

GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM
TECHNICAL WORK GROUP MEETING
OCTOBER 13-14, 2021
FINAL MEETING MINUTES

Start Time: 8:36 AM Pacific Daylight Time (PDT)

Conducting: Seth Shanahan, Technical Work Group (TWG) Chair

Meeting Recorder: Carliane Johnson, SeaJay Environmental LLC

Welcome and Administrative

- **Introductions and Determination of Quorum (16 members):** [Seth Shanahan, Southern Nevada Water Authority (SNWA) and TWG Chair] Introductions were made, including the two vice chairs Clarence Fullard, Bureau of Reclamation (Reclamation) and Michelle Garrison, Colorado Water Conservation Board (CWCB) and new TWG members. Quorum was reached with at least 16 TWG members/alternates.
- **Adoption of Prior Meeting Minutes:** June and October meeting minutes will be approved in January.
- **Next Meeting Date(s):** January 11-13, 2022 (virtual).
- **Ad Hoc Group Membership and Updates:** [[DOWNLOAD](#)] [Craig Ellsworth, Western Area Power Administration (WAPA) and Budget Ad Hoc Group (BAHG) Chair] The BAHG just started working on developing budget priorities. [Seth Shanahan, SNWA and TWG Chair] A comment had been heard from Larry Stevens, Grand Canyon Wildlands Council (GCWC), about an emergency ad hoc process to address unanticipated issues (such as low dissolved oxygen [D.O.] in Lake Powell) more quickly than during quarterly meetings. The Steering Committee Ad Hoc Group (SCAHG) will take on this task. ACTION: Anyone who wants to be involved in the SCAHG or other Ad Hoc committees should contact Clarence Fullard.
- **Review Action Items, Motions, and Votes Form:** Refer to the list here: [DOWNLOAD](#).
- **Update on Program Funding:** [Lee Traynham, Reclamation] We are now in Fiscal Year 2022 (FY22), and are currently under a Continuing Resolution (CR). An update will be provided at the January meeting.
- **Science Advisors Program Status:** [Clarence Fullard, Reclamation] Reclamation manages the contracting for the Glen Canyon Dam Adaptive Management Program (GCDAMP) science advisor program. Reclamation now has a five-year contract with Sound Science as the Science Advisor provider
- **Update on Monitoring and Research Trips to Occur From Today Until Next Meeting:** [Mike Moran, Grand Canyon Monitoring & Research Center (GCMRC)] The GCMRC trip table is here: [[DOWNLOAD](#)] [Brian Healy, National Park Service (NPS) Grand Canyon] NPS just completed its Havasu humpback chub monitoring trip and installed the weir to intercept trout at Bright Angel Creek. On October 19, NPS will start its non-native fish removal project that will continue through January.

Update on Hydrology, Glen Canyon Dam Operations, and Water Quality Conditions in Lake Powell and Below Glen Canyon Dam

[Heather Patno, Reclamation] Current Upper Basin storage is summarized in the presentation [available soon]. The last month of Water Year 2021 (September) was both above and below average, but the annual seasonal precipitation was between 70-90% of average that was helped by the monsoon events. Current precipitation is good with snow in the upper elevations and rain in the lower elevations. Every decade, the National Weather Service does a data shift to a new 30-year average. The calibration of that data will be implemented this month. This will not change Colorado River Storage Program (CRSP) operations, but it will be more reflective of the dryer conditions from the last 21 years of drought. The October 2022 forecast for Lake Powell unregulated inflow shows the Most Probable at 7.4 million acre-feet (MAF) or 77% of average with the new 1991-2020 data shift. Reclamation is currently operating under the Drought Response Operations Agreement (DROA). Declines in hydrology and Lake Powell elevations continue to be observed. Additional DROA releases will continue through the end of this calendar year. Lake Mead is in shortage conditions under the Interim Guidelines, the first time this has been declared for Lake Mead and the Lower Basin.

Q&A and discussion

[Charlie Ferrantelli, WY] How does the decade shift change the Most Probable figure on Lake Powell's Unregulated Inflow? **[Heather Patno, Reclamation]** It is a significant shift that is showing dryer hydrology. The high volumes from the 1980s have been removed from the forecast, which is why there was a decrease in Lake Powell of 7.4 MAF in the October 2022 Most Probable volume, whereas it was 8.2 MAF (76% of average) from the October 2021 Most Probable when using the 1981-2010 data. **[Seth Shanahan, SNWA and TWG Chair]** Would volume be a better metric than percentage of average?

[Heather Patno, Reclamation] The percent of average is probably more relevant because this reflects the 21 years of drought. It is a lower volume and more in line with the dryer conditions. **[Larry Stevens, GCWC]** In the 1922 Compact with 8.23 MAF, how will the projections of 7.4 MAF alter the expectation of water than the basin can deliver? **[Heather Patno, Reclamation]** Those considerations are at a policy level. There has been a continued decrease and this new 30-year period takes those changes into consideration. From an operational standpoint, the new data allows for better discussions about water delivery and impacts from Lake Powell elevation levels, which should be more accurate.

[Rob Billerbeck, NPS] What is the dead pool/bypass elevation – does the lowest trace hit that? **[Heather Patno, Reclamation]** Reclamation has not operated at these levels since Lake Powell started filling. The minimum power pool elevation of 3,490 feet is at a higher elevation to limit impacts to the facility caused by vortices forming above the penstock. The bypass elevation is about 100 feet below that. With those traces, Reclamation would still be able to release water through the bypass.

[Seth Shanahan, SNWA and TWG Chair] Describe the statistics of what min, most, and max probable represent. **[Heather Patno, Reclamation]** The minimum probable in WY22 is the 10th percentile and the maximum probable is the 90th percentile of water volume.

[Jeremiah Drewel, Reclamation] For water quality conditions at Lake Powell, the surface waters are getting cooler with penstock levels at close to 15 degrees Celsius (°C). The current D.O. layer is suspected to have come from runoff from monsoonal rains. Typically, this would not cause problems,

but as the lake levels are lower, exposed sediments were scoured from the side canyons and the main channel creating biological and chemical oxygen demand, lowering D.O. At the penstock, D.O. was around 5 milligrams per liter (mg/l); it is now at 4 mg/l. The forebay had a value of 3.5 mg/l at 16 meters deep with the penstock around 23 meters in depth. About 50 km upstream from the dam, the value was at 0.5 mg/l. For temperatures in Lake Powell, there had been a larger thermocline in September 2019 that became more condensed in 2021.

Q&A and discussion

[Larry Stevens, GCWC] What impact might wildfires have on D.O. conditions in Lake Powell? **[Jeremiah Drewel, Reclamation]** Any added organic material, even burnt, would help to create that oxygen demand. **[Ryan Mann, Arizona Game and Fish Department (AZGFD)]** Really concerned that this is the new normal for the reservoir and how low D.O. might affect rainbow trout. In years past, AZGFD had waited for high flows to see how they would affect the penstock. With lower lake levels, this is likely to be a recurring issue year after year. The lack of mitigation options for low D.O. is even more concerning. **[Charles Yackulic, GCMRC]** The deltaic sediment hypothesis makes sense, but another thing is the role of these big monsoons after a lot of mineralization of the side channels. **[Jim Strogen, FFI/TU]** Does the timing of these releases contribute to this problem, and if so, can that timing be altered? **[Jeremiah Drewel, Reclamation]** Does not think so at the volumes being discussed.

