

**GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM**  
**TECHNICAL WORK GROUP MEETING**  
**OCTOBER 12-13, 2022**

**Day 1:** October 12, 2022

**Start Time:** 8:35 AM Pacific Daylight Time (PDT)

**Conducting:** Seth Shanahan, Southern Nevada Water Authority (SNWA) and Technical Work Group (TWG) Chair]

**Meeting Recorder:** Carliane Johnson, SeaJay Environmental LLC

### Welcome and Administrative

- **Introductions and Determination of Quorum:** Roll call was taken, and a quorum reached.
- **Adoption of Prior Meeting Minutes:** [Minutes](#) from the June 16-17, 2022 meeting were adopted.
- **Next Meeting Date(s): January 24-26, 2023:** This meeting will likely be in person in Phoenix.
- **Ad Hoc Group Membership and Updates:** This is no longer a standalone document. It is now on the [TWG website](#). Requests for changes should be directed to Tara Ashby (tashby@usbr.gov).
  - **[Erik Skeie, Budget Ad Hoc Group (BAHG) Chair and Colorado Water Conservation Board (CWCB)]** BAHG will begin developing a draft Triennial Work Plan (TWP) in January.
  - **[Craig Ellsworth, Administrative History Ad Hoc Group Co-Chair (AHAG) and Western Area Power Administration (WAPA)]** The [Wiki](#) site is active and continues to be updated.
  - **[Larry Stevens, Species of Management Concern Ad Hoc Group (SMCAHG) Chair and GCWC]** The SMCAHG is seeing how things settle on the non-native species actions. Will try to convene a meeting in the next couple of months.
- **Review Action Items, Motions, and Votes Form:** **[Seth Shanahan, SNWA]** Action items from the June minutes that are completed are: 1) Wiki updates have been made; 2) an update on the expert science panel for razorback sucker augmentation to be addressed in tomorrow's agenda.
- **Update on Program Funding and Limitations on Carryover Accounts:** **[Clarence Fullard, Reclamation]** Congress has passed a Continuing Resolution (CR). There have been questions about limitations of the carryover account for the Native Fish Conservation Contingency Fund (\$1.7 million), which is listed on the Reclamation side of the TWP and was created from power revenues.
- **Update on Monitoring and Research Trips to Occur from Today Until Next Meeting:** **[Mike Moran, GCMRC]** Refer to the [TABLE](#) on trips, which are organized and administered by GCMRC.

**The Secretary's Designee's August 2022 Requests – Action to Address Non-Native Fish** **[Clarence Fullard, Reclamation]** There were five requests that came out of the proposed action at the AMWG by Wayne Pullan, the Secretary's Designee. Following the directive, Reclamation set up an internal team to format the operational alternatives into an environmental assessment (EA) to do something next summer. Reclamation NEPA staff is now part of that team and have developed a Project Management Plan (PMP) that will be shared with partners on October 14. There were many suggestions from the Project and Implementation (PI) team to look at using the sediment that is in the system next spring and summer. This is something that Reclamation is working on to see if there are alternatives

with sediment resource benefits that will also disadvantage nonnative fish. The other item is planning to Evaluate Fish Exclusion. The final [Fish Exclusion Report](#) was posted today. Reclamation has developed a Next Steps Team that includes engineers from the Technical Services Center (TSC). The team will take the recommendations from the Fish Exclusion Report and assemble a subject matter expert (SME) group to identify an exclusion device that has the best chance of success at Glen Canyon Dam. Once that is determined, then Reclamation can take it through the planning and construction timeline for implementation in 2024.

### [Report from the Smallmouth Bass Ad Hoc Group Including a Discussion of Operational Alternatives and Exclusion Devices to Prevent Smallmouth Bass and Other Invasive Fish Establishment Below Glen Canyon Dam, Invasive Fish Strategic Planning Progress, and Early Detection and Rapid Response Immediate Needs](#)

**[Laura Dye, Colorado River Commission of Nevada (CRC)]** [PRESENTATION](#) The first goal was to develop the Invasive Fish Strategic Plan as a living document. Will also help to develop two to four operational alternatives. Would like to have the strategic plan reviewed and approved as soon as possible. Feedback is requested by October 26.

**[Charles Yackulic, GCMRC]** The first alternative involves mixing water between the penstocks and bypass tubes to maintain a daily water temperature below 16 degrees Celsius (°C) near the Little Colorado River. The one change to this alternative from WAPA is to modify the daily patterns to maintain at least 1,500 cubic feet per second (CFS). This might lead to slightly higher minimums. There were no changes to Alternative 2, which involves operations without using bypass that is not likely to stop smallmouth bass. Alternative 3 is to create a cold shock once a week for 48 hours over three months by switching to the minimum bypass, which is meant to disrupt nesting behavior. This means there would not be cold shocks at the Little Colorado River, but they would probably be sufficient to occur at Lees Ferry and Upper Marble Canyon. Alternative 4 involves cold shocks and flow spikes. This is the alternative that is causing the most headaches. The main idea is to get these flow spikes with sufficient velocities into the side habitats to disrupt smallmouth bass nest building behavior. To get through the whole slough requires around 39,000 to 40,000 CFS, which is most effective earlier in the season. The big constraint for WAPA under current monthly volumes for June is that the flow spikes and cold shock can't both be done while still having sufficient water to meet the minimums for the rest of the week. Modifications may require only doing this a couple of times and having the cold shocks during some weekends of the month or doing it more in June and moving water from July and August to June. Another consideration is if there would only be a few of these, the duration might be increased from 24 to 36 hours, which is supported by research from the Green River.

#### **Presentation, Q&A, discussion, and action**

**[Leslie James, CREDA]** Turbidity continues to be a question on these calls. Another is whether you have looked at dropping down to 1,000 CFS and then up to power plan to get that extreme range but not use bypass. Did you incorporate some of the modeling that has been done to look at the results that came out of LTEMP? **[Charles Yackulic, GCMRC]** Yes, that was looked at under Alternative 2 but only down to 1,000 CFS. Even that did not create enough disturbance. Too much habitat remained wet below 1,000 CFS. The process started by looking at different alternatives in LTEMP to see if enough could be done with that. The LTEMP models did not create enough disturbance, so this alternative was created as the most extreme without bypass. This alternative would reduce the abundance of smallmouth bass in the

long term, but it would not stop them from establishing in the system. It does not seem like a good choice. They are in the system, but reproduction does not necessarily mean there is establishment. Having a couple hundred young-of-year (YOY) in Lees Ferry is not the same as having a couple hundred adults. There is evidence of reproduction. Can't take that back.

### Continued Discussion: Exclusion Devices to Prevent Smallmouth Bass and Other Invasive Fish Establishment Below Glen Canyon Dam

**[Laura Dye, CRC]** SBAHG members have taken it upon themselves to learn more about these devices since the report has come out. **[Dan Leavitt, USFWS]** The idea that any of these alternatives could take a couple of years sounded concerning given the current threat with smallmouth bass. **[Clarence Fullard, Reclamation]** Three options that rose to the top in the report were: in-reservoir barrier nets, in-reservoir multi-stimulus barrier (i.e., bubble, sound, light), and energy dissipating sleeve valve. None are ideal, all have benefits and drawbacks, and they have consequences that need further consideration.

