Program and the Minute 323 Mexico Treaty activities.

- <u>Maintain interannual variability with GCD flows while protecting minimum flow levels.</u>
  - An important part of this concept is to maintain appropriate interannual variability but also to have some constraints on both higher flows and lower flows from GCD in any given year.
  - This concept allows for a range of GCD releases between 4.5 maf and 10 maf under most operations and interannual variability >0 for multiple years in a row.
  - Riverine ecology evolved with a high degree of variability. A number of resources degrade if there is a lack of variability. Striving for better correspondence to the variability of natural inflows would help keep native vegetation in better condition.
    - Limiting the maximum annual GCD releases to ~10 maf protects sediment resources in the sediment-depleted river corridor and helps to maintain the sand mass balance that can trigger frequent HFEs and protect resources (Grams and Mueller 2022, Sankey et al. 2023).

        - Limiting the annual GCD releases to 4.5 maf as a minimum would:
            - Have a greater chance of keeping river temperatures in the ranges suitable for native fish, without promoting the growth and reproduction of nonnative fish.
            - Be more likely to protect river-based recreation if flows can be maintained at or above 5000 cfs for flows during the main recreation season months of March 1-October 31.
- Achieve sustainability through higher reduction or water storage averages.
    - Implementing a strategy that emphasizes building higher elevations at Lake Powell will help ensure there is enough water available to benefit both the environment and the water delivery system of the southwestern US. This concept supports a robust and sustainable Colorado River system and would reduce the risk of dropping below critical levels at reservoirs and experiencing extreme flow shortages below dams as a result. In this document we are sharing the water levels and values we used in the modeling on-line tool that appeared to protect our environmental priorities and reduce the risk of extremely low flows. Sustainable management of both reservoirs may also minimize environmental impacts below Hoover Dam at the multi-decadal timescale, when compared to the no action, current operations, and other alternatives.
    - The Upper and Lower Division State proposals both suggest a system-wide reduction in total consumptive uses and losses of 1.5 maf, or approximately 10% of current levels, that applies under optimistic hydrologic conditions. We request examining if earlier, progressive reductions could avoid the need for larger shortage reductions when hydrologic conditions may be further stressed. In our exploration of the online modeling, strategies that considered an 18-20% reduction under drier scenarios made the system more sustainable and avoided extreme low flows. This proactive level of reduction in releases and/or increases in shortage in the lower basin would improve the robustness under variable climate change hydrologic conditions for the future of both reservoirs and the entire system. Proactive release reductions would decrease the chances of a severe water shortage impacting park resources, endangered species, cities, power supply, and agriculture. This approach also supports maintaining water quality for both the environment and human uses over the long term by better balancing inflows and outflows and maintaining an appropriate overall volume in both Lake Powell and Lake Mead.
- Colorado River Delta Releases
    - The strategies we considered in the online model also included Colorado River Delta Releases at the level of 0.04 maf/1 yr.
- Upper Basin Operational Concerns and Constraints
    - It is very important to both NPS and USFWS to maintain natural fluvial processes and ESA listed fish populations in the Green, Upper Colorado, the Gunnison rivers and the San Juan River basins and to protect park resources in Dinosaur National Monument, Canyonlands National Park and Black Canyon of the Gunnison National Park. To achieve this, we recommend:
        - Maintenance of current operations and RODs and Biological Opinions at the Upper Basin reservoirs.
        - Maintenance of interannual variability in flows and environmental flows in the Green, Gunnison and San Juan Rivers between current annual release variability and the increased natural level of variability that existed pre-dam (the most desirable level). These environmental flows include the experimental and management flows out of Flaming Gorge, Aspinall and Navajo.
        - Maintenance of the upper basin reservoir elevations at elevations appropriate for maintaining management targets for water quality. NPS is currently identifying this threshold for Blue Mesa.
- BOR GCD Infrastructure Considerations
    - Devices, dam modifications or modified dam operations to reduce entrainment and river warming above 15.5C are an important and integral part of this concept.
        - Even if an alternative is chosen that keeps Lake Powell over 3570'on October 1, it appears from the online modeling that there will be individual years when we could expect Powell to drop lower, increasing the risk of nonnative fish entrainment and reproduction below the dam. If reservoir elevations can't be kept high enough it is critical to find long term sustainable approach

to reduce entrainment and to reduce nonnative fish reproduction below the dam, especially smallmouth bass (SMB) that pose a significant threat to humpback chub and other native fish. Continued use of river bypass tubes, installation of a thermal curtain or a temperature control device, or other such tools would address downstream temperatures and is an integral component of this concept.