[Clarence Fullard, Reclamation] Would like to continue the calls on D.O. impacts and risks. **[Seth Shanahan, SNWA and TWG Chair]** It is incumbent on folks who are involved in this issue to feed information up to the SCAHG. **[Jan Boyer, AZGFD]** It would be helpful to have real-time D.O. data from the dam. **[Mike Moran, GCMRC]** Real-time data from just below the dam is now accessible online and should be available to anyone soon. GCMRC is also working on doing the same for Lees Ferry. **[Jeremiah Drewel, Reclamation]** Internal access to the data is up to the minute, but outside of that, the data is delayed about a week. **[Seth Shanahan, SNWA and TWG Chair]** ACTION – coordinate to make this data available to the SCAHG and others.

Discuss Dissolved Oxygen

[Mike Horn, Reclamation] [PRESENTATION](#) was given on the Glen Canyon Dam/Lake Power Dissolved Oxygen Status. Currently acquiring literature from Reclamation, U.S. Army Corps of Engineers, municipalities, etc. There are essentially four ways to mitigate low D.O.: source, forebay, dam, and tailrace. For Lake Powell, D.O. and temperature can affect each other. There is likely not many opportunities for success with mitigation options at the source. There are many popular options for forebay mitigation, but all have benefits and drawbacks such as nutrient loading and precipitating metals. Mitigating D.O. within a dam has been used by Reclamation, but whether or not they can be used often depends on the design of the facility, and it is not likely feasible at Glen Canyon Dam. There has been a lot of work related to tailrace mitigation with success depending on conditions (for example, having sufficient head differential for an aeration weir).

Q&A and discussion

[Larry Stevens, GCWC] Suggests looking at paper on hyporheic anoxia. Glen Canyon Dam is unusual. Will there be a cost-benefit analysis and how much would aeration weirs cost? **[Mike Horn, Reclamation]** Will not be looking at costs. Does not think there is enough gradient below the dam to do an aeration

weir. Probably need at least a couple meters of differential. **[Jim Strogen, Fly Fishers International (FFI)/Trout Unlimited (TU)]** How long will this take before actual mitigation could occur? **[Clarence Fullard, Reclamation]** Probably no action would occur until there is a list of options to choose from that assesses impacts to resources. **[Brian Healy, NPS]** What sort of compliance issues would need to be considered? **[Clarence Fullard, Reclamation]** That would also depend on the type of mitigation strategy being considered, which would need to be discussed with the facilities and operations staff.

Long-Term Hydrologic Projections for the Colorado River Basin and Methods for Considering Uncertainty

[Jim Prairie, Reclamation] The state of the system from 1999-2021 shown in this [PRESENTATION](#) depicts combined storage starting from a full system to drought. It includes unregulated flows, which have not often occurred above 100%. The current drought is one that has not been seen in the historical record. Looking out to five years, key things are past observations such as precipitation and streamflow variability. No trends can be seen in precipitation over the years. The other piece is temperature, which is showing an increasing trend of 2.4 degrees Fahrenheit since 1979. This is unprecedented since the record began in the early 1900s. There has been a 10% decline in full hydrology over the 1906 to 2021 record. This is the “stress test hydrology” which is more likely to happen over the next five years. More information on this is available at: <https://www.usbr.gov/lc/region/g4000/riverops/crss-5year-projections.html>. Warming conditions are driving the change. Hydrology scenarios each depict a different picture of the future. Changes in operations will need to be considered within the range of these shifting risks. This leads us to consider a framework under deep uncertainty when there is limited confidence of future conditions and to not have to make a certain hydrological choice because there is going to be a range of risks. Reclamation is working on outreach efforts to help people understand Decision Making under Deep Uncertainty (DMDU) methods. This allows a shift away from statistics-based analysis and to focus on robustness with performance “good enough” in a wide range of futures.

Colorado River System 5-year Projected Future Conditions and Other Information

[Alan Butler, Reclamation] Three models were used for Reclamation’s basin-wide projections. Heather’s presentation was on two of these – the 24 Month Study and the Colorado River Mid-Term Modeling System (CRMMS) Ensemble Mode Projections (ESP). The basis for this presentation is the Colorado River Simulation System (CRSS) for two to five years of projections. There had been several changes to the process between the June and August projections. One change is that future modeling will incorporate only 32 years (or scenarios) from the 1998 to 2019 years. The other was a change to no longer include the assumption of Upper Basin Drought Response Operations in the model. All modeling projections are available at: www.usbr.gov/lc/region/g4000/riverops/coriver-projections.html including the CRMMS visualization tool demo (see the “Dashboard” links on that page).

Q&A and discussion

[Clayton Palmer, WAPA] There have been studies by Connie Woodhouse showing that increased temperatures in Colorado River Basin resulted in greater evaporation and soil retention. The relationship between precipitation and runoff has changed since 1988. Did you see a relationship? **[Jim**

Prairie, Reclamation] That is correct. Not seeing a long-term trend in precipitation with streamflow, but it is a different picture when runoff is considered. While there is no trend, the relationship “efficiency” is different, which was seen with temperature as the likely driving force. This is why the stress test is being used. A publication is coming out soon on this. See also the [presentation](#) from the 2020 Colorado River research symposium.

Current Levels of Threats from Non-Native Aquatic Species in Glen Canyon National Recreation Area and Grand Canyon National Park – An Update to Appendix F from the Expanded Non-Native Aquatic Species Management Plan Environmental Assessment

[Brian Healy, NPS] This is a presentation on the 2021 update to Appendix F, which is a threat assessment on invasive fish. Noted was the increasing trend in abundance in Lake Powell of both smallmouth bass and walleye. Flathead catfish is a new addition with the threat considered “very high” because of high piscivory although they do not do well in cool temperatures. Updates were made to brown trout and rainbow trout was added only to Grand Canyon (not Glen Canyon). The threat level of green sunfish was increased to “high.”

Q&A and discussion

[Jim Strogon, FF/TU] What about the channel catfish threat in the Little Colorado River (LCR)? **[Brian Healy, NPS]** Documenting their abundance is difficult, but it is of concern. **[Bill Davis, CREDA]** What about quagga mussel and New Zealand mud snails? **[Brian Healy, NPS]** Ted Kennedy did some work on them, but they are very low density. There is less concern with them than other invasives such as smallmouth bass or brown trout. But they are listed in the appendix. **[Bill Davis, CREDA]** Carp and catfish were abundant in the canyon before the dam. Are they both considered non-native species for control purposes? What about striped bass? **[Brian Healy, NPS]** It is possible there could be sleeper species because we do not have a good handle on their impacts in changing conditions and they could increase in abundance. Need to better understand their risk level. Striped bass are in the report, but no updates. **[Seth Shanahan, SNWA and TWG Chair]** Where is the documentation? **[Brian Healy, NPS]** It will be posted to the NPS website. ACTION: Will send the link when those documents go live.

Existing and Planned Monitoring of Non-Native Aquatic Species in Lake Powell and Below Glen Canyon Dam

[Brian Healy, NPS] Many people contributed to this presentation. Information was provided on the different sampling types and monitoring locations. There are also limitations based on certain gear and gaps when the trips occur. All programs can detect a rare, invasive species, but not many are specifically focused on non-native fish.

[Clarence Fullard, Reclamation] [\[PRESENTATION\]](#) Presented on a project which is a follow up to the *Reclamation Technical Service Center 2007-2009 Hydroacoustic Survey*. Reclamation is coordinating a forebay study on Lake Powell with led by Reclamation’s Technical Service Center and Utah State University to assess fish abundance and distribution using nets coupled with hydroacoustic gear. This project will start in November and continue through the end of 2023, culminating in a thesis and

publication from Utah State University. Reclamation will also be examining the best technologies currently available to prevent fish passage through Glen Canyon Dam.