### Continued Discussion: Early Detection and Rapid Response Immediate Needs

**[Melissa Trammell, NPS]** [PRESENTATION](#) on rapid response considerations. A design plan has been evolving over last several weeks on how to conduct rapid response. Charles Yackulic drafted a science plan to evaluate the effectiveness of electrofishing smallmouth bass in Lees Ferry.

### Status of Non-Native Fish in Lake Powell

**[Barrett Friesen, Utah State University (USU)]** This [PRESENTATION](#) is an update of the one given in June along with another full-scale sampling trip conducted in August. The study is looking at fish assemblage in the forebay and identifying potential for escapement.

### Q&A and Discussion

**[Melissa Trammell, NPS]** Can the gear catch fish smaller than described? **[Barrett Friesen, USU]** Smaller than 150 millimeter (mm) in the gill net is unlikely but have been catching YOY smallmouth bass in the minnow traps in August (60-70 mm), which were not shown in the presentation. Closest place to put these traps near the dam is where the reservoir turns the corner before the confluence where it slopes to the water. At least 80-90% of the fish caught in the minnow traps are green sunfish. **[Seth Shanahan, SNWA]** When referring to sampling from 1 to 14 meters, does this mean one net for that depth or multiple nets? Can the captures be aggregated to a finer resolution by depth? **[Barrett Friesen, USU]** Yes, finer resolution can be done. This is done by using experimental mesh gillnets that are 24.4 meters long. In the forebay, they will hang nearly vertically just above waterline. Depending on the eight, 10-foot panels in the net, the fish can be assigned to a panel as the net is being retrieved. The net's angle as it hangs in the water is measured to estimate depth. **[Dan Leavitt, USFWS]** Why aren't the ichthy hauls catching anything? **[Barrett Friesen, USU]** Generally try to do those tows early in the morning. Will tow as far as possible, often back and forth in front of the exclusion lines or until a corner is reached. It is opportunistic but there is a flow meter in the net, so the volume is known. Restricted to conducting these tows in the center of the lake. A two- or three-minute tow back in March was completely full of Daphnia, which was not seen in the summer. How much is collected limits how long the tows are. In summer, it was mostly plastic.

**[Mike Horn, Reclamation]** [PRESENTATION](#) on fish distribution in open water of the forebay using hydroacoustics. Three sections of the reservoir were sampled (forebay area, Wahweap, and a

confluence site). Each transect is sampled for three consecutive nights to get a handle on any variation because small changes with low numbers of fish will bump up the variance in the samples. Color shown on a typical sonar echogram relates to fish size. Sampling was done the same time as Barrett's study. In June, not a lot of fish were seen in open water; most are in the shallow water column. In the August graph, there were very low dissolved oxygen (D.O.) levels with low penstock depth. No fish were seen except in the top 10 meters. Not all the targets were fish, and some might be phytoplankton. The low D.O. is limiting fish from moving deeper into the water column.

## Q&A and Discussion

**[Ryan Mann, AZGFD]** What do you attribute that layer of low D.O. between 10 and 20 meters? It seems there were concerns in years past about these high inflows. **[Mike Horn, Reclamation]** Some of that will be attributed to the thermocline and to light penetration. There will usually be a D.O. decrease at that level. But Robert Radtke and others have seen flow routing through the reservoir. Flow routing probably happened this year when there were the right elevations in the reservoir and the temperatures lined up just right.

## The Secretary's Designee's August 2022 Requests – How to Optimize High-Flow Experiments in the Current Environment

**[Mike Moran, GCMRC]** This refers to Directive 1 for GCMRC to look at ways to evaluate HFEs and perhaps modify them through design and optimization during low reservoir conditions. To address the questions asked, Paul presented to the PI Team for the HFE that was considered this fall. To summarize the results in that presentation: 1) HFE magnitude (i.e., volume of water released during an HFE) will have the strongest control over deposition of sandbars. The higher the magnitude, the higher the sandbar building. 2) Duration of HFE is an important variable to building sandbars but it is not as significant as magnitude. The longer the period, the more sandbar building. 3) Frequency is also important, but it is more difficult to tease out because it has to be assessed backwards in time.

**[Clarence Fullard, Reclamation]** The presentation that Paul gave to AMWG and TWG members was on September 27, and it was also emailed. It described the alternatives to meet the objectives of an HFE by going outside of the accounting windows in LTEMP.

**[Larry Stevens, GCWC]** A draft motion was posted in the chat to create a formal statement from TWG to AMWG. This is an ideal situation to hold both a flow that disrupts reproduction of invasive fish and restore beaches at the same time.

**[Ryan Mann, AZGFD]** Can the NEPA process change the sediment accounting windows or would that be an action for an alternative flow for this upcoming year only? **[Clarence Fullard, Reclamation]** This is a one-off opportunity for next year, can't change the accounting windows without opening up LTEMP.

**[Ryan Mann, AZGFD]** That means that work still needs to be done. Many stakeholders look at spring flows and operational alternatives as something to work on now, but if this is only one year, then the next step needs to be taken to address those sediment accounting windows

## Trout Management Flows Hypsometric Analysis and Literature Review

**[Josh Korman, Ecometric]** This [PRESENTATION](#) includes a literature review and an analysis of what works best on Trout Management Flows (TMFs). Mechanical removal studies have shown that when there is a lot of trout in Marble Canyon from a big recruitment in Glen Canyon, those fish will leak down

to the Little Colorado River. Mechanical removal is not effective, it can be expensive, and the tribes strongly object to it.

#### **Q&A and discussion**

**[Seth Shanahan, SNWA]** The conditions were much different when TMFs were first considered and TMF was required under LTEMP. It is critical information if those conditions occur again, but it has great relevance to smallmouth bass now. **[Larry Stevens, GCWC]** After witnessing several stranding events, what are the differences in life strategies among different species. Trout will go back into these pools until finally killing themselves. How much variation is there in other species to these stranding behaviors? **[Josh Korman, Ecometric]** This is seen in salmonids in British Columbia rivers and sometimes in non-salmonids, which are less studied. There are studies in Europe from non-salmonids. Most juveniles of any species tend to use the immediate shoreline areas. They hide out in shallow, slow waters near the edge of the river, which are areas that tend to get dewatered. It is suspected this behavior would be similar with smallmouth bass.

#### **The Secretary's Designee's August 2022 Requests – How to Optimize High-Flow Experiments in the Current Environment**

**[Mike Moran, GCMRC]** This is progress to date with Directive #2 to develop a budget and schedule to evaluate potential downstream impacts to LTEMP resources from water surface elevations at Lake Powell dropping below minimum power pool and below dead pool for more than three months. That is the broader part of the request to look at all LTEMP resources. There is also a narrower focus of the request for GCMRC to take the Colorado River Mid-term Modeling System (CRMMS) probabilistic results and using them in GCMRC's temperature, water quality, and fish models to determine impacts to these resources. Have made some progress on the work with agency meetings to better define the scope and outline the work tasks. GCMRC will obtain the worst-case CRMMS traces and then use them in the models to evaluate what might be the predicted impacts from these lower flows. A draft is expected by November 15.

#### **Q&A and discussion**

**[Seth Shanahan, SNWA]** There will be assumptions about releases when using CRMSS (likely 7 MAF). **[Mike Moran, GCMRC]** GCMRC can look at a variety of possibilities in terms of effects on resources. Will keep that in mind.

