Glen Canyon Dam Adaptive Management Program
Adaptive Management Work Group Meeting
August 18-19, 2021

Wednesday, August 18, 2021

Start Time: 8:30 AM Pacific Daylight Time (PDT)
Conducting: Wayne Pullan, Secretary's Designee to the Adaptive Management Work Group (AMWG) and AMWG Chair.
Recorder: Carliane Johnson, SeaJay Environmental, LLC.
Facilitator: J. Michael Harty, Kearns & West, Inc.

Welcome and Administrative

Opening Remarks

[Wayne Pullan, AMWG Chair] Joining this meeting are Daniel Picard, Deputy Regional Director and Acting Designated Federal Officer to the Adaptive Management Work Group (AMWG); Kerry Rae, Chief of Staff to the Assistant Secretary for Water and Science; and Christina Kalavritinos, Senior Advisor to the Assistant Secretary of Water and Science.

Introductions and Determination of Quorum

[Michael Harty, Facilitator] Roll call was taken, and a quorum reached with 19 members represented.

Approval of May 19, 2021, Meeting Minutes

[Wayne Pullan, AMWG Chair] The draft was distributed on July 2, 2021. **[Todd Adams, Utah Division of Water Resources]** Motion made to approve the May 19, 2021 minutes. **[Sara Price, Colorado River Commission of Nevada (CRCN)]** Seconded the motion. **[Wayne Pullan, AMWG Chair]** May AMWG meeting minutes were passed by consensus.

Administrative Updates

- **Summary of May Meeting Evaluation [Terra Alpaugh, Kerns & West]** provided the results of the May AMWG Meeting Evaluation.
- **Nominations and Appointments [Wayne Pullan, AMWG Chair]** Department of Interior (DOI) is currently processing 22 nominees for AMWG members and alternates. There have also been eight new appointments to the Technical Work Group (TWG).
- **Action Item Tracking Report [Wayne Pullan, AMWG Chair]** There are five action items, two of which are recommended for closure:
    - Monitoring Metrics – GCMRC is presenting a draft plan on Day Two of this meeting.
    - Budget Prioritization – the DOI Bureaus are working on identifying high priority issues and will deliver findings to the Budget Ad Hoc Group.
    - Temperature Projections for Minimum Hydrology – the Bureau of Reclamation (Reclamation) staff are proposing to close this action item because the projections will be included in the Hydrology and Operations PowerPoint from now on.

- Funding Updates – Reclamation is proposing to close this action item, because it has now been incorporated as a standing agenda item.
- FY22 River Trip Invitation to Secretary Haaland – planning for this trip is advancing cautiously because of COVID; everyone will be informed as the plan progresses.

Review of Colorado River Operations Agreements

[PRESENTATION] **[Rodney Smith, DOI Solicitor's Office]** The focus of this presentation is Colorado River water law, including the US-Mexico treaty. The overview included definitions, the 1922 Compact, the 1948 Upper Colorado River Basin Compact, and various Congressional acts, guidelines, and agreements.

Questions

[Larry Stevens, Grand Canyon Wildlands Council (GCWC)] Where do recreation, fish and wildlife, and other concerns fall within the enabling suite of objectives? **[Rodney Smith, DOI]** They are in the 1956 Act in reference to the creation of the Dam and are more specifically enumerated in the Grand Canyon Protection Act. The Long-term Experimental and Management Plan (LTEMP) then tried to address those objectives.

[Alicyn Gitlin, Sierra Club] If the Colorado River Storage Project (CRSP) specifies that power is to be produced "incident to" the other uses, why was there such a priority on sending drinking water downstream to Lake Powell to protect power production? It seems that the water would be more valuable if kept higher in the watershed, where evaporation is less of a risk and there are more potential uses. **[Lee Traynham, Reclamation]** This will be discussed in the next session related to drought. **[Rod Smith, DOI]** The Drought Response Operations Agreement (DROA) is concerned with protecting infrastructure more broadly: there are a finite number of outlets at the dam that need to be protected; in the DROA provision being referred to, the outlet of concern is related to hydropower production.

Introduction of Additional Reclamation Staff Members

[Wayne Pullan, AMWG Chair] Additional staff include Jacklynn (Jaci) Gould who was recently named as Director of the Lower Colorado Basin Region. Carly Jerla was selected as Senior Water Resources Program Manager. Katrina Grantz is now Assistant Regional Director in the Upper Colorado Basin Region.

[Katrina Grantz, Assistant Regional Director] This is an overview of this year's drought response operations and the DROA that was initiated in collaboration with the states and tribes to protect critical elevations in Lake Powell. The lowest elevation at which power can still be generated is at 3,490 feet. Falling below that level has the potential to lead to cavitation, debris entrapment, and severe damage to the facility. Continued generation of power is critical to the dam's operation as well as for funding environmental compliance efforts. One purpose of the DROA is to protect the target elevation of 3,525 feet, which is 35 feet above the minimum power pool elevation. There are two key tools to help Reclamation do this: 1) Adjust the timing of deliveries from Lake Powell to Lake Mead within the confines of the LTEMP Record of Decision (ROD), and 2) make supplemental deliveries from the upper reservoirs (Flaming Gorge, Blue Mesa, and Navajo). In July 2021, under the emergency provisions of the DROA, Reclamation initiated supplemental water deliveries to Lake Powell, which will continue through the end of the year and total 181 KAF. Reclamation and the Upper Basin states have started developing a plan to address releases longer term, which should be in place by April 2022 and will be done in coordination with stakeholders.

Basin Hydrology, Water Quality, and Operations

[PRESENTATION] **[Heather Patno, Hydraulic Engineer, Reclamation]** As of August 15, the Upper Basin is in a decreasing storage base flow period. Lake Powell hit its historical low on July 24, and its elevation is expected to continue to decrease through next spring. There would need to be continued precipitation for the remainder of the fall to have a beneficial initialization for next year's water accumulation and retention. Peak runoff occurred in March 2021. This is now the second driest water year on record. Lake Mead has been determined to be in Level 1 Shortage Conditions. The water reductions for Arizona, Nevada, and Mexico are shown in the table in the presentation. The maintenance schedule was also shown using the August 24-month study most probable elevations. The five-year outlook is expected in late August or early September. Reclamation is also currently working on a website with a new visualization tool.

Q&A and discussion

[Sara Price, CRCN] Regarding the slide showing the 30-year average from 1981-2010. When will this be replaced with the 1991-2020 average in the 24-month study? This would eliminate the wetter hydrology in the 1980s from the average. **[Heather Patno, Reclamation]** The Colorado Basin River Forecast Center (CBRFC) will calibrate its model to the new averages during the water year 2020. The shift to the 1991-2020 averages is expected to begin in October 2021. The water volume forecast will likely be lower because it will not include the wetter years from the 1980s.