Q&A and discussion

[Kelly Burke, GCWC] If crayfish have the potential to take off, then what capacity is there to monitor that? **[Brian Healy, NPS]** Crayfish are present in Lake Mead, Glen Canyon reach, and lots in Lake Powell. They can have a large, cascading impact on the ecosystem. NPS does not have monitoring in place to understand trends and distribution. **[Jan Boyer, AZGFD]** AZGD is catching maybe one or two crayfish each year. They are present but cannot say much more about them. **[Kirk Young, United States Fish and Wildlife Service (USFWS)]** They are caught every year in Western Grand Canyon, in Surprise Canyon; up to 3 or 4 per trip. **[Larry Stevens, GCWC]** They are in Spencer Creek and are widespread in the LCR. **[Kim Dibble, GCMRC]** Brandon Holden with NPS said he had gotten eDNA samples from North Canyon to River Mile 275. There are two crayfish species. The lab is still developing assays, so baseline data is available. **[Dave Speas, Reclamation]** It was mentioned that fish disburse when the lake turns over. The pilot study takes place in late October/early November. Can useful information be obtained if the lake happens to turn over during this time? **[Clarence Fullard, Reclamation]** Yes, the team hopes to collect data before the forebay turns over, which occurs later than the rest of the lake. **[Sinjin Eberle, American Rivers]** Is there a delay in identifying whether species like smallmouth bass or walleye can get through the dam, and if so, what are the implications about when they could be detected downstream versus when they have come through the dam? **[Brian Healy, NPS]** Capture probabilities of brown trout are high in the tributaries; they are lower in the mainstem, with maybe a 11% probability. The issue is that by the time bass or walleye are being detected, they could be more numerous. This is a big concern that needs to be discussed more. **[Charles Yackulic, GCMRC]** One way to determine how long they have been in the system is looking at otoliths because growth would be slower in colder water. There might be other ways to address this latency. **[Ryan Mann, AZGFD]** It is not unusual to find these species in Lees Ferry over the past 20 years of monitoring, but they are always rare. One issue to tackle is the likelihood of establishment, which will depend on water temperature. For walleye, they can survive and likely live below the dam while others might only be able to establish in the sloughs with warmer temperatures like green sunfish. It is not necessarily what is getting through the dam but what other dynamics are affecting their persistence. **[Clarence Fullard, Reclamation]** There were discussions about these small numbers of non-natives and how to know for sure whether they came through the dam or have been there for a long time. A good methodology was not found so it would be good to hear from others on how to get at this. **[Larry Stevens, GCWC]** The otoliths might be a way. **[Ryan Mann, AZGFD]** Seeing comments in the chat about larval fish sampling being restricted to lower in the river. What is the extent of this? Is it correct this is not occurring at Lees Ferry? **[Brian Healy, NPS]** It is occurring at random sites just downstream of Bright Angel Creek to Pearce Ferry. This involves six trips per year. It does not extend upstream past Bright Angel. **[Randy Van Haverbeke, USFWS]** A seining effort was tacked onto the aggregation trip this year that involved seining 30 miles downriver to Pearce Ferry and catching Age-0 fish (to 20 millimeter). The ability to detect these fish is good. The seining project, which occurred every year in September until 2020, would seine literally every backwater between Lees Ferry and Diamond Creek, an average of one backwater per mile or 200 per trip. **[Helen Fairly, GCMRC]** Is there any kind of arrangement/agreement with the Lees Ferry fishing guides to report observations of rare/uncommon non-native fish species? **[Ryan Mann, AZGFD]** AZGFD receives reports from the creel

surveys, which includes the occasional striped bass. **[Seth Shanahan, SNWA and TWG Chair]** Is there any sportfish work that Utah does in Lake Powell? **[Clarence Fullard, Reclamation]** There is some sportfishing monitoring in Powell. Our partners at Utah State University have that information. **[Seth Shanahan, SNWA and TWG Chair]** This could be a gap. Perhaps getting an information exchange would be helpful. Can Jim Stroger get the word out? **[Jim Stroger, FFI/TU]** The type of tackle the guides use probably would not be capturing those fish. **[Brian Healy, NPS]** One thing that NPS includes in its research and monitoring permits is the stipulation to report rare, non-native species within a couple of weeks. It does not always occur, but that could be one way to step up this reporting and detection and to make it more structured and consistent. **[Seth Shanahan, SNWA and TWG Chair]** Does Glen Canyon have that requirement too? **[Ken Hyde, NPS-Glen Canyon National Recreation Area (GLCA)]** Yes, GLCA has that requirement, too, but the angling guides are mostly using fly fishing gear. **[Seth Shanahan, SNWA and TWG Chair]** ACTION: acknowledge the potential gaps in our non-native species surveillance program.

Addressing Detections of Non-Native Aquatic Species Through Preventative and Reactive Actions

[Brian Healy, NPS] The actions might be to: 1) Focus on preventing new invasive species, 2) Consider the complete monitoring program and the ability to detect rare species, and 3) Establish a rapid response plan. Probably the biggest gap is to make sure there is a clearly identified process to respond, if needed.

Discussion

[Larry Stevens, GCWC] What is the review process for fisheries toward understanding all these elements? **[Seth Shanahan, SNWA and TWG Chair]** This is what is done at the Annual Reporting Meeting (ARM) to track and understand what is known and what remains of concern. Maybe it needs to be more organized and coordinated as it is being discussed today. **[Kelly Burke, GCWC]** In the past, there used to be a convening of fishery researchers and stakeholders on these issues that was very helpful. While this is still being done to some degree at the ARM, it might be even more helpful to have a more focused meeting on a topic every three to five years. **[Brian Healy, NPS]** All the fishery biologists get together every year to collaborate, coordinate, and present ideas. Maybe a short summary of monitoring results might be good to do at the ARM. **[Seth Shanahan, SNWA and TWG Chair]** What is available now (or soon) is an updated assessment of risks of non-natives. It is known there are limitations in the monitoring for detections. There are good programs to be able to detect at least some of the riskier species, but there are still gaps to be able to take advantage of information from other surveillance programs. Prevention is probably the key as long as resources are available. What is the rapid response capacity if something happens – this needs to be talked about.

Monitoring Metrics

[Helen Fairley, GCMRC] [\[PRESENTATION\]](#) – *Example Metrics for the Long-Term Experiment and Management Plan* The focus of this effort is to present some example metrics to get broad feedback on how they might apply to other resources and how they are achieving Long-Term Experiment and Management Plan (LTEMP) goals. **[Lucas Bair, GCMRC]** GCMRC has started to develop each metric with the stated goals in LTEMP. For the hydropower and energy metric, the primary focus is to maximize economic value of energy generation and capacity. The example metric for Recreational Experience is

based on whitewater rafting, which is transferrable to angling or other experiences in Glen Canyon. This “Whitewater Conceptual Model” includes a “willingness to pay” that provides a net economic value based on different attributes and tradeoffs. **[Charles Yackulic, GCMRC]** The humpback chub metric is to match what is currently being monitored relative to LTEMP. Items of concern are capture probabilities, future conditions, and climate change.