#### **Status of the Lees Ferry Trout Fishery Including Angler Reports and Water Quality Conditions of Concern and a Review of Handling Procedures to Prevent Mortality**

**[Ryan Mann, AZGFD]** [PRESENTATION](#) on the rainbow trout fishery and water quality issues. The declining trend in relative abundance in the fishery continues to the point where it fell below the management goal in July 2022, which was the lowest since 2011. There is also a higher proportion of smaller fish (which is an indication of spawning and potential recruitment) but need to see juveniles making up at least 20-50% of the population. How that translates to the fishery is through the creel surveys. Have contacted 595 anglers for the upstream reaches of Lees Ferry and another 94 walk-in anglers. The numbers are slightly above observations last year but still below the management goal. The data show that the fish in the system are overall in good condition. The bad news is that fish are chronically exposed to high temperatures (over 20°C). There have been reports of fish mortality and

higher die-offs are expected with increasing temperatures. There is a threat for catastrophic loss of this fishery.

**[Jim Strogon, FFI/TU]** With the stresses, are there concerns about temperature and D.O. levels that need to be considered for smallmouth bass runs? **[Josh Korman, Ecometric]** Smallmouth bass are more active when temperatures are warmer, so the July and September trips are probably going to be the most productive. That is the tradeoff. The bigger concern may be the effect on anglers after shocking an area for weeks. The solution to the buckets is to add oxygen but the stress from electroshocking might not be overcome. Have also heard from guides that anglers just catching and releasing fish has resulted in mortality. If the effort were to increase substantially, then the number might represent 50% of the population over six trips, which is something to consider if the mortality is high.

**[Melissa Trammell, NPS]** NPS is also concerned about incidental mortality of rainbow trout and changes have been made such as avoiding netting or landing rainbow trout and limiting processing of the fish with no weighing or tagging. Temperatures are starting to drop. It is hoped that this will become less of an issue soon. Would be interested in suggestions on reducing this mortality.

**[Seth Shanahan, SNWA]** Goals for the fishery are not being met. Maybe one of the conclusions is that some of the ideas for controlling smallmouth bass can also improve the trout fishery conditions. That could be a co-benefit for considering those alternatives. As Reclamation considers the purpose and need, a narrow precise only-next-year set of options is not the most helpful. There needs to be a framework to consider different options given different conditions in future years.

## **A Review of Nutrient Fertilization to Enhance Fish Production, and Scoping for Glen Canyon Dam**

**[Josh Korman, Ecometric]** [PRESENTATION](#) on work funded by WAPA to look at drought related effects to low phosphorous concentrations on the aquatic ecosystem downstream of Glen Canyon Dam, and its potential to improve productivity using nutrient fertilization. There is good information available from a lot of management actions (including those that are one-offs) on effects to macroinvertebrates (bugs), rainbow trout, or humpback chub. Because equalization flows tended to produce more trout, some moved downstream and affected chub. It was hypothesized that those response were stimulated by phosphorous rather than flows. Experimental flows have not been a win for humpback chub; they've either been neutral or had a negative effect. The data support the statement that flows have not improved things. On the other side of the ledger, there are water quality effects that are going to vastly outstrip the effects of flows. It might be better to think less of flow quantity and more about water quality. One water quality condition that can be manipulated is phosphorous concentrations. It is very difficult to regulate water temperature and oxygen, and it would be very costly. This leaves the jet tubes to manipulate temperature and oxygen, which has a great impact on hydropower. Water quality (rather than flow) might be the dominant influence on fish populations downstream of the Glen Canyon Dam. Low concentrations of soluble reactive phosphorous is limiting for algal production. The purposeful addition of nutrients is a common and well-tested method for enhancing productivity in freshwater ecosystems during periods when they are nutrient limited. This has been mainly to mitigate the effects from dams on nutrients that are no longer flowing into the reservoir, and primarily focused on salmonids. WAPA will be releasing its report to the GCDAMP soon. It could be possible to include some type of evaluation of this in GCMRC's work plan.

## Q&A and Discussion

[**Seth Shanahan, SNWA**] How would warming temperatures and flow of any kind breakdown the benefits? [**Josh Korman, Ecometric**] If low D.O. causes trout mortality, adding phosphorous is not going to help. If D.O. reduces their growth rate substantially, which is believed to have caused the die-off in 2014, then more food could offset that metabolic cost and it might also help them do better in higher temperatures. [**Seth Shanahan, SNWA**] Is there a relationship with flows where the benefits would breakdown, too? [**Josh Korman, Ecometric**] Based on the literature, the phosphorous effects are going to overwhelm the flow manipulations because the flow effects are pretty benign to trout.

## Public Comment

None

Meeting adjourned at 4:32 PDT

# **GLEN CANYON DAM ADAPTIVE MANAGEMENT PROGRAM TECHNICAL WORK GROUP MEETING OCTOBER 12-13, 2022**

**Day 2:** October 13, 2022

**Start Time:** 8:34 AM PDT

**Conducting:** Seth Shanahan, SNWA and TWG Chair

**Meeting Recorder:** Carliane Johnson, SeaJay Environmental LLC

## Welcome and Administrative

- **Introductions and Determination of Quorum** Roll call was taken, and a quorum reached.
- **Unresolved Issues from Yesterday's Meeting** [**Seth Shanahan, SNWA**] Larry's proposed motion was sent to TWG members for discussion. Operating procedures are on the TWG website. Motions are to be made either verbally or in writing before a meeting. The intent is to allow some consideration and thinking ahead of time, which takes work and effort to build coalitions of support and consensus to consider certain actions. Those conversations and working through the text can be valuable. The proposed motion has met the spirit of the intent of the operating procedures because members had a day to consider it. There needs to be flexibility to have conversations, especially if there are emergency-type of responses, and have time to approve a motion during a TWG meeting; however, it is important to not take that too far.

[**Michelle Garrison, Colorado Conservation Water Board (CWCB)**] This is duplicative of SBAHG efforts to work with the federal agencies to scope something under the NEPA process. Don't have the bandwidth to do be doing multiple passes at this at the same time, but there is space in the SBAHG to consider the benefits to other resources. This would be part of the alternatives considered under NEPA. Believes the current SBAHG charges cover what is in the motion.