[Larry Stevens, GCWC] Reclamation has long recognized the possibility of system failure. How much has system management flexibility decreased following the 1996 ROD in response to a single year drought, such as in 2002? **[Rod Smith, DOI]** It is a different issue. Heather is referring to an annual amount of water. The distinction that was being highlighted in the Review of Colorado River Operations Agreements presentation is that the ROD and what was updated in LTEMP in 2016 do not affect the annual release volume. Any hourly, monthly, or daily changes would not affect low water coming in or going out on an annual aggregate basis. To the extent there is management flexibility, that has probably increased over time.

[Peter Bungart, Hualapai Tribe] Do we know how many Glen Canyon Dam units can be expected to be online to support a fall High Flow Experiment (HFE)? **[Heather Patno, Reclamation]** There will be four units available in November.

[Jan Balsom, National Park Service (NPS)] Is there any potential to delay the November maintenance schedule to allow for more units? **[Heather Patno, Reclamation]** Transformer replacements are being executed by a contractor, so the constraints of that contract and delays would need to be considered. Will bring up this question with Glen Canyon Dam facilities personnel to see what flexibility is available, but it would be within those limitations.

[Chip Lewis, Bureau of Indian Affairs (BIA)] At the 95% confidence interval, what is the plus/minus number of feet for the 24-month most probable elevation of Lake Powell? Basically, what is the statistical accuracy of the models? **[Heather Patno, Reclamation]** There is an 80% range between minimum and maximum probable – which means there is a 10% probability that flows will be wetter and 10% probability that they will be drier. Within that 80% probability range, there is also uncertainty about what the monsoon season might bring and what the soil moisture condition might be, as well as significant variability between January and April about the forecast volume.

Panel Discussion—Federal Agency Leaders Discuss Drought

- NPS: **[Billy Shott, Glen Canyon National Recreation Area (GLCA), Superintendent]** The impacts to the park fall in the following five categories:
    1. Fiscal and Other Supporting Resources. Drought decreases visitation, which reduces visitor and franchise fees. This impacts general construction, utilities, boat access, and research and monitoring work.
    2. Administration Policy and Law. NPS' normal business practices are characterized by lengthy contracting and review processes to ensure the appropriate use of appropriated funds. There are other funding sources that kick in to support response to and rehabilitation after natural disasters like fires and floods. Those funding sources are not accessible in drought and low water events, meaning that NPS is constrained in their ability to respond nimbly. They are looking at ways to categorize drought as a natural disaster in order to enable more timely response to both public and natural resource needs.
    3. Safety and Wellness are being impacted. There is increased risk exposure for employees and visitors as NPS is forced to move marinas, change maintenance schedules, and maintain the significant aid-to-navigation system that NPS is obligated to maintain by law.
    4. Publicity and Communication. There is a need to communicate with the public about how quickly drought impacts have arisen and that climate change and drought impacts are not short-term issues.
    5. NPS's Mission is to maintain natural resources and provide enjoyment. In addition to the focus on fee reductions, this includes many other concerns such as exposed cultural sites, erosion, effects of warmer water, encroachment, and grazing.
- NPS: **[Rob Billerbeck, Colorado River Coordinator]** Described the NPS Units and the natural resources that are affected by the Colorado River drought. The NPS does not manage the water through its Units, which makes it difficult to manage its resources. The NPS has many concerns about the impacts from climate change, and the biological and physical effects of changing water levels. While NPS does not have control over water policy, it wants to be part of decision-making through multi-agency planning processes.
- Reclamation: **[Katrina Grantz, Upper Colorado Basin, Assistant Regional Director]** Reclamation's Upper Colorado Basin Region directly operates and manages the initial units of CRSP, which include Glen Canyon Dam, Flaming Gorge Dam, Navajo Dam, and the Aspinall unit on the Gunnison. Reclamation's mission is to manage, develop, and protect water and related resources. The Interim Guidelines in 2007 determined which users would reduce use and helped enhance voluntary actions to reduce water use. The reservoirs are hitting their lowest levels since they were filled. In July 2021, as runoff conditions worsened, drought operations were initiated: the upstream units of CRSP will deliver an additional 181,000 acre-feet to Lake Powell by the end of 2021. Downstream releases will be reduced in 2022 due to declining reservoir levels. In the Lower Basin, this represents the first shortage declaration. Drought impacts have environmental and economic dimensions; these include greater risks to endangered and threatened species and reduced environmental program funding because of falling revenue generated through the sale of hydropower, primarily through Glen Canyon Dam.

- U.S. Fish and Wildlife Service (USFWS): **[Jess Newton, Arizona Fish and Wildlife Conservation Office, Project Leader]** The USFWS mission is to conserve, protect, and enhance fish and wildlife and their habitats. For the Grand Canyon, this boils down to a focus on the fisheries. The main impacts of drought on the resources are to water quality. Warming temperature shifts have had a beneficial effect on humpback chub recruitment and growth, but future projections of more warming are concerning for favoring predatory, non-native species. The problems in the tributaries are the lack of flood flows to clean out the sediment and poor recruitment. Have seen positive effects from translocations.
- U.S. Geological Survey (USGS): **[Michael Chotkowski, Interior Region 8, Science Coordinator]** The drought in the Colorado River basin is longstanding and now includes a deep drought in California. Because USGS's mission is research and monitoring, it is not directly affected by the drought; however, the agency provides support to partners directly impacted by drought conditions. USGS is deeply engaged in the Colorado River Basin and elsewhere both locally through GCMRC and nationally through its modeling products.
- Western Area Power Administration (WAPA): **[Tim Vigil, CRSP Management Center, Senior Vice President and Manager]** WAPA delivers hydropower under the CRSP Act of 1956. Revenue from the sale of electricity pays for WAPA's operations, for Reclamation's equipment on the dams, and funds environmental programs. WAPA is very concerned about the water elevation in Lake Powell and has been suffering from drought effects on hydropower production for a long time. Currently undertaking a new rate process, which would increase rates and reduce purchased power. Glen Canyon accounts for about 75% of CRSP generation. Because of the current situation, maintenance is reduced and costs deferred. End users represent five million people across six states.

The following five topic areas were discussed by the panel:

1) **<u>Lessons Learned</u>**: *The current drought has persisted now for over 20 years. What has your agency learned about the effectiveness of actions taken during that time period? How can those lessons learned be applied to the current and future droughts?* **[Jess Newton, USFWS]** USFWS has some tools that can help through the severe times. One is translocations, which have shown that the fish survive better and grow faster. Have also learned that temperature is a huge driver for native species, and it may be a preventative for non-native species. If a tool for temperature can be developed, that can have huge benefits although there are engineering and cost considerations. **[Billy Shott, GLCA]** The lessons learned are still being developed. NPS needs to engage in a longer-term management effort and take the opportunity to project existing data into sustainable investments in the future (i.e., two to five decades). **[Michael Chotkowski, USGS]** Conducting scientific investigations alongside management is important for learning about potential management implications. One example is temperature regimes on fish populations. Some effects are predictable, but some have elements of surprise. This information needs to be known to aid management decisions. Another lesson learned is that extended periods of low flow allow sandbars and beaches to build up. Quantifying that would allow managers to make future operational decisions on flow regimes. **[Katrina Grantz, Reclamation]** One lesson is the importance of maintaining strong relationships and close communication with partners, which allows for quick adaptation to changes.