Q&A and discussion

[Larry Stevens, GCWC] The question remains about resources that cannot be measured or are measured differently such as sediment. Metrics that relate to feelings are more difficult but could also apply to Native American resources. A “willingness to pay” may not hold up. There is a lack of willingness in this program to quantify desired future conditions and to create metrics instead, which may not apply to some resources. **[Helen Fairley, GCMRC]** Some of these limitations are going to be seen as the analysis proceeds. A few more examples will be presented at the ARM while others will still be in progress. **[Kelly Burke, GCWC]** Are there other programs that have gone through this? **[Clarence Fullard, Reclamation]** The science advisor effort includes reviewing benchmarking at other programs and synthesizing these findings, which will be available in the coming months. **[Larry Stevens, GCWC]** Recommends including Bhutan’s Gross National Happiness as it relates to cultural issues. **[Brian Healy, NPS]** The NPS also has metrics written into their fishery management plans. **[Seth Shanahan, SNWA and TWG Chair]** Is there enough information on hydropower when only a couple of metrics are being proposed? **[Leslie James, CREDA]** How much do we stray from the specific wording in LTEMP? The word “value” is tough for CREDA because it depends on different entities and resources. Valuation of resources, particularly hydropower, is always a challenge. **[Lucas Bair, GCMRC]** One thing economic value does not encompass is any sort of distributional issue. Distributional issues in LTEMP are related to Glen Canyon operations, which are not very significant. It is recognized that hydropower value relates to “economic value” but there could be concerns in the future about distributional issues of energy and its impacts on the grid. **[Leslie James, CREDA]** Would there be a way to add a financial value because the distributional aspects associated with Glen Canyon hydropower will have direct financial effects on tribal entities as well as Sierra’s Peak customers. **[Lucas Bair, GCMRC]** That is valid. Distributional issues are an important consideration. **[Leslie James, CREDA]** Could also consider a grid valuation and the relationship between Glen Canyon Dam hydropower to grid stability. **[Lucas Bair, GCMRC]** If power is affected then both services could be incorporated. **[Cliff Barrett, Utah Municipal Power Agency (UMPA)]** The energy value issues are rapidly changing throughout the country. The value of hydropower is going up when other services (such as solar and wind) are going down. It could also change the generation schedules for meeting carbon controls. Can these be recognized in the valuation? **[Lucas Bair, GCMRC]** These can likely be captured in the valuation, but it is hard to model all potential changes. **[Rob Billerbeck, NPS]** The direction for defining these metrics was specific in the Record of Decision (ROD). The reason the monitoring metrics were not defined during LTEMP is because it was felt a few more years of experience were needed. Strongly suggests not rewriting the LTEMP goals. Need to find the best ways to monitor those goals with metrics. **[Seth Shanahan, SNWA and TWG Chair]** To summarize this discussion: 1) Provide comments to Helen, 2) This is not a re-write of the resource goals, but there needs to be ways to develop the metrics that are cognizant of these other concerns, and 3) There is tension between developing too many metrics, and not having enough.

Projected Climate and Geomorphic Changes in the Little Colorado River Watershed and Potential Links to Humpback Chub Habitat

[Dave Dean, GCMRC] [\[PRESENTATION\]](#) Many geomorphic changes have occurred in the system resulting in narrower channels, increases in vegetation, variable water supply, and growing human populations. A simple model of how this happens is the balance between sediment supply and sediment transport. Part 2 of the presentation is a geomorphic study in the LCR Gorge, an important area for humpback chub with large travertine dams in the study area. The study looked at elevation changes of the channel bed over time. There have been 10 meters of major incisions and aggradation since the dam complexes eroded, which could lead to physical barriers to humpback chub movement. **[Maria Dzul, GCMRC]** As adults, humpback chubs are found in either the Colorado River or LCR, but only spawn in the LCR. Age-0 humpback chub abundance in the LCR can fluctuate widely, mirroring subadult and adult populations.

Q&A and discussion

[Larry Stevens, GCWC] Are travertine dams similar to beaver dams in enhancing habitat variability? It would be an interesting comparison. **[David Dean, GCMRC]** They do provide channel complexity, but the travertine dams are getting very big and are potentially limiting movement and possibly affecting habitat. **[Larry Stevens, GCWC]** How important is the role of cannibalism in Age-0 humpback chub? There are lavage methods to get at this. **[Maria Dzul, GCMRC]** There probably is cannibalism, but there is no management strategy to prevent this. Research on lavage was done but do not recall that a lot of fish were found. **[Brian Healy, NPS]** Translocations could be informative but maybe not in the LCR proper. What about catfish relationships with other non-native fish (carp) that might drive recruitment? **[Charles Yackulic, GCMRC]** Both catfish and carp show up as adults. For catfish, they tend to get washed in during monsoon events, which could negatively correlate with carp. **[Randy Van Haverbeke, USFWS]** Adult carp are seen spawning in LCR but do not know what their actual reproduction is. **[Seth Shanahan, SNWA and TWG Chair]** What is the role of skip spawning and the year-over-year immigration potential for spawners? **[Maria Dzul, GCMRC]** Do not think that is a strong influence. Skip spawning is still occurring but not to the extent that was previously reported because a lot of fish moved into the LCR, but they were not detected. It probably plays a smaller role than was previously thought but will still evaluate that question. **[Leslie James, CREDA]** If much of the implications of Age-0 fish are related to factors not associated with the dam, then that would be important information, too. **[Rob Billerbeck, NPS]** It is not easy to fix these issues in the LCR, but it might suggest being careful about not putting all humpback chub into the LCR alone. It might be important to consider other tributaries, too. **[Charles Yackulic, GCMRC]** Management actions are already being done that are unrelated to the dam to reduce conflicts. Translocations were decided versus lowering water temperatures. Similarly, some issues such as food in the mainstem are directly related to dam operations while others are not, and maybe there are cost-effective solutions that would allow cheaper management strategies than more difficult and costly decisions about temperature control. Also, the idea of cannibalism originated in early 2000s because of the even-odd pattern that had been seen, which has since dissipated. If it is out there, it is a small effect.

Public Comment

None.

Meeting adjourned at 4:18 PDT.

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Day 2: October 14, 2021

Start Time: 8:31 AM PDT

Conducting: Seth Shanahan, TWG Chair

Meeting Recorder: Carliane Johnson, SeaJay Environmental LLC

Welcome and Administrative

- Introductions and Determination of Quorum (16 members): **[Seth Shanahan, SNWA and TWG Chair, SNWA/TWG Chair]** Quorum was reached with at least 16 TWG members or alternates in attendance.
- Unresolved Issues from Yesterday's Meeting: Happy Retirement to Ken Hyde, NPS-GLCA. This is his last meeting.
 - Volunteer Opportunities: **[Brian Healy, NPS]** Please contact Brian or Emily about volunteering for Bright Angel trips or translocation monitoring next summer. There are also vegetation and cultural trips. **[Joel Sankey, GCMRC]** GCMRC has volunteer opportunities, too. Send list of skills and which trips to both Joel and Mike Moran.
 - Questions from Chat: **[Clarence Fullard, Reclamation]** To answer Randy's questions in the chat: 1) *is low D.O. pushing trout out of Lees Ferry and downstream?* Mike Horn (in the study described yesterday) is tasked with a risk analysis on the effects of D.O. on the movement of trout. Randy also asked: 2) *if the contingency fund could be used for an emergency response in the future?* Yes, See C.6 in TWP for more details on that fund. It could potentially be used for that.
 - **[Larry Stevens, GCWC]** Because Rob Billerbeck has a clear vision of the LTEMP goals, perhaps he can do one or more of those metrics to help guide that process? [Rob Billerbeck, NPS] This is a Department of Interior team effort.

Discussion About Possible Experimental and Management Actions That May be Implemented in the Next 12 Months and Any Budgeting Issues

[Clarence Fullard, Reclamation] The LTEMP process starts each year with the science reporting by GCMRC at the ARM followed by TWG meetings, then consultations, PI Team recommendations, and DOI's decision. Refer to the table in this for proposed Water Year 2022 experiments and implementation windows. The sediment accounting period for a spring HFE will start December 1 with possible implementation in March or April. More information will be available soon on trout management flows including: 1) a white paper from Reclamation, 2) a literature review by GCMRC, and a 3) Hypsometric analysis that is being performed on the dewatering aspects. A synthesis report on the bug flows experiment will be sent to the TWG soon for comments.