[**Shane Capron, WAPA**] Struggles to see how to get through the NEPA process in time to implement something next summer. There should be considerations of proposals like this where there are flows that are similar to what was looked at in LTEMP under the various alternatives,

which may be easier to get to a Finding of No Significant Impact (FONSI). It still needs to meet the purpose and needs of smallmouth bass. This also needs to be discussed in SBAHG. **[Kristen Johnson, Arizona Department of Water Resources (ADWR)]** Thinks the motion is duplicative of what is already being done, but it is properly within the mission of the resource agencies to get a supplemental EA done in time for the spring. Understands the conversations happening in the SBAHG but is nervous about having too big of a mission in what was supposed to be a narrowly focused ad hoc group. However, the proposed motion is already being considered by Reclamation and appears to be what the Secretary's Designee had charged the TWG at the last AMWG. **[Ben Reeder, GCRG]** The motion language is concise and addresses all the issues in a combined effort to achieve the goals. It makes sense to consolidate the conversation in the SBAHG. Where that input happens is less important than whether the issues in the proposed motion are being addressed. As to the timing, the process was influenced by the HFE webinar and the news breaking about the decision to not conduct a fall HFE. **[Mike Moran, GCMRC]** From GCMRC's perspective, as the science providers and not stakeholders, there is overlap from the August AMWG, but there is more specificity in the wording than what was in the directive about how to do an HFE or other type of flow that would address other resources. The way it was initially considered, it was to benefit sediment. From internal discussions, and discussions with Reclamation, GCMRC believes there are additional benefits to other resources. A few of them were mentioned yesterday such as smallmouth bass and aquatic foodbase. There would be benefits to other resources such as cultural. Maybe the TWG can look at Directive 1 in a larger manner with respect to other resources. **[Laura Dye, CRC]** There is a lot going on in the SBAHG to address the Secretary Designee's directive and the TWG needs to consider operating alternatives that can impact as many resources as possible. Encourages everyone to join those conversations. It is hoped that SBAHG provides feedback and an avenue for stakeholder input on the proposed alternatives for the EA, but also wants to make sure that SBAHG remains focused on the main concern with smallmouth bass so there are actions in place by next spring and summer. Concerned about adding too much to the group to meet those goals. **[Emily Higuera, ADWR]** Agrees this is an important conversation to have but wants to make sure the SBAHG remains focused to meet the deadlines on smallmouth bass. **[Kelly Burke, GCWC]** There is urgency to accomplish this in the timeframe needed to address the crisis. This can simplify things. It is intended to make it easier to tier off the LTEMP on things that have been analyzed and have buy-in to meet goals of the Grand Canyon Protection Act. It is a struggle to figure out how to accomplish the compliance that would be necessary to shift this from the fall to the May-June window if looking at it from the perspective of an HFE as outlined in Paul Gram's work. It is probably too late to provide input through the compliance process of this being another alternative. It is also important to not complicate the SBAHG. The Secretary Designee's directive was to find a way to do an HFE and prevent establishment of smallmouth bass that includes operational alternatives. The third piece is to have a place to talk about the obstacles and challenges, which include water and power.

**[Kathy Callister, Reclamation]** Reclamation is currently working on the federal action, and the purpose and need. Reclamation is looking at ways to incorporate a flow experiment similar to a spring HFE into the operational alternatives, but there are still some steps to figure out how that will work as part of the action. As this process becomes more developed, will start looking at the actions and how they could be incorporated. Reclamation is trying to complete this EA by the



end of March. The EA needs to stay as focused as possible on specific federal actions Reclamation needs to take on operational alternatives. A spring HFE-type of experiment is being considered. **[Rob Billerbeck, NPS]** The overwhelming pressing issue is smallmouth bass, which will probably make or break the fate of native fish in the Grand Canyon and status of humpback chub whether there are appropriate flows in place by June or not. That is the absolute priority of the compliance process. There has not been an HFE since 2018. The sediment resource is degrading and there is the Grand Canyon Protection Act. The goal of the GCDAMP is to figure out how to adapt dam operations to protect and mitigate adverse effects to and improve fish, sediment, and other resources on the river. There is probably a way to do this that has fewer impacts on hydropower than if HFEs were run per LTEMP. This effort is supported whether it is part of the proposed motion or already happening as part of compliance, but one thing NPS asks, if sediment issues are not addressed as part of this short-term EA, then it is really important for GCMRC to follow that directive and fully document a proposed solution that could be submitted for a post-2026 process. **[Erik Stanfield, Navajo Nation]** It sounds as if nearly everyone involved has an interest in a spring HFE even though there are questions about water and power generation. It seems this is more of an organizational problem around how an HFE going to be evaluated. If it is done under managing smallmouth bass, that gives the perception that is the purpose of it even though there are other benefits. It is important to have this outlined in a more comprehensive and holistic way. It does not need to duplicate what SBAHG is doing but it needs to incorporate that and represent the value of HFEs on their own. If the compliance is done through working with the FLAHG, couldn't that be a compliment to what Reclamation is doing as opposed to a duplication? This charge seems to represent the larger interests of HFEs rather than smaller management actions related to smallmouth bass. **[Kristen Johnson, ADWR]** What is being contemplated in the motion is already being rolled into the NEPA compliance. Kelly's point about how this would be a forum or a place to talk about things before compliance is not clear. None of the groups under the GCDAMP are cooperating agencies and, even in an EA, there is probably not enough time to engage in a full cooperating agency process. Not sure what will be gained from the FLAHG process because NEPA is moving quickly, and the technical experts are already engaged. There is a process for stakeholder engagement through the NEPA process that is happening now and opportunities to comment on the draft. There is no reason why anyone on the TWG or SBAHG couldn't start building a coalition and having a multi-agency comment letter. That is more appropriate than re-initiating the FLAHG. The existing NEPA framework is sufficient. **[Larry Stevens, GCWC]** The intent of this draft motion was to stimulate discussion. The narrow focus of the SBAHG is concerning. It is not just smallmouth bass although that is an important issue, but it is running parallel to the issue of sandbar degradation because of long periods with no high flows. There is a limited timeframe to get compliance done. It is good to know Reclamation is working on an EA that is expansive enough to incorporate this as well. If this is not set up in a comprehensive way, and a spring HFE is conducted, then the science might not be in place to assess the effects. This might also be the last time over next few years there is the opportunity to run a high flow event. That puts additional pressure on making the right decision for this spring. **[Colleen Cunningham, New Mexico Interstate Stream Commission (NMISC)]** The smallmouth bass issue is the most urgent priority for New Mexico. Given all the resource constraints (but especially Reclamation, Charles Yackulic's time, and WAPA), it seems that having another process might take away energy and

effort that could be put toward doing right in the current process. Concerned about limited resources and a very tight schedule. **[Martina Dawley, Hualapai]** What does “experimental springtime non-native pulse disturbance HFE to disrupt nesting smallmouth bass” mean? **[Larry Stevens, GCMRC]** It means sending a pulse of cool water and high flows next year to disturb the reproductive process of smallmouth bass a high flow after the winter that disturbs the nesting to affect their reproductive success, and perhaps washes them away. It does not kill the fish.

**[Seth Shanahan, SNWA]** It is clear based on the comments there is not consensus on this proposed motion. The TWG strives for consensus although motions can be passed without it, but that is not desirable. It might also be concluded that the forum to address this issue is not the concern, but rather that the issue is being discussed and attended to. Based on responses from Reclamation and the SBAHG co-chairs, they are considering having a high flow that looks similar to an HFE as part of their alternatives. As Kathy noted, Reclamation is thinking about it from a sediment point of view as part of what is needed in the purpose and need. The TWG has heard that the topic is going to be addressed. The TWG also heard there is a need for people to participate in the forums where this conversation is occurring. Still waiting for Reclamation on the steps for the NEPA process as to when the public will be involved, which is forthcoming, but there are already forums including the SBAHG, where people can weigh in on those conversations on the topic. Lastly, also hearing there is tension between immediate need to prevent establishment of bass as the highest priority and most in need of resources, with this longer-term need regarding an interest in having spring HFEs available forever, regardless of the low reservoir conditions. To move forward next year to meet the immediate need, the highest priority actions are to prevent establishment, but they should also include opportunities for improving the beaches, which are not in good condition. Lastly, there was also a request for the federal agencies to not be so narrow to foreclose opportunities in the EA alternatives, and that they should be available beyond 2023. Given this, recommends the motion is not made and that people discuss this in the SBAHG.