2) **Funding**. *There has been a lot of news about appropriations and infrastructure funding to support drought response in the West. Will your agency receive any of those funds? How will you spend them? Does your agency have the resources it needs to address drought impacts?* **[Tim Vigil, WAPA]** The proposed Infrastructure Investment and Jobs Act has a provision on WAPA's reserve balances, which is a result of the drought. The Senate bill would provide $500 million in borrowing authority for WAPA to use for purchase power and wheeling. It would have to be paid back in ten years and at the Treasury rate. This is something WAPA can use if there is a dire situation such as going below the minimum power pool. There could be other bills related to drought that could affect WAPA. **[Katrina Grantz, Reclamation]** Reclamation is working closely with WAPA to address concerns about the Basin Fund. Sufficient funding is anticipated in FY22, but the long-term funding outlook remains a concern. With respect to major retrofits to CRSP facilities that might mitigate drought impacts to downstream resources, if there are projects that people feel strongly about, please share this with Reclamation. **[Billy Shott, GLCA]** NPS has $600 million in projects that have been started and has identified another $20-30 million to address long-term drought issues. The problem is implementation. Current business functions do not always allow for rapid planning, designing, or building. This process needs to be streamlined.
3) **Collaboration**: *As you think about what is needed for an effective, holistic response to the drought, looking outside your own agency, what should the priorities be for other levels of government – state and local, non-governmental organizations (NGO)s, and the broader public? Feel free to share activities that support or dovetail with federal efforts or those that need to be taken independently*. **[Rob Billerbeck, NPS]** A lot of the past processes were developed over years of collaboration; that firm foundation and strong relationships are helping speed processes that have taken years in the past. For example, Reclamation's response to hydrology changes had to occur in a compressed timeline. That was able to occur because of the collaboration between agencies, and it helped everyone understand how water levels will affect recreational facilities. This has been a new approach. This informed conversations around NPS docks, such as the one at Curecanti/Blue Mesa Reservoir, which is a major $8 million concrete facility that supports a restaurant and other services that provide about $44 million in local economic benefits. It takes a great deal to move them, which needed to be done in weeks. Collaboration cannot take years anymore. **[Katrina Grantz, Reclamation]** Collaboration has been excellent and has helped tremendously. The WaterSMART Grant Program works with local groups and water districts to conserve water, which is another opportunity for collaborative solutions.
4) **Public Information Tools**: *I would like to keep tabs on drought conditions and impacts in real time, but it's challenging to find good information. What tools and information sources does your agency make available that can help?* **[Mike Chotkowski, USGS]** USGS can provide the underlying data that Reclamation and others rely on to operate facilities. The Water Dashboard provides real-time, provisional data on nationwide stream gages for surface water. GCMRC can recommend Grand Canyon-specific research projects or reach out to other USGS offices for specific data. GCMRC monitoring stations app is available at: https://www.gcmrc.gov/discharge_qw_sediment/stations/GCDAMP. Another USGS web tool that might be useful is https://waterwatch.usgs.gov/. **[Rob Billerbeck, NPS]** NPS climate website has extensive plans for adaptation, as well as our climate change research and monitoring and

our installation of new electrical vehicle charging stations at our visitor centers across the country See: https://www.nps.gov/subjects/climatechange/index.htm. **[Katrina Grantz, Reclamation]** Reclamation has a new drought portal that synthesizes data across the West. See: https://www.usbr.gov/addressing-drought/index.html. See also the webpages for the Upper Colorado Basin Water Operations, the Glen Canyon Dam Operations, the 24-Month Study, and the 5-Year Projections.

5) **Future Outlook**: *What do you see as the long-term outlook/implications of continued drought for the resources that are the focus of the AMWG?* **[Katrina Grantz, Reclamation]** Reclamation is expanding its approach and sharing information on a wider range of conditions in addition to maximum and minimum probable forecasts. This information will be released in early September, probably when the 5-year projections are released. It will likely take four or more consecutive years of above-average snowpack and inflow to restore the system as it was before the drought. Therefore, Reclamation is planning for continued dry conditions, lower reservoir levels, reduced releases, and warmer water. Working with partners to develop additional drought response plans by the end of 2021 with implementation by 2022. Committed to continued collaboration to address the ongoing drought. **[Billy Shott, GLCA]** There is still so much uncertainty. For example, in Lake Powell operations, the difference between the high and low probability estimates is 120 feet. The rainbow trout fishery is one example of many species for which exact impacts are not known, but changes are anticipated. **[Rob Billerbeck, NPS]** Recreational "sport" fish and endangered fish are of concern throughout the whole system. The system is highly variable, but the focus needs to be on the overall trend of water availability from climate change because there is not likely to be above-average snowpack again for four to five years in a row. **[Jess Newton, USFWS]** The planning needs to be done for a future negative scenario because there are likely going to be increasing threats to endangered species.

Tribal Partners Report

[Jakob Maase, Hopi Tribe] The Hopi are currently on their river trip. This is now the second to final phase for re-opening the reservation. Will also start hiring the archivist and the temporary ethnography positions soon. **[Peter Bungart, Hualapai Tribe]** As of July 30, no longer employed by the Hualapai Tribe but is still representing the tribe in the AMWG. Expect that Richard Powskey (AMWG alternate) will be the AMWG representative in the future. Dr. Martina Dawley is Peter's replacement at the Hualapai Department of Cultural Resources and will likely be participating in the GCDAMP. The tribe is on a new lock-down due to COVID-19. The Cultural Department is still planning a river trip in September. **[Erik Stanfield, Navajo Nation]** Navajo Nation has increased its restrictions because of COVID-19, which caused the cancellation of the yearly monitoring trip. Still trying to do some smaller, land-based, monitoring trips to the Little Colorado River, Lees Ferry, and to the San Juan arm. The Navajo Nation has established a Climate Change Office with four staff members, which includes consideration of drought effects. **[Arden Kucate, Pueblo of Zuni]** Pandemic restrictions were lifted, but some are being reinstated. Currently, everyone is back to work. A Zuni river trip is planned for August 21-30. During the 2018 river trip, 22 sites out of 24 visited were showing adverse impacts from human visitation. The tribe met in July to discuss tribal knowledge and the matrix to work out some of these concerns. With the lack of snow and water resources, environmental and natural stewardship based on past National Environmental Policy Act (NEPA) documentation is becoming questionable for the future. For example, the benefits of warm water versus cold water to native fish. These are critical areas for the Zuni tribe,

and their traditional knowledge should be incorporated. **[Daniel Bulletts, Southern Paiute Consortium]** A mask mandate was implemented for all tribal buildings and stores. Have not had any closures yet but they are expected in the fall and winter. The tribe's 10-day monitoring river trip occurred in June. "White algae," which looks like fish guts, was seen throughout the trip and is concerning. Even though the park was closed, there was a lot of use where people could hike down to the river. People on private boats were talking about rock climbing at Deer Creek, which they are not supposed to do. The trip was a success, and a report will be submitted to Reclamation.