Q&A and discussion

[Seth Shanahan, SNWA and TWG Chair] The last couple of meetings there had been conversations about the monitoring work and whether there are other ideas to consider with the expected hydrology and warming next year. It was determined there is already a good network in place that could quickly identify any new changes to the system. **[Craig Ellsworth, WAPA and BAHG Chair]** Another LTEMP experiment is low summer flow to increase growth of humpback chub. Is there implementation of a study plan to specifically study that experiment to address these questions? **[Ted Kennedy, GCMRC]** There will be lower flows that will be fundamentally different than described in LTEMP. At least for aquatic habitat ecology, the routine monitoring projects have all been designed to be responsive to interannual changes in discharge and could be implemented across the whole range of hydrology. **[Craig Ellsworth, WAPA and BAHG Chair]** It was understood that the low flow experiment was to increase temperatures for humpback chub. Can these questions be answered with this warming trend? **[Seth Shanahan, SNWA and TWG Chair]** Don't we already have these answers, and the monitoring in place, to know what the warming trend will do? **[Charles Yackulic, GCMRC]** GCMRC is in a good place to detect effects from low flow conditions and will report out what is happening. **[Kirk Young, USFWS]** It is not about low flows, but the temperature state that is achieved in the LCR to see if there is a response in the mainstem. There is a fair amount in place to detect that but might want to improve the timing to ensure that small year class fish are seen. The other thing is whether the monitoring is in place to capture an unanticipated issue such as a non-native response.

[Peggy Roefer, Colorado River Commission of Nevada (CRCN) and Flow Ad Hoc Group (FLAHG) Chair] If there is not enough sediment for a spring HFE, could it be possible to do a spring disturbance flow because there is sediment left from this fall? Is there a process for that? **[Lee Traynham, Reclamation]** There is a process, but the timing is tight. It would be heard first at the ARM. If there are clear positive effects and no unacceptable adverse effects, then a potential pathway would be for the AMWG (at the February meeting) to request a spring disturbance flow. At that time, Reclamation would then task the Planning and Implementation Team (PI Team).

Potential Fall High Flow Experiment (HFE) ≤ 96 Hours or ≤ 192 Hours; Status of Resources and Experimental Plan

[Lee Traynham, Reclamation] [\[PRESENTATION\]](#) This presentation covered the reasons why Reclamation decided not to implement a fall HFE. **[Mike Moran, GCMRC]** Reviewed the purpose of HFEs in LTEMP for sediment. There had been significant erosion and gulying of the sandbars especially during the summer 2021 thunderstorms. If an HFE would have occurred, some repair would have occurred in these areas. Cumulative sand input at the Paria River is approximately 1.339 million metric tons, which is the second highest amount since the HFE protocol was established. **[Lee Traynham, Reclamation]** Reclamation runs the sand budget model to determine the duration of an HFE. It was known by late August that an extended duration HFE of 192 hours (8 days) was possible for the first time under LTEMP. Given the 7.48 MAF year, the PI Team wanted to make sure there were sufficient hydrograph alternatives. Additional details on the review and impact assessment of resources are in the [PI Team recommendation report](#). An HFE does not affect the total annual release volume. Bypass water would be reallocated to other months. There is also a cost to WAPA. **[Mike Moran, GCMRC]** A model recently developed by Erich Mueller and Paul Grams helps predict sandbar volume going back to 2004. The output shows how the

sandbars react to HFEs. As of September 2021, sandbar size was the lowest over the past ten years. Will soon have the measured values of these sandbars from 2021. The model predicts what would happen if a 96-hour HFE is run. The HFE would have increased sandbar volume and then erosion would have occurred afterwards, which is what always happens. Potential negative effects were also assessed, which would not have been significant for a 60-hour HFE. **[Lee Traynham, Reclamation]** The PI Team recommended not implementing a 192-hour HFE and did not reach consensus on a 60-hour HFE. Reclamation decided not to implement a fall HFE based on concerns about pool elevation and the Basin Fund, although there would have been a positive effect on sediments especially given the unprecedented drought conditions. The [DOI Decision Memo](#) was issued on October 5, 2021.

Q&A and discussion

[Larry Stevens, GCWC] One concern is that the process did not include active voices from the tribes and environmental groups because they were not involved in the PI Team. The details are very much appreciated but informed consent is not in keeping with adaptive management and that sets the wrong precedent to the Secretary. The second point is that the Basin Fund was valued higher than environmental sustainability concerns. This needs to be clarified. Thirdly, while the conclusions of the alternatives are not in dispute, the decision process lacked creativity and flexibility such as having a springtime HFE or a high flow event due to high winter inflows. The other problem is the way the accounting budget is set up for sediment that the Adaptive Management Work Group (AMWG) needs to address. Even a normal winter could allow a power plant capacity flow. It should be a red flag that the system is at its lowest sandbar volume since 2004. An HFE in the spring would support elevated sand during the next couple of years of projected low flows. **[Ben Reeder, Grand Canyon River Guides (GCRG)]** The ROD is a great document, but it has major flaws. The PI Team is weighted heavily by the power and water interests. Stakeholders had to fight for the HFE in 2018. There seems to be any excuse to not do an HFE. The beaches are absolutely hammered. The sediment accounting period needs to be addressed so there is flexibility for spring HFEs. Is this program built on stakeholder input and scientific data or on water and power to maintain the status quo? Requests that the accounting period be placed on the agenda and to also address the PI Team process to be able to conduct experiments that can mitigate dam management. **[Peter Bungart, Hualapai Tribe]** There was no tribal representation on the PI Team. It seems the Grand Canyon Protection Act was not given much weight and the decision was based on economic concerns. **[Seth Shanahan, SNWA and TWG Chair]** There are items in the ROD that continue to come up in the GCDAMP. Requests that Reclamation include these topics in a future meeting.

Discuss Temperature Control, Including a Re-Review of the Cooling Capacity of the Bypass Flows and Obtaining TWG Input on Refining the Problem Statement

[Nick Williams, Reclamation] Is currently the Power Manager in Upper Colorado Basin and was formerly in the Water Quality Group from 2004 to 2014. Elevation, inflow volume, and volume of release all affect release temperature. In 2011, a year with a high runoff, temperature releases from the dam were the warmest since 2005 even though the reservoir level was 50 feet higher. The reason was the additional volume of cold water that was moved out of the reservoir. By the time of late summer,

warmer water was left in the reservoir. This amount of water that is moved is a significant factor. The model was able to accurately predict this, which can be used to forecast future conditions. The highest temperature peaks used to occur in the fall. As the reservoir becomes lower, there is less heat storage so it turns over sooner and peak temperature will now occur in the summertime. If there is a transition in July from power plant releases to bypass releases, then there would be an immediate drop in temperature because of the 100-foot elevation difference in the two release points. The power plant's capacity is around 30,000 cubic feet per second (CFS), but under LTEMP, the maximum is 25,000 CFS (except during HFEs). The capacity of the bypass tubes is 15,000 CFS, but below 3,500 feet, that capacity starts to decrease because of the decreasing head. Opening of the jets is based on this velocity limitation. As a temperature control, if the water is released through the bypass tubes (depending on the month and with peak flows likely around 20,000 CFS), then about half the flow would be needed through the bypass to decrease temperatures from 20 to 15 °C. The other scenario is to add generation to the bypass. That is a little different discussion because the capacity for discharge through a theoretical power plant is about half to a third of the capacity of the current bypass because it will remove that energy that was available and convert it to electricity. So, if 20,000 CFS is released with 7,000 CFS pulling colder water through the bypass, then it might be able to cool down 15-16 °C assuming the temperature at the bypass is 7-8 °C.