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

**[Heather Patno, Reclamation]** The Upper Basin continues to be in base flow and storage is expected to decrease. Flaming Gorge and Blue Mesa elevations are slightly lower than typical; Lake Powell is at critically low elevations. Water Year 2022 is the 11<sup>th</sup> driest year on record. Continue to see high temperature impacts on evaporation and soil moisture. Runoff is below average across all the reservoirs. Still in a period of significant uncertainty and have yet to see snowpack start. If high temperatures continue to be seen over next several weeks, this will continue to decrease the soil moisture deficit and impact runoff next year. For the unregulated inflow (min, max, and most probable forecast) for WY23, the good news is that the minimum probable increased slightly, which indicates that the observed water runoff last month had increased the minimum flows expected next year, but still seeing changes. Reclamation is still operating under the Upper Basin Drought Response Operations Agreement (DROA) in which water continues to be released from upstream reservoirs to increase elevations and storage levels in Lake Powell. Another 500 thousand acre-feet (kaf) is being released from Flaming Gorge to Lake Powell as an additional DROA action. Also continuing to operate under operational neutrality with 480 kaf left in Lake Powell to increase that storage, but Reclamation is calculating operations as if that water had been delivered to Lake Mead. Under DROA, Reclamation is doing monthly minimum probable runs,

while the maximum probable is done at least four times per year (last time was in August; next ones are in October and January). The August 24-month study run shows Lake Powell in lower elevation balancing tier with Lake Mead. Lake Mead is in Level 2 storage condition for the first time. Additional conditions have been placed on WY23. Balancing releases have started at 7 maf with potential for an April adjustment depending on certain constraints. CRMMS modeling for Lake Powell operations forecast shows March and April 2023 elevations are quite low (down to 3,496 feet – about 6 feet above minimum power pool). The drier traces indicate storage or elevations below minimum power pool into 2024. There is still a significant amount of uncertainty in the forecast, which is based on historical information. Reclamation continues to look into the possibility of releases below 7 maf and what compliance would be needed under the Interim Guidelines to implement that. The next Five-Year outlook will be out in January. This is showing increased probability of Lake Powell below minimum power pool in 2024, but none of the traces are seen as dropping below dead pool of 3,375 feet. The lowest elevation traces for Lake Mead do not come into play until 2026. For hydropower maintenance in WY23, there will be either 4 or 6 units available. Units 3 and 4 are the last transformer replacements. It has been determined that the lining of the bypass tubes need to be replaced before they are operated below power pool. The current schedule for that is to begin April or May for four to five months when they would not be available (unless there is an emergency or elevation falls below power pool). Reclamation continues to consider smallmouth bass concerns. For the weekend steady flows, there was an increase in releases to 9,300 CFS because Glen Canyon cannot meet regulation at 8,000 CFS.

**[Robert Radke, Reclamation]** There was a short trip to Lake Powell in September. Water is still fairly stratified above the penstocks with some cooling, but turnover has not yet begun. Same scenario is seen with D.O. with hypoxic inflow throughout the reservoir. Monsoonal input seemed to extend this interval. Below the dam, there is an increasing trend in D.O., while temperature is decreasing, and conductivity is increasing slightly. This infers that water is mixing a little bit below the penstock. Temperatures next year in the system are projected to be the same as this year with maybe a degree cooler in the fall.

## **Q&A and Discussion**

**[Larry Stevens, GCWC]** Have spring peak inflow arrival dates become earlier in post dam time? Have the differences in annual prediction uncertainty of inflow increased over time? **[Heather Patno, Reclamation]** Runoff over the last few years has been getting to peak one to two weeks earlier, which has to do with snow accumulation. Also have a 30-year average during 1991-2020 period that was lower than 1980-2010 period. As to uncertainty, at specific lead times, has increased. At the same time, dealing with historical traces of precipitation and temperature that are used to make forecasts. In 2020-2022 increased especially in 2021 when observed elevations were below the minimum. In large snowpack years, that signal is still good although this runs into the same pattern that snowpack does not align with the runoff. It would probably take a few years to correspond.

## **Status of Harmful Non-Native Fish Below Glen Canyon Dam, Updates for the Incentivized Harvest Program, and Activities to Control Harmful Non-Native Fish in the RM-12 Sloughs**

**[Bud Fazio, NPS]** [PRESENTATION](#) A lot of fishery activity is focused on the lower slough (about 6 acres in size and open to the Colorado River mainstem) and the upper slough, which is tiny. The data show a pattern of alternating temperatures between weekends (higher temperature during steady flows) and weekdays (lower temperatures and fluctuating flows). At the end of April, the upper slough was pumped out and green sunfish removed with 155 relocated into Lake Powell to respect Tribal concerns. A large

number of YOY carp were found. In June, YOY smallmouth bass were found there for the first time. Around September 14, there was a lot of activity to remove native and beneficial fish prior to application of Rotenone. NPS believes it was successful but then learned smallmouth bass were found in other locations of the Glen Canyon reach. NPS is retaining any YOY smallmouth bass for later analysis. A net was placed to try to keep smallmouth bass out of the slough. This is the first year that green sunfish were found in large numbers (~1,400) in the lower slough. Fall efforts will address smallmouth bass and other warm water invasives

**[Craig Ellsworth, WAPA]** It appears that temperatures were 10 degrees warmer during that experiment?

**[Bud Fazio, NPS]** Yes, there is a significant temperature difference between the mainstem and slough almost all of the time. Also have almost like tidal surges going in and out of the slough depending on flows, which have heavy influences on the slough. From late spring to early summer, have noticed tremendous growth of aquatic vegetation compared to what was there before. **[Craig Ellsworth, WAPA]** The temperature logger in the upper slough, which is disconnected from the mainstem, also showed this difference. **[Bud Fazio, NPS]** It is shallower and has minimal flows. Green sunfish love it in there. **[Craig Ellsworth, WAPA]** Recalls during bug flow tech team calls that many fisheries biologists in this program thought that the temperature in the sloughs was a non-issue. Would request this be reconsidered because it seems to be a big deal. Where are the smallmouth bass that were collected? **[Bud Fazio, NPS]** About 20 were collected and they are stored at the park (some frozen and some stored in ethanol).

**[Craig Ellsworth, WAPA]** Requests that someone analyze the otoliths to see if there is a growth signature. Need to investigate whether to continue with steady flow experiments with bass in the river. If bass show a signature that they are growing under those experimental conditions, that is something to drill down into.

**[Melissa Trammell, NPS]** Note that temperatures in slough are warm enough for spawning on regular weekdays as well. **[Bill Persons, FFI/TU]** The temperature data is curious. There is daytime warming and nighttime cooling. Have seen this in other areas of the canyon so not sure if this is a flow effect or diurnal effect. Warm water and low oxygen might be what are needed to disadvantage non-native fish. The D.O. data are harder to collect but it would be good to get some readings to know what it is during high temperatures.