Q&A and discussion

[Daniel Picard, Reclamation] Hoping to fill the AMWG Tribal Liaison position soon. The application period closes August 26.

[Ernie Rheaume, Reclamation] There will be a meeting this Friday (August 20) with the Assistant Secretary for Water and Science, the Commissioner, leadership from the Upper and Lower Colorado Basins, and all of the Colorado River tribes. The purpose is to kick off a forum for Reclamation and the tribes to exchange information about decisions being made on the Colorado River. This initial meeting will include hydrology reports, the DROA, and other pressing topics. Reclamation is looking for feedback from the tribes. It is expected these meetings will be held monthly. Reclamation is also working on building tribal capacity on modeling activities, including assessing training needs or providing technical help to the tribes, so that they can better engage with all the information that Reclamation has on the Colorado River. **[Arden Kucate, Pueblo of Zuni]** Will that request for feedback go to all the Southwest tribes close to the Colorado River? **[Ernie Rheaume, Reclamation]** Yes, it will go to everyone.

Basin Fund Status and Long-term Funding Considerations for Hydropower Revenues and Appropriations

[PRESENTATION] **[Brian Sadler, CRSP Administrative and Technical Services Manager, WAPA]** Recent projections show revenues will not cover operations and maintenance expenses in 2021, which means forgoing the scheduled repayment obligations. This is unprecedented and is because of the continuing drop of Lake Powell's elevation with decreasing generating efficiency. To mitigate the corresponding decrease expected to the CRSP Basin Fund, WAPA is considering deferring projects, increasing rates, and reducing funding to Reclamation for environmental programs.

[PRESENTATION] **[Kathleen Callister, Resources Management Division Manager, Reclamation]** Reclamation needs both an Authorization (an Act of Congress) and Appropriations (to provide funding) to conduct its programs. The GCDAMP is authorized under Public Law (P.L.) 102-575 (refer to Sections 1807 and 1808) and P.L. 106-377 (Section 204). Neither is in a sunset clause, so GCDAMP is in a good position with its Authorization. Funding for GCDAMP is in the President's budget, which included $21.4 million for "Colorado River Activities." Right now, both the Senate and House Appropriations bills have language that authorizes these funds. For GCDAMP in FY22, funding levels are expected to remain the same at $11.36 million. The FY24 budget request is being developed now.

Discussion

[John Hamill, FFI/TU] Is there a potential to increase power generation at Glen Canyon by retrofitting the bypass tubes with turbines? Could that also address temperature and dissolved oxygen concerns? **[Wayne Pullan, Reclamation]** Reclamation was close to implementing a temperature control device at

one time but could not push that through; retrofitting the bypass tubes is very expensive. More information will be provided on Day 2 of this meeting. **[Matt Rice, American Rivers]** Is there the potential to make the rate adjustment match the increased costs? **[Brian Sadler, WAPA]** WAPA is proposing to reduce generation to eliminate most of the purchase power expected over the next couple of years. That is one of the goals of this rate proposal, which is based on expenses and what is being charged for that energy.

FY 2022 Budget and Work Plan

[PRESENTATION] **[Seth Shanahan, Southern Nevada Water Authority (SNWA) and TWG Chair]** The last TWG meeting was in June when the Budget Ad Hoc Group (BAHG) provided its recommendation to the TWG. This will be presented as a motion to AMWG for its consideration.

[PRESENTATION] **[Lee Traynham, Reclamation]** GCDAMP's anticipated funding for FY22 is $11.36 (80% to GCMRC and 20% to Reclamation). FY22 budget is expected to be short but anticipate making up that difference from FY21 funds. If there are remaining funds, Reclamation would like to use up to $50,000 to conduct a dissolved oxygen risk assessment. Other emerging issues to consider if funding is available are fish passage prevention, temperature control, humpback chub status and trigger response, and archiving/updating the LTEMP models.

[PRESENTATION] **[Mike Moran, Acting Chief, GCMRC]** The projects in GCMRC's budget were shown. The BAHG had requested for GCMRC to prioritize its projects if end-of-year funding is made available. The priorities were detailed in the presentation. It is expected there will be $203,000 in carryover funding that will be used to balance the FY22 budget. The Lake Powell Water Quality Project is listed in the Triennial Budget and Work Plan (TWP), but it is not funded through GCDAMP. An update was also provided on the new building and its expected overhead rates.

Discussion

[Jan Balsom, NPS] What is being done on the project regarding fish passage and the issue to exclude non-natives? There is an urgency as water temperatures keep shifting. **[Lee Traynham, Reclamation]** The best plan for controlling non-natives is preserving lake elevations. The risks are much greater when elevations get closer to 3,490 feet. The Technical Services Center (TSC) had looked at some creative ideas, but the solution is not readily apparent. Any physical barrier becomes an significant maintenance effort, and some non-natives are already present below the dam. **[Clarence Fullard, Reclamation]** There are efforts being pursued regarding fish passage with the TSC and Utah State University to better understand the risks and explore exclusion ideas. More to come later.

[Larry Stevens, GCWC] Will there be a monitoring system to be able to recognize changes or novel patterns? The foodbase is much more dynamic than previously thought with more seasonality patterns with the macrophytes. As the water warms, there will be more potential for disease. Water quality issues during monsoons can also affect bacterial levels. How can this be tracked better? **[Mike Moran, GCMRC]** It is hoped that normal monitoring by GCMRC would catch effects from temperature and disease. If not, maybe there can be an evaluation to respond to a spike in some other way. **[Larry Stevens, GCWC]** Perhaps include this as an agenda item in the next TWG meeting. **[Jan Balsom, NPS]** Ken Hyde or Billy Shott can address water quality issues in Lake Powell. The NPS also has a new Public Health Officer at Grand Canyon who can be made aware of concerns about bacteria. **[John Hamill, FFI/TU]** It is troubling to see temperature control and fish passage being delayed. There needs to be

more urgency to address these issues, because it takes time for the agencies to get going on them. **[Lee Traynham, Reclamation]** These were flagged, but that was not intended to imply they would be delayed. It was to show that additional funding was not being requested for these items in FY22, but should be on our radar as a potential need. There are many challenges and Reclamation is interested in hearing solutions that others might have. **[Larry Stevens, GCWC]** Fish parasites are also a possible concern with increased warming, which might not be detected through monitoring.

FY 2022 Budget and Work Plan Recommendation

[Seth Shanahan, SNWA and TWG Chair] The TWG motion that was approved by consensus was presented to the AMWG.