Q&A and discussion

[Peggy Roefer, CRCN and FLAHG Chair] What had been talked about is trying to use the bypass to cool the water below the dam for trout. Would that work or not? **[Nick Williams, Reclamation]** There are scenarios when it would not work such as below minimum power pool. It is also believed that Reclamation would not open the bypass to cool water. To a certain point, it could work, but once the temperature of the releases through the main power plant is around 25 °C, there would be limited capability for cooling although it could be some. **[Brian Healy, NPS]** There is a risk of warm water invasives going through the dam and they need water warmer than 20 degrees. Is there a way to cool the water to disadvantage non-natives such as smallmouth bass? **[Nick Williams, Reclamation]** Releases through the bypass could be feasible, but whether it would be allowed is not known. **[Seth Shanahan, SNWA and TWG Chair]** Whether it can be approved is not the question; this group is considering whether it is technically feasible. **[Rob Billerbeck, NPS]** The NPS is very concerned about non-natives passing through the dam. These are interesting options to consider. A bypass flow that cold shocks the fish is worth discussing. **[Shane Capron, WAPA]** What happens if the reservoir goes below minimum power pool? Are the bypass tubes turned on? What are the downstream environmental implications with the temperature differential or which season? This is worth thinking about ahead of time. **[Kirk Young, USFWS]** It is going to present challenges to some warm water fish, but maybe it is better without the non-natives. What is being heard is that the bypass can be used to cool water with various effectiveness, but it might not be possible to bypass hydrogeneration. If hydrogeneration is part of that, it would limit the effect by half. More importantly, if the elevation gets below power pool, then downstream water needs might not be met. If that is the case, can the hydrogenerators on the bypass tubes be "valved" to still be able to deliver power? Another thing to think about is the effect of overnight cooling at typically low flows and whether all of that could go through the bypass tubes. **[Larry Stevens, GCWC]** Requests a motion for the next TWG meeting to forward to AMWG a recommendation that power generation be installed in the bypass tubes to accomplish both power and cooling. This issue

first came up in 1987 and it needs to be moved forward. **[Seth Shanahan, SNWA and TWG Chair]** There are good forecasts on temperature, but there is not a compatible scenario to show how much temperature reduction could occur under certain assumptions of bypass flow, season, elevation, and capacity limitations. This needs to be added to the monitoring network to determine maximum cooling under these different conditions. This technical information is needed for the AMWG to recommend policy direction. **[Clarence Fullard, Reclamation]** If there is a motion to push for generation of the bypass tubes, which would have a huge financial cost, Reclamation needs to know what can be accomplished. There is good temperature information, and this could be a useful tool to disadvantage non-natives but need to know thresholds for the various resources and how long the cooling would need to occur. The TWG needs to help Reclamation document how this tool can be used.

Morphodynamic Sandbar Model

[Erich Mueller, Southern Utah University (SUU)] [\[PRESENTATION\]](#) – *A Morphodynamic Model to Evaluate Long-term Sandbar Rebuilding Using Controlled Floods* The focus of this modeling is on the reattachment bars, which tend to be the larger types, and with varying amounts of vegetation. It is physically based model of deposition during high flows, and erosions during low flows. Deposition is controlled by an eddy exchange coefficient and only occurs on the bar that is submerged. Erosion is also captured through an erosion rate parameter. It is a simple model that uses high resolution data from the gages but misses some important erosion and vegetation processes. Hoping to continue this work.

Q&A and discussion

[Larry Stevens, GCWC] Would it be possible to run the model to contrast fall versus spring HFEs and could it include the 1996 event, which was a good example of a long-term spring HFE? **[Erich Mueller, SUU]** Yes, a spring run can be done but the results will be similar to the fall. The only concern about developing the model on a long time series is that the bars become smaller over the winter months. Could look into what data are available from the 1996 event. **[Kelly Burke, GCWC]** How can this inform vegetation experiments as to where to leave vegetation or not, especially on bars that are not fully covered? **[Erich Mueller, SUU]** Even on bars that are shown in the model as “unvegetated” they do have some vegetation on them. The model could potentially be run so that it is specific to the individual bars. **[Josh Korman, ECOMETRIC Research]** Because of erosion or loss of sediment over winter, would expect to see slightly less of a response to the bars from a spring flood. In summarizing the statistics of that pattern, it might be helpful to show it at the beginning of the spring or summer because of the erosion over the winter. The main reason for bar building events is for the boaters. A spring flood would then “score” much better. **[Erich Mueller, SUU]** That would likely produce a larger bar during the summer months even if the average bar size over the entire year is about the same. **[Seth Shanahan, SNWA and TWG Chair]** There is interest in the usefulness of the model. Requests that Erich and Paul report back to this group more frequently and report data during the summer when the sandbars are most useful to users. The other part of this would be to use the projections from Reclamation and start reporting sandbar volume given the future release scenarios. This could help give TWG members more understanding of future conditions and on what could be done.

Additional Information Regarding Purchase Power Cost Estimates, Including Assumptions and Uncertainty, Such That Effects To Hydropower Are Minimized If Bug Flows Are Implemented In The Future

[Jerry Wilhite, WAPA] [\[PRESENTATION\]](#) GTMax SuperLite is the model that was used to help understand hydropower financial impacts from bug flows. It models electricity, water flow, and energy prices, and is specifically optimized for bug flows. The model minimizes purchase costs to meet demand. At peak demand, the model tries to not make any purchases. An analysis was done to estimate the financial impacts of the bug flows experiment. The key point is that the current experimental design is going to be difficult to do when there are high energy prices and big peaks in price. There are some ways to mitigate this such as moving the water during times of peak energy costs, and avoiding Sundays, which can have big costs during certain months. High energy prices are also driving this because it does not take much to affect the spread.

Q&A and discussion

[Leslie James, CREDA] Please explain why specific prices cannot be shared? **[Jerry Wilhite, WAPA]** That information is through a paid subscription from ARGOS. Their forecasts cannot be shared. **[Peggy Roefer, CRCN and FLAHG Chair]** How do you move capacity to when energy prices are high to when they are low? **[Jerry Wilhite, WAPA]** The red in the graphics is what needs to be moved, and the blue represents where the water could be moved to, but this is also restricted by the daily fluctuation levels. There are small tweaks that could be done if the experiment continues. Doing this exercise was helpful because it identified how water could be moved to make things work better. It was a good opportunity. **[Leslie James, CREDA]** Is it the limitations in LTEMP that prevent moving the lower blue areas to the higher blue? Is WAPA looking to move volume to reduce cost (or outlay) and not increase revenue costs? **[Craig Ellsworth, WAPA and BAHG Chair]** It is how the experiment was initially designed. Is there flexibility in the bug flow experiment that would still have compliance under LTEMP? The hydropower goal in LTEMP is to “reduce or improve.” **[Ted Kennedy, GCMRC]** This gives a much better understanding of the history and why the years were different. The bug flow report should be distributed soon. It includes new modeling of gross primary productivity (GPP) responses in all months. March and April have high GPP and could be the months to explore for tweaking because they were also the months of the lowest energy spread. **[Brian Healy, NPS]** Is GPP an LTEMP goal? **[Ted Kennedy, GCMRC]** It is not specifically called out, but there is a goal to increase productivity of larval life stages of insects. **[Rob Billerbeck, NPS]** Since LTEMP anticipated regular experiments like this, how has WAPA budgeted for those costs since they are expected commitments? **[Shane Capron, WAPA]** They are not described as commitments, but as potential effects of LTEMP. Experiments in this program are to be posted as non-reimbursable expenses. After implementation, the actual costs are determined. In the year they occur, they affect the Basin Fund because WAPA must purchase power to make up the costs. Afterwards, they are booked as a non-reimbursable, constructive return.