**[Ryan Mann, AZGFD]** Regarding Craig's comments, there is mischaracterization about the lower slough and bug flows. There is a belief that the risk would not change substantially whether bug flows go forward or not. That is still relevant. As noted, the mainstem was above 16°C so spawning could have been occurring. It is exceedingly high at 34°C even for warm water species. That is starting to reach upper temperature limits of smallmouth bass with chronic exposure of 29°C and acute at 31°C.

## Effects of Frequent Use of Bypass at Glen Canyon Dam on Electrical Generation and Transmission

**[Craig Ellsworth, WAPA]** [PRESENTATION](#) WAPA recognized that its environmental group did not have the expertise to understand how the ideas being discussed in the program might affect the rest of WAPA or the Colorado River Storage Project (CRSP) system such as with electrical transmission and power marketing. What is being discussed with GCMRC about bypass flows for bass at Glen Canyon Dam is exceptional. These are very different types of alternatives that are being proposed. In the past, there were flood releases and Beach Habitat Building Flows that were precursors to HFEs. Operational alternatives currently being considered are much different from past experiences in which Glen Canyon

was never really “turned off” except during the Cave Creek fire when the facility was off for three days. What is being proposed now is toggling Glen Canyon Dam between generation and bypass, which is quite different from losing it because it falls below power pool. WAPA identified seven areas that might be impacted or will be impacted in known or unknown ways. These issues need to be sorted out in the NEPA document. There are services that Glen Canyon Dam provides (regulation, reserves, emergencies, black starts). Regulation for the grid is better with big hydropower than smaller generating facilities. Black starts is a contract to Palo Verde Nuclear Plant, if they were to go down, to get them or another generation unit back online, a big facility like Glen Canyon is needed if they were to have an emergency shutdown. WAPA does not have much experience in Glen Canyon Dam becoming a non-functioning facility. Need to think about how these concerns will be affected during the NEPA compliance evaluation or in any experiment being proposed for next year.

### Update on Project N Activities Including a Discussion of Hydropower Improvement Flows

**[Lucas Bair, GCMRC]** [PRESENTATION](#) on Project N, which is to coordinate and collaborate on monitoring and research opportunities associated with operational experiments at Glen Canyon Dam that can meet hydropower resource objectives. It is a smaller component of GCMRC’s workplan. The metrics behind the hydropower and energy goal is established in LTEMP. Hydropower is able to offset high costs of other energy resources such as natural gas. If water is shifted during different times, energy might be produced when it is not as economically viable. In the LTEMP goal, it mentions emissions as a goal. When operating regimes are shifted from on-peak to off-peak, this causes a shift to more coal-fired generation. When other costs are incorporated, such as from greenhouse gas emissions, there could be human health concerns and agricultural production issues, from replacing energy at certain times of the day or month with hydropower. GCMRC looked at what the emissions might be of different scenarios from Lake Powell reservoir and when it might be more efficient to implement a TMF. This is another way of systematically thinking about hydropower and its role in the system. More tools are needed to think about trout management flows and to better estimate energy costs under the different scenarios. These projects address the Secretary Designee’s request, and it feeds into the work on tradeoffs related to a predictive model for sandbar building (Project J.1).

### Q&A and discussion

**[Seth Shanahan, SNWA]** Appreciates the attention to these topics. GCMRC’s efforts help one of CREDA’s goals from Leslie’s comment in chat that Project N was envisioned to focus on the LTEMP Objective to “maintain or increase hydropower” because there was nothing in the TWP or in the program to address that specific objective. **[Leslie James, CREDA]** Struggles to understand how that modeling was done. There hasn’t been any involvement in the Socioeconomics Ad Hoc Group (SEAHG) since the emissions presentation a few years ago. In reading responses to the work in developing the metrics, there are possible areas of disagreement in economic versus financial value. Not sure Project N is meeting the mark as to what it was intended especially with limited resources. **[Lucas Bair, GCMRC]** Aware of this frustration. Project N was written broadly, it has limited resources, and it was intended to piggyback on other projects, which takes time and did not have time for outside collaboration. Thought that developing in-house tools to estimate economic value of experiments would be the best way to address Project N and build on existing efforts. Is aware of interest in hydropower improvement flows but that would have required additional tool development and resources. The work to integrate TMFs and HFEs into the models is taking time but is making steady, forward progress. **[Seth Shanahan, SNWA]** It seems

clear that Project N offers tools to evaluate impacts. Is the concern more about not making progress on hydropower improvement goals? **[Leslie James, CREDA]** Yes, that is it. Maybe it can be addressed in the prioritization of the TWP process. Knows that Project N has limited resources and very little was allocated. Requests an effort to address these concerns. When Project N was proposed, it was focused on the first part of that objective, but there are many constraints. **[Lucas Bair, GCMRC]** Heard comments about reopening the SEAHG. Would be open to that. The project would require more resources. Doesn't feel as if there are fundamental differences between economic or financial metrics, but what is being reported are the economic outcomes associated with experiments.

**[Cliff Barrett, UAMPS]** One concern is that not much work is being done to assess impacts of these changes to power customers. CREDA members could provide this data and tell you what the impacts are from these experiments. They need to be included in the decisions. **[Lucas Bair, GCMRC]** That point is well taken. **[Seth Shanahan, SNWA]** Either we need to get member representatives to provide input on the impacts on the metrics or have these customers come in to provide that information so we can use them and understand the impacts.

**[Shane Capron, WAPA]** WAPA can provide a lot of this analysis with financial and economic impacts. There are impacts from customers that are not being captured and that is going to get worse. For example, the rough estimate for economic burden passed onto customers under WAPA 199 (lower releases and inability to provide full energy) was about \$96 million last year. It will be a bigger number in 2023. That has a lot of people concerned. It does not account for the burden and risk of dealing with energy. If WAPA had to purchase that power in 2022 to meet its contracts, which were the baseline in LTEMP, that would have resulted in a Basin Fund of \$20 million, which is unsustainable. WAPA is working to tweak these models and hopes to have some estimates of costs for the SBAHG within about a week. GCMRC can focus on other components of risk and has access to all the prices and models to estimate this without reinventing the wheel.

### Review of TWG comments on the Monitoring Metrics

**[Helen Fairley, GCMRC]** provided an overview of the project, and its purpose to assess whether the 11 LTEMP goals have been achieved. In this project, the focus was on defining the metrics to assess and track the LTEMP goals. Performance metrics help answer whether progress is being made on achieving the goals, but they do not necessarily help answer why or why not. It is better to have a few, high quality metrics that are easy to understand because they are also communication devices and are easy to compare over time. One example is the metrics to meet humpback chub recovery goals. Some conditions, such as aggregation, are not really that important anymore because habitat has expanded substantially over time. The biologists developed three performance metrics. Underlying these are many other variables (i.e., water quality, food base, predator loads, and activities in the Little Colorado River) that are not part of the performance metrics but are acknowledged as being key drivers that will influence the outcome of the goals. There are also many metrics in the knowledge assessment, but it was noted there is no numeric goal for aquatic foodbase in the program. It is treated as a means objective rather than one of the fundamental goals. The same is seen with water quality, which is important for all aquatic life forms, but there is no goal under LTEMP for achieving a certain type of water quality. For recreational experience, many variables have been considered under different assessment, the metrics draft bundled all of those variables under a single metric called Economic Value of Recreational Experience.