Discussion

Larry Stevens, GCWC] With all the uncertainty, it might be advisable to develop an Ad Hoc Committee for contingency planning purposes to quickly respond to emergency situations. This would be tangentially related to the BAHG, if funding is also needed. **[John Hamill, FFI/TU]** Could the TWG be tasked to do this? **[Larry Stevens, GCWC]** The responsibilities would need to be clear, but a committee that meets monthly might be quicker to respond than the quarterly TWG. **[Leslie James, CREDA]** If there is end-of-year funding, could this be held in the Basin Fund, or could it be applied to the GCMRC Water Quality Project to mitigate impacts of other power revenue funding? The authority to find alternative funding sources already exists and needs to be considered going forward. **[Lee Traynham, Reclamation]** It is a constant struggle to find cost efficiencies in these programs and to incorporate them long-term. Reclamation feels confident in the funding for FY22, but the outlook beyond that is uncertain. There is a need to consider end-of-year funds to address and mitigate the uncertainty in future years. This has been discussed in the BAHG.

[Larry Stevens, GCWC] Moved the motion. **[Sara Price, CRCN]** Seconded the motion.

The following motion was approved by consensus:

> *The Adaptive Management Work Group recommends for approval to the Secretary of the Interior the Fiscal Year 2022 budget as described in the attached worksheets, with the following revisions:*
>
> > *First, the addition of the following prioritized list of Grand Canyon Monitoring and Research Center projects to be considered as appropriate sources of funding become available (e.g. Triennial Work Plan carryover funds from prior years or through annual review of the Triennial Work Plan or other Reclamation considerations).*
> >
> > 1. *Juvenile Chub Monitoring-West (2023).*
> > 2. *Additional Trout Recruitment and Growth Dynamics Site (2023).*
> > 3. *Aquatic Vegetation Removal Pilot in Lees Ferry (202?) (Subject to additional proposal detail and completion of compliance requirements).*
> > 4. *Decision Analysis - Project O.11 and Bug Flow Review (Additional proposal detail requested following Science Advisor review).*
> > 5. *Aquatic Food Base – Project O.1 (2022).*
> > 6. *Sediment Mapping Below Diamond Creek - Project O.2 (2022).*
> >
> > *Second, the addition of a Dissolved Oxygen Risk Assessment to be completed by Reclamation in 2022 as appropriate sources of funding become available.*

Public Comment

None.

Meeting adjourned at: 3:35 PM PDT

Thursday, August 19, 2021

Start Time: 8:30 am PDT
Conducting: Wayne Pullan, AMWG Chair
Recorder: Carliane Johnson, SeaJay Environmental, L.L.C.
Facilitator: J. Michael Harty and Kearns & West team.

Welcome and Administrative

- Introductions and Determination of Quorum. **[Michael Harty, Facilitator]** Roll call was taken, and a quorum reached with 18 members represented.
- Revisit any outstanding items from the previous day. **[Lee Traynham, Reclamation]** One item was temperature control and concerns about decreasing lake levels. This link is to a presentation to the TWG about temperature control devices. The 2016 LTEMP biological opinion includes a conservation measure for Reclamation to evaluate a control device under a broad range of conditions (i.e., warming and cooling, high and low flows, and high and low reservoir levels). The earliest conversations (back to 1978) focused on high lake levels and the need to provide a warming device. Recently, the TSC prepared a summary report about the range of temperature control devices and technologies as well as associated challenges and opportunities. The focus of the conversation has changed in recent years to providing cooler water but have found that these options are more limited. One opportunity is to look at the bypass tubes, which are below the penstock intakes and could access cooler water. One of the challenges is that the potential cooling capacity of this alternative is very limited. Reclamation is also hoping the GCDAMP can help refine the temperature objectives. It has been fortunate to have a "just right" temperature regime below Glen Canyon Dam that has reduced challenges with non-natives, which are prevalent in the Upper Basin, and has allowed humpback chub to recruit. Continuing to maintain this "just right' temperature regime is going to be challenging. Refining the objectives for temperature targets downstream of Glen Canyon Dam will inform the most appropriate solutions. **[Nick Williams, Reclamation]** Adding power generation to the river bypass could provide limited temperature control capability. With the addition of power generation, the bypass tubes would have reduced discharge capacity of an estimated 7,000 cubic feet per second [CFS], compared to 15,000 CFS for the existing bypass structure. Temperature control is limited because changes can only be affected based on the water that can be released at a single, fixed elevation. The last study by Reclamation on bypass generation, published in 1983, estimated a power plant on the bypass would have a maximum capacity with two units at 250 megawatts (MW). That compares to the current power plant, which has a capacity of 1,320 MW. The concept was recently discussed with WAPA including the benefits of bypass generation, e.g., temperature control, water quality, experiments during HFEs, operational flexibility during maintenance, and replacing power generation, such as constructing

a smaller plant to generate power for when the elevation is below the power pool. That could potentially cost nine months and $1 million to complete an appraisal study and at least $500 million to build.

Federal Agency Updates

- WAPA: Glen Canyon Dam Emergency Exception Criteria **[Tim Vigil, WAPA]** This year there have not been any emergency events like last year's rolling blackouts. There was a potential for California to hit a threshold in early June, but this did not happen. There is still a possibility for it to occur in September.
- USFWS: Humpback chub, razorback sucker, Kanab ambersnail Endangered Species Act (ESA) status **[Jess Newton, USFWS]** Jessica Gwinn, USFWS Colorado River Coordinator, has accepted a position in the regional office and her former position is now vacant. The final rule on reclassifying humpback chub from endangered to threatened should be out soon. Revisions to the Recovery Plan will occur after the final rule. A detailed presentation on razorback sucker will be held later in this meeting, which will cover the proposed down-listing and the associated 4(d) rule. The delisting of Kanab amber snail (due to taxonomic reclassification) became effective on July 19, 2021. This species falls under state wildlife agency authority so Arizona Game and Fish (AZGFD) will manage this population, but it is no longer a listed species under the ESA.
- NPS: Non-native Aquatic Species Management Plan **[Ken Hyde, NPS-GLCA]** NPS is still conducting the first year of the incentivized harvest program with 340 brown trout turned in with two-thirds of them 12 inches or larger. Recently checked the upper slough (at -12 miles, just below the dam) for green sunfish. There were young present so will look into transferring them to Lake Powell prior to an HFE and to address tribal concerns. Will start preparing the 12-month review of the incentivized harvest program in November for the technical meetings in January. **[Brian Healy, NPS]** Grand Canyon was not able to translocate humpback chub this summer due to COVID-19 and because of low production of young-of-year in the Little Colorado River. Will continue to suppress brown and rainbow trout this winter and will complete monitoring of the translocation sites this summer.
- DOI Solicitor's Office: LTEMP Litigation **[Rod Smith, DOI]** DOI is still in the procedural phases of the LTEMP litigation. LTEMP was challenged by Save the Colorado and Center for Biological Diversity alleging that the NEPA analysis was wrong based on climate change. DOI has been working on the Administrative Record and discovery issues. The last motions before the court were briefed last spring. Now waiting on the court to make its decision on those motions. Once that is done, then the court will have established the factual basis for the lawsuit and move on to a substantive briefing on the merits of the case. Any interested organizations who would like to become intervenors in support of LTEMP should contact Rod.
- BIA, GCMRC, Reclamation **[Chip Lewis, BIA]** No updates. **[Scott VanderKooi, GCMRC]** Has accepted a new position as Director of Southwest Biological Center but will still be overseeing GCMRC. Mike Moran is GCMRC acting chief. Ted Kennedy is helping with the deputy duties. GCMRC's field season this year has not been disrupted. **[Kathy Callister, Reclamation]** Katrina Grantz is the new assistant regional director along with Daniel Picard. Zac Nelson is the new archeologist. The GCDAMP Tribal Liaison position is now open for applicants.