Informational Updates

- [Spring Disturbance Flow](#) **[Ted Kennedy, GCMRC]** GCMRC will provide an update in the 2021 Annual Report.

- Bug Flow Review [**Ted Kennedy, GCMRC**] The bug flow report will be distributed by Reclamation. Two workshops are scheduled for October 28 and November 4 to review bug flows and identify next steps.
- Rainbow and Brown Trout Status in Lees Ferry [**Jan Boyer, AZGFD**] AZGFD completed a monitoring trip in September. Comprehensive electrofishing sampling was done throughout the river and in some non-native hot spots. Rainbow trout numbers are low compared to previous years. Brown trout numbers went from almost no catches to high levels. Warmwater non-natives are at low numbers so only totals are given. The good news is that non-native numbers, such as walleye, are not increasing.
- Trout Recruitment, Growth and Population Dynamics (TRGD) [**Josh Korman, ECOMETRIC Research**] Have had low numbers in 2020. The current population is dominated by the largest size classes, which have higher energetic demands. This means they are more sensitive to degrading conditions such as lower prey, higher temperature. If something happens to those fish, there are not a lot of younger, more resilient fish behind them. The only silver lining is that the current population has fat reserves and can handle some starvation. Brown trout relative to rainbow trout are a lot fatter (i.e., in a better energetic status) and there is less seasonal variation in that condition factor. This is due to differences in growth rate, which influences the variations between season with larger rainbow trout losing weight in the fall while brown trout are gaining weight.
- Green Sunfish Status and Incentivized Harvest Program Implementation [**Ken Hyde, NPS**] Green sunfish were to be removed last week but it was decided to postpone because there was no HFE and they are mostly small fish that are hard to capture. For the Incentivized Harvest Program, there was an average of 28 anglers after 11 months. Some were repeat anglers and some only caught one fish. One person caught 20 fish and made nearly \$1000 with the bonuses, then returned in September to catch another 16 fish, receiving \$1978 from the bonuses and by turning in tagged fish. Part of the reward money is also going to videos and a nationwide marketing effort.
- Colorado Pikeminnow Reintroduction Feasibility Report [**Kim Dibble, GCMRC**] This report has been finalized and was submitted to TWG members for review.
- Humpback Chub Downlisting Final Rule [**Kirk Young, USFWS**] The rule publishes on October 18.

Update on 5-Year Review of Management Triggers for Humpback Chub

[Kerri Pedersen, Reclamation] The thresholds for a Tier 1 Response were triggered this year. The trigger review document is Appendix O of the Environmental Impact Statement and Appendix D of the Biological Assessment. The first five-year update was required in 2021. **[Kirk Young, USFWS]** No major changes were made to the document. Next step is to get this reviewed because it is a regulatory document. The appendix will outline the issues that still need to be resolved.

Q&A and discussion

[Ben Reeder, GCRG] One slide in the presentation noted a trigger that was reached for humpback chub, but it was recently delisted. What happened? **[Kirk Young, USFWS]** This is not a delisting; it is a downlisting that has the same protections as before. The trigger was meant to be sensitive to avoiding declines that could cause more drastic measures, and when there are more effective options.

Peer Review Comments on the GCMRC Fiscal Year 2020 Annual Project Report for the Glen Canyon Dam Adaptive Management Program

[Dawn Johnson, Wood PLC] Highlights of the independent review of the 2020 Annual Project Report were provided in this [\[PRESENTATION\]](#). The report summarizes the findings and includes the full reviews.

Q&A and discussion

[Kurt Dongoske, Pueblo of Zuni] It appears that there was not a reviewer who had professional experience and training in geomorphology and the effects of natural and cultural transformation processes in the creation and preservation of the archaeological record. Similarly, the omission of this expertise contributes to the dominance of a Western science ontological perspective of this ecosystem which unintentionally continues to disenfranchise Zuni relationship to this sacred place, their deep time connection, and the reception of Zuni concerns when expressed. **[Dawn Johnson, Wood PLC]** Initially had tried to find a cultural person, but they were conflicted with the tribe or the program. This needs to be pursued further. It is going to be difficult. ACTION: Clarence to contact Kurt Dongoske to help find people with tribal/cultural resources backgrounds for future reviews.

2021 Annual Reporting Meeting – Planning

[Peggy Roefer, CRCN and FLAHG Chair] Would like to hear what happened during the spring disturbance flow especially on the beaches. **[Ben Reeder, GCRG]** Would ask Paul Grams to report on the state of the sandbars after the monsoon. Let's forget about camping beaches in the Grand Canyon for a minute. What's most disappointing about not conducting a fall HFE is that this flow is what the ecosystem of Grand Canyon needs right now.

[Larry Stevens, GCWC] Would like to have a master overview of fisheries-related research information needs – what has been accomplished and what are the remaining unknowns – in relation to the LTEMP goals? Maybe it would be a panel discussion or an entire day. **[Joel Sankey, GCMRC]** It would be helpful to know how this request would be different from past ARM presentations. **[Seth Shanahan, SNWA and TWG Chair]** Maybe the level of uncertainty with the different research needs to be resolved. **[Scott VanderKooi, GCMRC]** This timing is good with respect to LTEMP especially since a lot of the program is focused on fisheries. The metrics project could also tie into this.

[Ben Reeder, GCRG] Can the FLAHG be charged with looking at different options for spring disturbance flows? In the presentation about the fall HFE, the science was pointing to an extended duration flow. The decision was disappointing because the 60-hour flow had minimal impacts. That is what is driving this request and the short window to make it happen in the spring. **[Brian Healy, NPS]** Would be interested in participating if the FLAHG gets involved. **[Bill Persons, FFI/TU]** Should this be a new charge for the FLAHG or an action item? **[Seth Shanahan, SNWA and TWG Chair]** There is a process with the FLAHG but had been told by the AMWG that additional considerations needed to begin there first. **[Lee Traynham, Reclamation]** The AMWG went through an involved process. It was understood that a review of those results would be the precursor before another disturbance flow. GCMRC is pulling that information by January. It would be difficult to have a discussion before that is available. **[Peggy Roefer, CRCN and FLAHG Chair]** Is it possible to develop a hydrograph and have that available by the time of the

ARM? This way, it could be possible to work out with the AMWG at that time. **[Lee Traynham, Reclamation]** The AMWG went through an explicit process for the one-time spring disturbance flow and the results of that need to be heard, which would be the precursor before another disturbance flow. It would be challenging without that information. GCMRC is working to put that data together. **[Peggy Roefer, CRCN and FLAHG Chair]** Can a hydrograph be developed and then work with the AMWG when the information comes out at the January meeting? **[Lee Traynham, Reclamation]** Some features of a hydrograph are set, with some questions about duration and purpose. How would the TWG get to that design without the information from the scientists? **[Larry Stevens, GCWC]** If the information does become available by the ARM, the next day is when the TWG meets. This is the same timeline that has been done in the past. **[Lee Traynham, Reclamation]** If the data bears out, there is a potential pathway that could work next year.

[Kurt Dongoske, Pueblo of Zuni] The United Nations Declaration on the Rights of Indigenous Peoples calls upon federal agencies to fulfill a larger goal than merely complying with federal land laws. To that end, federal land agencies have a responsibility of producing knowledge about the nature of the land and its cultural significance to the American public of which Tribal people are a part, but also have a unique relationship to Tribal people as members of a sovereign nation. It is incumbent upon Federal agencies to help lead our nation to an inclusive land ethic for the twenty-first century that meaningfully incorporates Tribal nations. One way to achieve this goal is to follow the principles described in the Declaration, which allows agencies to recognize, respect, and incorporate indigenous values when managing places important to indigenous peoples. Perhaps, a session that speaks directly to this topic should be considered for the ARM. **[Seth Shanahan, SNWA and TWG Chair]** Acknowledges this comment in chat.