### Q&A and Discussion

## A Review of the Implementation Process that Was Used for a Potential Fall High Flow Experiment and Possible Experimental and Management Actions in the Next 12 Months

**[Clarence Fullard, Reclamation]** [PRESENTATION](#) on the process for considering fall HFE and the experiments over WY 2023. The sediment accounting period for a spring 2023 HFE starts in December. Average monthly sand load from the Paria is accounted for in the fall and then used in the spring before it is washed away. The concern is about resetting the clock right in the middle of this, which affects the sediment accounting for a spring trigger under the LTEMP ROD. There is a desire to change this. The Secretary's Designee has not yet signed the decision memorandum on the fall HFE but is expected to do this based on consensus recommendations from the Technical Team and Leadership Team to not recommend a fall HFE even though the conditions of the sand mass balance would have allowed for an extended duration fall HFE. The concern was the need to borrow water at another critical time when power pool was low.

## Highlights of: Assessment of Potential Augmentation and Management Strategies from the Razorback Sucker Expert Science Panel

**[Kerri Pedersen, Reclamation]** A razorback sucker expert science panel occurred in December 2021. That [REPORT](#) is now available. It is not intended to be a decision document but to inform possible consultations, recovery plan updates, and possible science-based management recommendations.

**[Phaedra Budy, Utah State University (USU)]** [PRESENTATION](#) The overarching questions to the panel were 1) whether the population of razorback sucker in Lake Mead and Grand Canyon are sustainable, and 2) should the population be augmented. Long-term persistence of razorback suckers is questionable because a small number of fish could be affected by an environmental disturbance. There were also concerns about hybridization. The panel addressed other questions such as effective population size, recruitment conditions, other critical uncertainties, Grand Canyon connectivity and viability, habitat quality, hybridization with flannelmouth suckers, spawning success, and whether Pearce Ferry Rapid acts as a barrier to movement between Lake Mead and Grand Canyon. Most of the panel, but not all, agreed that augmentation should occur in Lake Mead with certain conditions as to where, how many, what size, and when. There was near consensus to try experimental augmentation in Grand Canyon under certain conditions. Monitoring and addressing knowledge gaps are critical to experimental augmentation.

### Q&A and discussion

**[William Davis, CREDA]** Are razorback suckers considered to be a lacustrine fish and if so, is their history in Grand Canyon one of a migratory corridor rather than an ideal habitat for a sustained population?

**[Phaedra Budy, USU]** Don't know the answer to that but do know they probably moved very far (i.e., 200 miles) in the past probably because the rivers were much more lake-like from ice dams.

### Informational Updates

- **Razorback Sucker Augmentation Activities in Grand Canyon [Emily Omana-Smith, NPS]** This is a pilot project that NPS designed with the USFWS to consider razorback sucker augmentation. The NPS Fish Management Plan from 2013 includes augmentation and included a consideration of findings and recommendations from expert panels. It is important to look at movement, survival, and growth in this process. The study will involve a release of juveniles into Grand Canyon at multiple sites with four objectives: 1) to release a minimum of 500 juveniles per year

between 2023 and 2025 at two sites; 2) conduct biannual sampling to help model survival, movement, and growth; 3) to achieve population growth in a positive direction; and 4) assess factors that influence survival and growth that will contribute to the knowledge of future augmentation and recovery efforts. Will rely on existing monitoring and two trips per year. The plan is to release the first batch of 1,500 fish into Havasu Creek this spring.

**[Bill Persons, FFI/TU]** Has the second location been picked? Could some of the larvae collected be subjected to genetic analysis collected by Bio-West to see if they are hybrids? **[Emily Omana-Smith, NPS]** The next idea was at the mouth of Bright Angel but there are some concerns with access and monitoring. **[Kerri Pedersen, Reclamation]** The earlier samples from 2014-2015 were stored in formalin so no genetic analysis could be done. There were very few fish (maybe 8-10) in the more recent sampling and those were hybrids.

- [Water Quality Studies Requested by the AMWG in February 2022](#) **[Bridget Deemer, GCMRC]** This data paper is based on over a half century of monitoring records from Lake Powell (1964 through 2021). The data will be updated once a year. They are going to be used to answer various research questions to improve the CE-QAUL W2 model. Water quality is very dynamic right now. Temperature, D.O., and conductivity peaks and troughs are shifting. The model is going to be key toward understanding the mechanisms that are driving these changes. There has also been a pronounced increase in phytoplankton biomass in reservoir surface waters in recent times. The CE-QUAL W2 model is being updated. Weather input options will be considered and also incorporating more information from a long-term dataset. Trying to better understand D.O. demand below the dam and temperature sensitivity, which will be incorporated into the model. There are also differences seen in sediment type.

**[William Davis, CREDA]** Is there any fish data in releases from Lake Powell with limnology data (e.g., shad coming through the penstocks)? **[Bridget Deemer, GCMRC]** The biological data is limited to surface, phytoplankton, and zooplankton tows, but no fish data. **[Seth Shanahan, SNWA]** Looking forward to the CE-QUAL model to include D.O. to see what future conditions could look like.

- [Trout Management Flow White Paper](#) **[Kerri Pedersen, Reclamation]** This white paper compiled information on all the things to consider for implementing a TMF. Feedback was received from two stakeholders, which is being incorporated into the document. Once that is done, the document will be submitted to the USFWS along with the letters of sufficient progress report on why a TMF won't be implemented. It is not a decision document and will remain a draft document since it needs to be updated as things change. Consultation with the Tribes related to TMF and other fish activities is also continuing.

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

**[Seth Shanahan, SNWA]** Items heard include: 1) a plan to respond to smallmouth bass in Lees Ferry. Contact Melissa Trammell to support those activities; 2) the strategic plan is out for comments by the TWG (by October 26) and then the SBAHG will come to a final recommendation on the plan for the TWG to consider in January; 3) the downstream impacts proposal will be available by November 15; 4) many topics are to be addressed in the SBAHG and people are encouraged to attend to provide input; 5)



Provide red-line comments with proposed solutions to Helen on the monitoring metrics by October 31; 6) there had been concerns about Heather's comments on the availability of the bypass tubes next spring, but it seems Clarence has answered this question and Reclamation can pursue a federal action to make sure the flow options are available.

### **Q&A and Discussion**

**[Jakob Maase, Hopi Tribe]** Can there be a workshop on the metrics? There are many resources that are not discussed from a tribal perspective. **[Seth Shanahan, SNWA]** Can there be an alternative reporting format at the ARM in which the conversations on resources would be more freeform? Requests Jakob attend the SCAHG calls to formulate this idea.

**[Helen Fairley, NPS]** Will send out a clean version of the draft to reviewers. Requests that reviewers use track changes function in the document. If new text is proposed, that might be better received separately, but tied to the comment made in the document.

**[Scott VanderKooi, GCMRC]** Interviews have started for the GCMRC Chief. Will have seminars from a few of those candidates for a subsequent interview that will give seminars open to the stakeholder groups. This is likely to occur the first week in November. **[Mike Moran, GCMRC]** This will be his last TWG meeting as he is retiring at the end of the year. His position will be advertised after the chief's position is in place.