Proposed Rule for Downlisting Razorback Sucker

[PRESENTATION] **[Julie Stahli, Deputy Director, Upper Colorado River Endangered Fish Recovery Program and Kevin McAbee, Fish Biologist, USFWS]** The decision to down-list the razorback sucker was proposed in 2018. The Recovery Plan will be revised after publication of the rule. A Special Status Assessment (SSA) was done as well as a peer-review process. Details are contained within the presentation.

Q&A and discussion

[Jan Balsom, NPS] Curious about the time lag of the SSA evaluation. How will the recent changes be addressed? For razorback suckers that rely on a stocking program, it does not seem sustainable in light of changing environmental conditions. Maintaining native species is a key component of the NPS mission, too. **[Julie Stahli, USFWS]** There are a variety of reasons why the process might take a long time. The down-listing was not an easy decision for USFWS but it came back to the definitions of threatened versus endangered. There is a need to balance the needs of the species to the changing conditions. For example, Colorado pikeminnow went through a similar process but its trajectory in the Green River was declining, which resulted in the decision to continue to list it as endangered. There have been great improvements in the Upper Basin for razorback sucker resulting in it not being endangered at this time.

Stakeholder Updates:

- States: **[Dave Rogowski, AZGFD]** Monitoring was completed in Lees Ferry reach last month. The lower slough is open to the river. Did not find any rare non-natives (e.g., no green sunfish, walleye, smallmouth bass, etc.). Rainbow trout fisheries are at low levels right now; the lowest seen in about 20 years. **[Charlie Ferrantelli, Wyoming]** Have been focused on DROA, releases from Flaming Gorge, the Work Group meetings, and public outreach on those releases.
- Tribes: **[Peter Bungart, Hualapai]** Acknowledges the resources devoted to the sediment situation in the Western Canyon (Project O.2) and is looking forward to the study results. **[Kurt Dongoske, Pueblo of Zuni]** The Zuni River trip will launch on Saturday and will follow GCMRC's COVID-19 protocols. Regarding the monitoring metrics, there is concern about the qualitative values of the resources, which should be given commensurate consideration as the quantitative values. Zuni is developing a collaborative mitigation strategy with the NPS on an ancestral site in the Grand Canyon. Also hope to receive funding soon from Reclamation on that proposal.
- Non-Governmental Organizations (NGOs): **[Matt Rice, American Rivers]** American Rivers will be hosting a river trip next week through Gates of Lodore to discuss renegotiation of the basin guidelines. Will continue to support the investigation of returning rivers in Lower Cataract Canyon. **[Kelly Burke, GCWC]** Plans have been approved for the Paria Beach restoration project with NPS and others. **[Kevin Garlick, Utah Municipal Power Agency]** Power purchasers, utilities and municipalities, are working to mitigate costs related to reduction in power generation. It was noted that the replacement of hydrogeneration typically involves a fossil fuel source, which results in higher carbon emissions. **[John Jordan, FFI/TU]** The ongoing study of the temperature control devices was informative. FFI will continue those discussions and work toward implementation. **[David Brown, Grand Canyon River Guides]** The monsoons this past season have been very violent. There was an unfortunate incident in Marble Canyon that killed one person and seriously injured another.

LTEMP Experiments Considered & Implemented for WY 2021 and WY 2022

[PRESENTATION] **[Lee Traynham, Reclamation]** Presented summary of the process by which LTEMP flow experiments were discussed and considered. No flow experiments were recommended for implementation by the Planning and Implementation Team for 2021. However, there were two research-related flows that were implemented in 2021: the spring disturbance flow that was done in conjunction with the apron repair and the overflight data collection effort and associated flow.

[Ted Kennedy, GCMRC] The spring disturbance flow was implemented over a ten day duration in March 2021 because of needed dam maintenance. One concern was the potential for the stranding of native fish. Only a few small were observed in isolated pools. An overall update will be reported at the Annual Reporting meeting. **[Michael Moran, Acting Chief, GCMRC]** The other major data collection effort was for the overflight. From the photographs and remote sensing information, a digital elevation model was developed. For experiments that could be occurring in FY22, there is the potential for a fall HFE. Inflows have occurred from July to current with significant sand inputs from the Paria.

[Lee Traynham, Reclamation] Reclamation runs the sand budget model, which determines whether the trigger is met for an HFE. The current model suggests a 48-hour HFE could occur in the fall. This means that the trigger has probably been reached, based on the preliminary model run. The Planning and Implementation Team will start meeting next week.

Q&A and discussion

[John Hamill, FFI/TU] Why are trout numbers in Lees Ferry the lowest that AZGFD has observed in 20 years? **[Ted Kennedy, GCMRC]** There are a couple of hypotheses. Brown trout (being piscivorous) might be abundant enough that they are suppressing rainbow trout recruitment. **[Dave Rogowski, AZGFD]** Agrees with this. Not much recruitment of rainbow trout has been seen. One possible explanation is that brown trout numbers are high enough that they are preying on small rainbow trout.

[John Jordan, FFI/TU] How does reduced water availability impact the consideration of HFE experiments, both related to water distribution and hydropower generation? **[Brian Sadler, WAPA]** WAPA will need to model the specific proposal. Where the water comes from is taken into consideration, plus the cost of hydropower, which are lower in the shoulder months of November and springtime.

[Jessica Neuwerth, Colorado River Board of California] Do HFEs require "borrowing" release volumes from other months, or just shifting release volumes within the month of November? Or does it depend on the duration of the HFE, i.e., shorter HFEs can be accommodated within the November release volumes, but longer HFEs require borrowing water from other months? **[Heather Patno, Reclamation]** Water can be borrowed from other months within the water year.

[Larry Stevens, GCWC] Given the maintenance schedule at the dam, how much discharge could be generated if an HFE was to be triggered? **[Heather Patno, Reclamation]** Probably around 26,000 CFS.

[Billy Shott, GLCA] Are there ways to determine how a proposed HFE under these parameters would affect the lake levels of Lake Powell? Especially considering the current lake levels are affecting the volume/depth ratios? **[Lee Traynham, Reclamation]** The Planning and Implementation Team will look at proposed hydrographs and how they might impact lake levels; elevation impacts will partly depend on the hydrograph and how water is reallocated within the year to accommodate the HFE.