[Kelly Burke, GCWC] Another item to discuss would be the potential for monsoons to occur in the future and increased safety issues.

[Larry Stevens, GCWC] Hopes to be able to present on the macrophyte assemblage in Glen Canyon.

Discussion of Emerging Issues, Updates on Items of Interest That Are in Consideration for Implementation Before Next TWG Meeting, and Request for Agenda Items for Next Meeting

[Larry Stevens, GCWC] The following draft language was proposed for TWG to consider at its next meeting. *The TWG recommends that the AMWG recommends to the Secretary of the Interior that hydropower production be constructed in the bypass tubes of Glen Canyon Dam. Such a facility will provide energy production during years of low inflow and during planned high flows. In addition, such capacity will provide at least some thermal control for the downstream Colorado River ecosystem. Such consideration will require additional information for a full evaluation, and the TWG requests authorization from AMWG to proceed with developing such additional information.* **[Seth Shanahan, SNWA and TWG Chair]** ACTION: Will also discuss this in the SCAHG meeting that will follow this TWG meeting.

Public Comment

[Lynn Hamilton, GCRG] Excellent presentation about the HFE and the comments that came after. Most people would have thought there was going to be an HFE until that last slide when it was not the case. The Grand Canyon River Act includes natural and cultural resources and visitor use. Yet, the decision-making process disenfranchised the tribes and environmental and recreational stakeholders. This process is in the ROD, but the Secretary is not making decisions based on recommendations from the full suite of stakeholders. This must be addressed, as well as the sediment accounting period. The structure of that inhibits our learning and may prohibit HFEs from occurring in the spring.

[Alicyn Gitlin, Sierra Club - Grand Canyon Chapter] What was heard is that the dam would not be operated according to what is required under the Grand Canyon Protection Act “to protect and improve conditions in Grand Canyon” because the Basin Fund needed to be protected despite optimal sand volumes and decimated beaches. The process needs to be more inclusive. It may not be possible to meet the goals without some changes.

Meeting adjourned at 4:35 PM PST

TWG Members and Alternates

Cliff Barrett, UMPA
Rob Billerbeck, NPS-GCNP (Alternate)
Peter Bungart, Hualapai Tribe (Alternate)
Kelly Burke, GCWC (Alternate)
Carrie Cannon, Hualapai Tribe
Shane Capron, WAPA
William "Bill" Davis, CREDA
Kurt Dongoske, Pueblo of Zuni
Craig Ellsworth, WAPA (Alternate)
Charlie Ferrantelli, State of Wyoming (Alternate)
Michelle Garrison, CWCB (Vice-chair)
Brian Healy, NPS-GCNP
Ken Hyde, NPS-GLCA
Leslie James, CREDA (Alternate)

Jakob Maase, Hopi Tribe
Ryan Mann, AZGFD
Betsy Morgan, State of Utah (Alternate)
Christina Noftsker, State of New Mexico (Alternate)
Bill Persons, FFI/TU (Alternate)
Shana Rapoport, CRBC (Alternate)
Ben Reeder, GCRG
Peggy Roefer, CRCN (Alternate)
Seth Shanahan, TWG Chair and SNWA
Emily Omana Smith, NPS-GRCA (Alternate)
Erik Stanfield, Navajo Nation
Larry Stevens, GCWC
Jim Strogon, FFI/TU
Kirk Young, USFWS

USGS/GCMRC Staff

Lucas Bair
David Dean
Bridget Deemer
Kim Dibble
Maria Dzul
Helen Fairley
Ted Kennedy

Teo Melis
Michael Moran
Erich Mueller
Joel Sankey
Scott VanderKooi
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Reclamation Staff

Tara Ashby
Alan Butler
Jerimiah Drewel
Clarence Fullard
Michael Horn
Mark McKinstry

Heather Patno
Kerri Pedersen
Jim Prairie
Dave Speas
Lee Traynham

Interested Persons

Joel Barnes, Prescott College
Richard Begay, Navajo Nation
Anna Bierbrauer, Wood PLC
Jan Boyer, AZGFD
Daniel Bullets, Southern Paiute Consortium
Julie Carter, AZGFD
Kevin Dahl, NPCA
Katherine Duncan, Colorado Attorney General's Office
Sinjin Eberle, American Rivers

Craig McGinnis, ADWR
Jessica Neuwerth, CRBC
Amy Ostdiek, State of Colorado
Stanley Palmer, WAPA
Casey Pennock, Utah State University
Michael Pillow, USFWS
Ted Rampton, CREDA
Pilar Rinker, USFWS
Shane Sanders, Arizona G&T Cooperatives

Mel Fegler, State of Wyoming
Kevin Garlick, UMPA
Alicyn Gitlin, Sierra Club
Carliane Johnson, SeaJay Environmental
Kristen Johnson, ADWR
John Jordan, FFI/TU
Mirko Kruse, Trout Raley
Arden Kucate, Pueblo of Zuni
Sara Larsen, Upper Colorado River Commission
Brandon Loomis, The Arizona Republic

Gene Seagle, NPS
Erik Skeie, State of Colorado
Gary Tallman, Northern Arizona University
Todd Tietjen, SNWA
Melissa Trammel, NPS
David "Randy" Van Haverbeke, USFWS
Tim Vigil, WAPA
Jerry Wilhite, WAPA
Eric Witkoski, CRCN

Abbreviations

°C - degrees Celsius

ADWR - Arizona Department of Water Resources

ARM - Annual Reporting Meeting

AZGFD - Arizona Game and Fish Department

AMWG - Adaptive Management Work Group

BAHG - Budget Ad Hoc Group

CFS - cubic feet per second

CR - Continuing Resolution

CRBC - Colorado River Board of California

CREDA - Colorado River Energy Distributors
Association

CRCN - Colorado River Commission of Nevada

CRMMS - Colorado River Mid-term Modeling System

CRSP - Colorado River Storage Project

CRSS - Colorado River Simulation System

CWCB - Colorado Water Conservation Board

DMDU - Decision Making under Deep Uncertainty

D.O. - dissolved oxygen

DROA - Drought Response Operations Agreement

ESP - Ensemble Mode Projections

FFI - Fly Fishers International

FLAHG - Flow Ad Hoc Group

FY - fiscal year

GCDAMP - Glen Canyon Dam Adaptive Management
Program

GCMRC - Grand Canyon Monitoring & Research Center

GCRG - Grand Canyon River Guides

GCWC - Grand Canyon Wildlands Council

GLCA - Glen Canyon National Recreation Area

GPP - gross primary productivity

GRCA - Grand Canyon National Park

HFE - High Flow Experiment

LCR - Little Colorado River

LTEMP - Long-Term Experimental and Management
Plan

MAF - million-acre-feet

mg/l - milligrams per liter

NPS - National Park Service

PDT - Pacific Daylight Time

PI Team - Planning & Implementation Team

Reclamation - Bureau of Reclamation

ROD - Record of Decision

SCAHG - Steering Committee Ad Hoc Group

SNWA - Southern Nevada Water Authority

SUU - Southern Utah University

TU - Trout Unlimited

TRGD - Trout Recruitment, Growth and Population
Dynamics

TWG - GCDAMP Technical Work Group

UMPA - Utah Municipal Power Agency

USFWS - United States Fish and Wildlife Service

USGS - United States Geological Survey

WAPA - Western Area Power Administration

WY - Water Year