**[Larry Stevens, GCWC]** Wants to figure out how to monitor the changing distribution of nonnative species such as New Zealand mud snails moving into the tributaries. Will be working with Grand Canyon Youth and the river guides to try to track their distributions. During the Paria Beach restoration work, an Asiatic clam was found, which has not yet entered Grand Canyon and is a new nonnative that could affect the ecosystem. Quagga mussels above Lees Ferry are very common in dredge samples (12-14 meters) because they colonize on top of each other with thickness of up to 20 centimeters. High flow events can move them into new areas. **[Seth Shanahan, SNWA]** Maybe Bridget can think about quagga in her water quality work.

### **Public Comment**

None.

**Meeting adjourned at 4:30 P.M. PDT**

## TWG Members and Alternates

Cliff Barrett (UMPA)  
Rob Billerbeck (NPS-GLCA)  
David Brown (Recreation Interests)  
Daniel Bulletts (Southern Paiute Consortium)  
Colleen Cunningham (NMISC)  
William Davis (CREDA)  
Laura Dye (CRC)  
Sinjin Eberle (American Rivers)  
Craig Ellsworth (WAPA)  
Mel Fegler (State of Wyoming)  
Charlie Ferrantelli (State of Wyoming)  
Clarence Fullard (Vice Chair and Reclamation)  
Michelle Garrison (CWCB)  
Emily Higuera (ADWR)  
Leslie James (CREDA)  
Kristen Johnson (AZDR)  
Dan Leavitt (USFWS)

Jakob Maase (Hopi Tribe)  
Ryan Mann (AZGFD)  
Scott McGettigan (Utah DWR)  
Betsy Morgan (Utah DWR)  
Christina Noftsker (State of New Mexico)  
Emily Omana Smith (NPS-GRCA)  
William "Bill" Persons (FFI/TU)  
Ben Reeder (GCRG)  
David Rogowski (AZGFD)  
Seth Shanahan (SNWA)  
Erik Skeie (State of Colorado)  
Erik Stanfield (Navajo Nation)  
Larry Stevens (GCWC)  
Gary Tallman (FFI/TU)  
Kirk Young (USFWS)  
Kerri Pedersen (Reclamation)

## USGS/GCMRC Staff

Lucas Bair  
Kate Behn  
Bridget Deemer  
Drew Eppehimer  
Helen Fairley  
Morgan Ford  
Ted Kennedy  
Anya Metcalfe

Michael Moran  
Joel Sankey  
Eric Scholl  
Laura Tennant  
Darrin Thome  
Scott VanderKooi  
Charles Yackulic

## Reclamation Staff

Amee Andreason  
Becki Bryant  
Kathy Callister  
Mike Horn  
Mark McKinstry  
Zachary Nelson

Heather Patno  
Jamescita Peshlakai  
Daniel Picard (Acting Designated Federal Officer)  
Robert Radtke  
Alex Walker

## Interested Persons

Jeff Arnold (NPS)  
Jan Balsom (NPS-GRCA)  
Cliff Barrett (UMPA)  
David Braun (Sound Science)  
Rod Buchanan (FFI/TU)  
Phaedra Budy (Utah State University)

Kevin Bulletts (Southern Paiute Consortium)  
Kelly Burke (GCWC)  
Shane Capron (WAPA)  
Julie Carter (AZGFD)  
Martina Dawley (Hualapai Tribe)  
John Dillon (Grand Canyon River Outfitters Assn.)

Sean Erickson (WAPA)  
 Sheri Farag (Salt River Project)  
 Bud Fazio (NPS)  
 Charlie Ferrantelli (State of Wyoming)  
 Barrett Friesen (Utah State University)  
 Kevin Garlick (UMPA)  
 Michelle Garrison (CWCB)  
 Alicyn Gitlin (Sierra Club)  
 Emily Halvorsen (State of Colorado)  
 Leslie James (CREDA)  
 Carliane Johnson (SeaJay Environmental)  
 John Jordan (FFI/TU)  
 Christina Kalavritinos (DOI)  
 Josh Korman (Ecometric Research)  
 Sara Larsen (Upper Colorado River Commission)  
 Brandon Loomis (Arizona Republic)  
 Jason Mayse (Salt River Project)  
 Kevin McAbee (USFWS)

Scott McGettigan (Utah DWR)  
 McKenna Murray (State of Utah)  
 Gerry Nealon  
 Amy Ostdiek (State of Colorado)  
 Michael Pillow (USFWS)  
 Sara Price (CRCN)  
 Ted Rampton (CREDA)  
 Shana Rapoport (CRBC)  
 Matt Rice (American Rivers)  
 Scott Rogers (AZGFD)  
 Amy Schott (NPS)  
 Gene Seagle (NPS)  
 Jim Stroger (FFI/TU)  
 Melissa Trammell (NPS)  
 Pilar Wolters-Rinker (USFWS)  
 Koreen Zelasko (USFWS)  
 Emily Zmak (CWCB)

### Acronyms and Abbreviations

oC	degrees Celsius	FLAHG	Flow Ad Hoc Group
ADWR	Arizona Dept. of Water Resources	FRN	Federal Register Notice
ARM	Annual Reporting Meeting	GCDAMP	Glen Canyon Dam Adaptive Management Program
AZGFD	Arizona Game and Fish Department	GCMRC	Grand Canyon Monitoring & Research Center
AMWG	Adaptive Management Work Group	GCRG	Grand Canyon River Guides
BO	Biological Opinion	GCWC	Grand Canyon Wildlands Council
BAHG	Budget Ad Hoc Group	GLCA	Glen Canyon National Recreation Area
CFS	cubic feet per second	GRCA	Grand Canyon National Park
CPUE	catch-per-unit effort	HFE	High Flow Experiment
CRBC	Colorado River Board of California	JCM	Juvenile Chub Monitoring
CREDA	Colorado River Energy Distributors Assn.	kaf	thousand acre-feet
CR	Continuing Resolution	LTEMP	Long-Term Experimental and Management Plan
CRBC	Colorado River Board of California	maf	million acre-feet
CRC	Colorado River Commission of Nevada	mm	millimeter
CRMMS	Colorado River Mid-term Modeling System	NEPA	National Environmental Policy Act
CWCB	Colorado Water Conservation Board	NMISC	New Mexico Interstate Stream Commission
D.O.	dissolved oxygen	NPS	National Park Service
DOI	U.S. Department of the Interior	PDT	Pacific Daylight Time
DROA	Drought Response Operations Agreement	PMP	Project Management Plan
DWR	(Utah) Department of Water Resources	PI Team	Planning & Implementation Team
EA	Environmental Assessment	Reclamation	Bureau of Reclamation
EIS	Environmental Impact Statement		
ESA	Endangered Species Act		
FFI	Fly Fishers International		

ROD	Record of Decision	TU	Trout Unlimited
SBAHG	Smallmouth Bass Ad Hoc Group	TWG	GCDAMP Technical Work Group
SCAHG	Steering Committee Ad Hoc Group	TWP	Triennial Work Plan
SMCAHG	Species of Management Concern Ad Hoc Group	UAMPS	Utah Associated Municipal Power Systems
SME	Subject Matter Expert	USFWS	U.S. Fish and Wildlife Service
SNWA	Southern Nevada Water Authority	USGS	U.S. Geological Survey
TMF	Trout Management Flows	USU	Utah State University
TRGD	Trout Recruitment and Growth Dynamics	WAPA	Western Area Power Administration
TSC	Technical Services Center	WY	Water Year
		YOY	young-of-year