- GCD Lower Outlet Considerations
  - The approach suggested here should preclude falling below powerpool at Powell, but if the alternative that is ultimately chosen includes reasonable probabilities for this to occur, we would request that NPS and USFWS be involved in discussions on the early evaluations and design considerations for potential lower outlets for GCD.

- <u>Consider adjustments to the timing of GCD releases</u>
  - While we would not consider this a required component of a strategy, we would ask BOR to consider timing adjustments to the water year for operations for GCD to evaluate how such adjustments would impact environmental concerns. For example, there may be advantage to aligning the timing of Lake Powell and Lake Mead by shifting from an October water year at GCD to a calendar year or to April 1. This or other timing adjustments have been suggested by GCMRC researchers as beneficial for these issues:
    - Avoid higher sediment erosion in higher volume years by allowing more months in which to deliver the water.
    - Avoid higher late summer water volumes that might distribute nonnative fish further downstream.
    - Improve natural hydrograph variability - get away from the static Oct-Dec volumes (which is potentially better for aquatic life and vegetation).
    - For other stakeholders this also would allow keeping volumes at a level that allows for more daily fluctuations to produce hydropower in higher volume years.

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Appendix A –Post 2026 Modeling Strategies for Consideration The following table includes example Post 2026 model strategies that got closest to meeting our overall goals, with the best three at the top, but each has some pros and cons. All of our example operational strategies have less than 1% chance of falling below 3500' at Powell in the drier hydrologic conditions but have a range of performance on other statistics particularly at Mead. NPS can provide additional specifications on the modeling parameters and results for the strategies mentioned here. The NPS and USFWS look forward to working with BOR and Virga to further optimize these example strategies, analyze these concepts into the Post 2026 EIS process, and/or incorporate these concepts into one or more EIS alternatives.

Strategy #	Strategy type	Pros	Cons
62216	Powell: continuous + hydrology Hoover: combined storage + continuous + hydrology	- Best for Powell and Mead, but somewhat larger average reductions/shortages - Maintains Powell > 3540' in 55% of the hydrologic runs and > 3530' in 65% of the hydrological runs - Meets HFE (>=55%) and SMB (<=.91 lambda) goals under drier hydrology - Meets vegetation and interannual variance goals acceptably well - Meets lake mead < 1000 goal very well. - Delta release of 0.04 maf/yr	- Higher average reduction/shortages (~2.2-3 maf) even in optimal hydrology - Max reduction/shortages + of 3.5-3.7 maf for optimal to drier hydrology,
51025	Powell: continuous + hydrology Hoover: combined storage + tiered + hydrology	- Maintains Powell > 3540' in 52% of the hydrological runs and > 3530' in 58% of the hydrological runs. - Meets HFE (>=54%) and SMB (<=.94 lambda) goals very well under drier hydrology - Meets vegetation and interannual variance goals acceptably well - Meets lake mead < 1000 goal very well - Delta release of 0.04 maf/yr	- Average reduction/shortage 1.67-2.71 for optimal to drier hydrology - Max reduction/shortage of 2.84-3.74 maf for optimal to drier hydrology
99779	Powell: continuous + hydrology Hoover: combined storage + tiered + hydrology	- Maintains Powell > 3540' in 52% of the hydrological runs and > 3530' in 58% of the hydrological runs. - Meets HFE (>=54%) and SMB (<=.94 lambda) goals very well under drier hydrology - Meets vegetation and interannual variance goals acceptably well - Meets lake mead < 1000 goal well - Delta release of 0.04 maf/yr	- Avg reduction/shortage 1.4-2.72 for optimal to drier hydrology - Max reduction/shortage of 3.12-3.67 maf for optimal to drier hydrology - Similar to strategy 51025, but slightly higher avg reductions/shortages and lower max reductions/shortages lead to a slightly higher Mead
87534	Powell: continuous + hydrology Hoover: combined storage + continuous + hydrology	- Maintains Powell > 3540' in 55% of the hydrological runs and > 3530' in 65% of the hydrological runs Meets HFE (>=55%) and SMB (<=.91 lambda) goals very well under drier hydrology - Meets vegetation and interannual variance goals acceptably well - Meets lake mead < 1000 goal moderately well - Delta release of 0.04 maf/yr	- Avg reduction/shortage 2.16-2.89 for optimal to drier hydrology - Max reduction/shortage of 3.2-3.44 maf for optimal to drier hydrology - Similar to strategy 62216 but smaller reductions/shortages keep Mead lower