[John Hamill, FFI/TU] Borrowing water from November to support an HFE could raise water temperatures and lower dissolved oxygen, which could significantly affect the Lees Ferry trout fishery. **[Mike Moran, GCMRC]** If water is being released in November and not replaced until later in the year, that could affect the lake. The intakes will come closer to the stratified level in the lake, which is the warm part and would be lower in dissolved oxygen. That could be an issue. **[Jan Balsom, NPS]** Will we see changes in temperature near the penstocks in the timeframe around a potential HFE? **[Ted Kennedy, GCMRC]** HFEs tend to cool the water. The jet tubes act like a giant aerator. Borrowing water in the winter months would need to be modeled. **[Lee Traynham, Reclamation]** The annual releases are fixed. Discussions around borrowing water relate to the monthly pattern. If there is an HFE, LTEMP requires that the total amount of annual water must remain the same.

GCMRC Science Updates

[Michael Moran, Acting Chief, GCMRC] This [PRESENTATION] includes only those projects with the most recent data results and how GCMRC is addressing the drought. Projects discussed were Sandbar Monitoring (Project B) and a recent publication by Mueller and Grams (2021) on morphodynamic modeling; Riparian Vegetation Field Measurements along with the remote sensing (Project C); Humpback Chub (Project G) with estimated numbers in the Little Colorado River likely to be at the lowest ever observed; Rainbow/Brown Trout in Lees Ferry (Project H) with low abundance of rainbow trout and the current population dominated by large fish, increased catch rates of brown trout continue to be observed); and Geospatial and Data Science (Project K). GCMRC could re-focus its work on drought, if requested, but it is constrained and would need to reduce the budget in other areas.

Q&A and discussion

[Sara Price, CRCN] How would it look different to monitor for drought? **[Michael Moran, GCMRC]** Larry mentioned fish disease. **[Ted Kennedy, GCMRC]** During monitoring trips, disease impacts such as lesions would be noted. Feels confident this would be seen and it is not a gap.

[Sara Price, CRCN] Would propping the lake up, just enough to address low lake levels, have that much of an effect? **[Kim Dibble, GCMRC]** It does matter. If there is not enough water, it would change the equation. That was the main point of the paper.

[Larry Stevens, GCWC] Can GCMRC participate in a Contingency Awareness Ad Hoc committee? **[Ted Kennedy, GCMRC]** This is going to be considered at the next TWG meeting.

[Jan Balsom, NPS] At the various water levels, these lower temperature and lower reservoir conditions have not been investigated. What would the conditions be like for aquatic vegetation at these lower release levels? **[Ted Kennedy, GCMRC]** In general, lower flows allow for more biological processes whereas at higher flows, things are just moving through. There are no red flags at lower flows although there might be surprises in store. There will be shifts. For example, dissolved nutrients will decrease while phytoplankton will increase. Regarding a contingency plan ad hoc committee, the ability to mitigate might be the most difficult to do. Perhaps we consider the stressors, the response times, and whether there may be a bottleneck to the response?

[Amy Mignella, Office of General Counsel, Hopi Tribe of Arizona] Are any graphics available depicting these perturbations and their likely system consequences? For example, has any modeling been done for zero river flows to work from there to improve conditions? **[Kim Dibble, GCMRC]** This paper looked

at future scenarios of water temperature and the probability native and non-native species may become common in various river segments in the future due to warming water temperatures. In addition, Charles Yackulic has been working extensively with folks from Utah State University to do more complex modeling of the issues you raised, and they now have additional funding to continue and expand upon that work.

Technical Work Group Chair Report

[PRESENTATION] **[Seth Shanahan, SNWA and TWG Chair]** The last TWG meeting was in June, which resulted in completion of the FY22 budget for the TWP that was approved yesterday. Next TWG meeting will be held virtually in October, and then possibly an in-person, annual reporting and TWG meeting in Flagstaff in January. The TWG has also been discussing and tracking low elevations in Lake Powell, drought response, budget, experimental actions, science updates, and monitoring metrics. The TWG also continues to discuss temperature control devices and to track many other issues (fish passage, conservation actions, the trigger document, power purchase cost, changes in Little Colorado River, etc.).

GCDAMP Monitoring Metrics

[PRESENTATION] **[Helen Fairley, Social Scientist, GCMRC]** The purpose of this project is to define "performance metrics" for the GCDAMP. The focus is primarily to evaluate progress towards achieving management goals of the LTEMP. A draft plan for how to identify the metrics was shared with the TWG in June and AMWG comments are requested by September 17. Preliminary draft metrics are expected to be submitted to the TWG at the October 2021 meeting.

[Clarence Fullard, Reclamation] Science Advisor will review similar types of large, multi-science programs, consider the lessons learned, and compare them with the approach to measure LTEMP progress.

Discussion

[Larry Stevens, GCWC] GCWC has submitted extensive comments on the process. The path that Western science takes is to develop a model. Several of the resource areas are very well modeled that can test the monitoring metrics such as sediment flow, water temperature, etc. These are world-class and straightforward. Other resource objectives are either vague or do not fit well into a model. A good exercise might be to prioritize which suite of questions can or cannot currently be applied with a metric. **[Helen Fairley, GCMRC]** Appreciates this input and would welcome further examples to bring forward.

[Peter Bungart, Hualapai Tribe] The situation now is much different than pre-dam conditions. Some tribal values also do not lend themselves to objective metrics. One resource does not necessarily exist in isolation from another. **[Jakob Maase, Hopi Tribe]** There are two phases of this, which is to learn the metrics (i.e., baseline) and the future metrics from that baseline. Cannot turn back the clock to a non-artificial environment, but can establish what is needed for a healthy environment moving forward. **[Helen Fairley, GCMRC]** In the early 2000s, drafted the Core Monitoring Plan, which took five years and a huge amount of time. The scope of the monitoring in that plan consumed the entire budget, and it was never implemented. This time around, GCMRC tried to constrain the scope and plans to develop a conceptual model that will acknowledge the various eco-drivers that affect the outcomes, but the intent is to keep the focus on the goals rather than all the system variables.

[Erik Stanfield, Navajo Nation] Regarding the Science Advisor, do any of the previous large programs have experience working with tribes or other indigenous groups? There are many international programs in New Zealand, Canada and other places that could broaden this thinking. Secondly, it can be valuable to collect qualitative data at the same time as quantifiable data. That would help alleviate some of the tribal concerns if they can assist in the interpretation. **[Clarence Fullard, Reclamation]** It is not too late to send in those other program examples and add them to the list.

[Jan Balsom, NPS] It is field season and getting staff input to this plan has been a challenge. The NPS has a lot of different and ongoing monitoring systems. It would be important to work directly with GCMRC. **[Helen Fairley, GCMRC]** Aware of other monitoring programs including those from the AZGFD, which has also developed metrics. The difficulty is going to be distilling them down to a few that are related to the goals.

[Leslie James, CREDA] Is the Core Monitoring Plan going to be culled for some metrics that may be used? **[Helen Fairley, GCMRC]** Not yet. Would not want to lose that effort, but the current effort is being done somewhat differently with a different focus. The goals have also changed since that time, so the metrics need to be relevant to the 2016 LTEMP but would not want to lose that earlier effort.

Public Comment

None.

WRAP-UP: Wayne Pullan, Secretary's Designee to the Adaptive Management Work Group

- Service Recognition **[Wayne Pullan, Reclamation]** Gives recognition to John Jordan, FFI/TU, John Hamill, FFI/TU; Jan Balsom, NPS; and Scott VanderKooi, GCMRC.
- FY2022 AMWG and Annual Reporting meeting dates **[Lee Traynham, Reclamation]** Send comments if there are conflicts with the proposed meeting dates. The January meeting will be virtual. The group will be notified if there are plans to conduct in-person meetings.
  - January 11-13, 2022
  - February 9-10, 2022
  - May 18, 2022 (webinar)
  - August 17-18, 2022

Meeting adjourned at 3:05 PM

Meeting Attendees

AMWG Members, Alternates, and Leadership

Jan Balsom, NPS-GRCA
Cliff Barrett, UMPA (Alternate)
Richard Begay, Navajo Nation
Peter Bungart, Hualapai Tribe
Charlie Ferrantelli, State of Wyoming (Alternate)
Kevin Garlick, UMPA
Michelle Garrison, State of Colorado (Alternate)
Paul Harms, State of New Mexico (Alternate)
Leslie James, CREDA
John Jordan, FFI/TU
Charles "Chip" Lewis, BIA
Jakob Maase, Hopi Tribe
John McClow, State of Colorado
Jessica Neuwerth, CRBC
Peggy Roefer, CRCN (Alternate)
Matt Rice, American Rivers
Brian Sadler, WAPA (Alternate)
William "Billy" Shott, NPS-GLCA (Alternate)
Arianne Singer, New Mexico
Larry Stevens, GCWC

Arden Kucate, Pueblo of Zuni

USGS/GCMRC Staff

Caitlin Andrews
Lucas Bair
Kimberly Dibble
Helen Fairley
Thomas Gushue
Meredith Hartwell
Nicole Herman-Mercer
Ted Kennedy
Josh Korman
Teo Melis
Michael Moran
Emily Palmquist
Diana Restrepo-Osorio
Joel Sankey
Russ Taylor-Grimes
Joseph Thomas
Darrin Thome
David Topping
Alicia Torregrosa
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Dave Isleman
Carly Jerla
Christina Kalavritinos
Kerri Pedersen
Daniel Picard
Alex Pivarnik
Ernie Rheaume
Wayne Pullan
Noel Santos
Dave Speas
Meghan Thiemann
Shana Tighi
Lee Traynham
Nicholas Williams
Jill Nagode
Heather Patno

Department of the Interior

Jabob Borton, *Solicitor's Office*
Noel Ottman, *Solicitor's Office*
Kerry Rae, *ASWS Chief of Staff*
Rodney Smith, *Solicitor's Office*
Susannah Thomas, *Solicitor's Office*

Interested Persons

Todd Adams, Utah
Terra Alpaugh, Kearns & West
Seth Arens, Western Water Assessment
Rob Billerbeck, NPS
David Braun, Sound Science
Jackie Brown, Tri-State Generation & Transmission
Rod Buchanan
Carlee McClellan, Navajo Nation
Scott McGettigan, State of Utah
Lisa Meyer, WAPA
Emily Omana Smith, NPS-GRCA
Betsy Morgan, Utah
McKenna Murray, Utah
RJ Neff

Daniel Bulletts, Southern Paiute Consortium
Kevin Bulletts, Southern Paiute Consortium
Kelly Burke, Grand Canyon Wildlands Council
Shane Capron, WAPA
Julie Carter, AZGFD
Mike Chotkowski
Lew Coggins, USFWS
Kevin Dahl, NPCA
Fred Daniel, Fireflies.ai
Martina Dawley, Hualapai Tribe
Kurt Dongoske, Pueblo of Zuni
Craig Ellsworth, WAPA
Ed Gerak, AZ Power Authority
Alicyn Gitlin, Sierra Club
Emily Halvorsen, State of Colorado
John Hamill, FFI/TU
Michael Harty, Kearns & West
Brian Healy, NPS
Ken Hyde, NPS
Carliane Johnson, SeaJay Environmental
Kristen Johnson, ADWR
Tildon Jones, USFWS
Edward Keable, NPS
Jess Newton, USFWS
Bill Persons, FFI/TU
Erika Pirotte, Navajo Nation
Sara Price, CRCN
Ted Rampton
Shana Rapoport, CRBC
David Rogowski, AZGFD
Amy Schott, NPS
Gene Seagle, NPS
Seth Shanahan, TWG Chair and SNWA
Erik Skeie, State of Colorado
Erik Stanfield, Navajo Nation
Julie Stahli, USFWS
Zach Stevens, DRLawFIrm.com
Jim Strogen, FFI/TU
Gary Tallman, Northern Arizona University
Melissa Trammell, NPS
Tim Vigil, WAPA
Sara Larsen, Upper Colorado River Commission
Randy Lavasseur, NPS
Mike Lyndon, NPS
Ryan Mann, AZGFD
Kevin McAbee, USFWS

Abbreviations

AMWG – Adaptive Management Work Group
AZGFD – Arizona Game and Fish Department
BAHG – Budget Ad Hoc Group
CFS – Cubic Feet Per Second
CRBC – Colorado River Board of California
CRCN – Colorado River Commission of Nevada
CREDA – Colorado River Energy Distributors Association
CRSP – Colorado River Storage Project
CY – Calendar Year
DOI – Department of the Interior
DROA – Drought Response Operations Agreement
ESA – Endangered Species Act
FFI – Fly Fishers International
FLAHG – Flow Ad Hoc Group
FY – Fiscal Year (October 1 – September 30)
GCDAMP – Glen Canyon Dam Adaptive Management Program
LTEMP – Long-Term Experimental and Management Plan
MW – Megawatt
NEPA – National Environmental Policy Act
NGO – Non-Governmental Organization
NTUA – Navajo Tribal Utility Authority
NPS – National Park Service
PI Team – Planning/Implementation Team
P.L. – Public Law
PST – Pacific Standard Time
Reclamation – Bureau of Reclamation
ROD – Record of Decision
Secretary – Secretary of the Interior
SNWA – Southern Nevada Water Authority
SSA – Special Status Assessment
TSC – Technical Services Center
TU – Trout Unlimited

GCMRC – Grand Canyon Monitoring & Research Center
GCRG – Grand Canyon River Guides
GCWC—Grand Canyon Wildlands Council
GLCA – Glen Canyon National Recreation Area
HFE – High Flow Experiment
TWG – GCDAMP Technical Work Group
TWP – Triennial Budget and Work Plan
USFWS – United States Fish & Wildlife Service
USGS – United States Geological Survey
WAPA – Western Area Power Administration