Glen Canyon Dam Adaptive Management Program
Technical Work Group Meeting [via webinar]
June 23-24, 2020

Day 1: June 23, 2020
Start Time: 9:04 AM Pacific Daylight Time
Conducting: Seth Shanahan, Technical Work Group (TWG) Chair
Meeting Recorder: Carliane Johnson, SeaJay Environmental

Welcome and Administrative: Seth Shanahan, TWG Chair

- Introductions and Determination of Quorum: Quorum was met with 20 members present.

  [**Seth**] At the August AMWG meeting, we will have a remembrance for Charley Bulletts who passed away last week. He was a critical member of this group and a long-time representative for the Southern Paiute Consortium. [**Jan Balsom**] A traditional wake was held on Sunday. Many of us who spent time with Charley understood his passion and love for the Grand Canyon and to educate others. He was an important voice of this program. The work that he did as a member of this group was revolutionary in many ways. We are going to miss him.

  [**Theresa Pasqual**] *Last year, in 2019, Outside Magazine published a story titled, The Theft of Grand Staircase Escalante, in which Charley and the author discuss knowing who and where you come from. Charley stated, "With European Culture, it's pieces of paper that tell you who you are and where you come from – your birth certificate, your deed, or whatever. But for my people, tradition instructs us that once your baby's umbilical cord comes off, you have to put it under a [young] tree or an ant pile. That way your kid can be connected to a place." Connected to place. This described Charley's life... I hope your memories of him help anchor your work and anchor you in some way to the canyon and to the river that he loved. Journey well and swiftly, Charley. May the ancestors greet you; and may you continue to bless the river, the canyon, and the people that you loved the most.*

  A moment of silence was given in honor of Charley. Please share your stories and photographs in advance of the August AMWG.

- Adoption of Prior Meeting Minutes **[Document]** [**Lee Traynham**] Jim Strogen had requested a minor edit. The April TWG Meeting Minutes were adopted with this edit.

- Next Meeting Dates: October 14-15, 2020. In-person or webinar is still to be determined.

- Ad Hoc Group Membership and Updates **[Document]: [Seth Shanahan]** Members have received the Ad Hoc group list in their meeting materials. Any member of the TWG can be part of an Ad Hoc group, please let Seth know if you're interested in membership and/or leadership positions.

  (1) **Flow Ad Hoc Group [FLAHG] [Presentation]** [**Peggy Roefer**] The FLAGH reported that the Grand Canyon Monitoring and Research Center (GCMRC) has developed a hydrograph designed around maintenance scheduled for March 2021, during which flows will be 4,000 cubic feet per second (CFS) for about a week. The FLAHG would like to take advantage of this low flow period and follow it with higher flows to simulate a spring flood and monitor any resulting environmental changes. The FLAHG will need to

see projected effects from GCMRC before the hydrograph can be approved at the next meeting and recommended at the August AMWG meeting. There are potential scheduling conflicts for this spring hydrograph, such as generator availability for capacity flows and apron repair scheduling. If the hydrograph is approved, the FLAHG will work on monitoring needs and metrics.

Q/A: [**Seth Shanahan**] Do we have enough time to consider the status of specific resource information ahead of making the decision on whether to approve the hydrograph? If the FLAHG gets to a recommendation, the TWG is open to a special meeting to discuss. There is also talk about the AMWG having a special session if this item is not ready for the August agenda. It is important to be thorough in technical considerations in order to be able to provide the TWG with the full breadth of potential outcomes from this hydrograph.

[**Ben Reeder**] Is 4,000 CFS necessary for the apron repairs? Grateful this is not being planned during the motor season. [Peggy Roefer] Yes, the Bureau of Reclamation (Reclamation) is trying to do the work outside of the recreation season.

- **Update on Hydrology, Operations, and Reservoir/Release Conditions [Presentation]:** [**Heather Patno**] The projected Lake Powell inflow for Water Year 2020 is currently at 6.76 million acre feet, while the projected release is 8.23 million acre feet. In April, WY 2020 was the 10th driest year for inflows; by May it was the 13th driest. Observed precipitation has decreased significantly, which has decreased the forecast. The June Most Probable forecast is in line with what was projected as the April minimum probable. For WY 2020, Lake Powell elevations are expected to peak at approximately 3,612 feet. For water year 2021, Lake Powell is projected to operate in the Upper Elevation Balancing Tier. Given coronavirus concerns, we are working on a month-to-month basis to determine the future maintenance schedule for water year 2021, but we probably won't have all eight generating units available by March. There is no concern regarding Lake Powell water temperatures; the pattern is normal.

  Q/A: [**Peter Bungart**] What is the average annual water temperature through the various reaches? [**Seth Shanahan**] Various answers were provided in the chart regarding temperature for spawning and humpback chub. [**Brian Healy**] Twelve degrees or so are needed. [**Charles Yackulic**] The Little Colorado River (LCR) temperatures have been on the lower end for the last 15 years.

- **Update on Activities Impacted Due to COVID-19 Restrictions: Monitoring and Research Trips [Presentation – Table1, Table 2]: [Mike Moran]** The first mainstem fish monitoring for Arizona Game and Fish Department (AZGFD) in early April was canceled. The GCMRC Lees Ferry trip scheduled for early April just launched on June 19. The aquatic food base trip was postponed to early July. Another trip that was scheduled to leave on May 15 for cultural resources monitoring was launched on June 16. The second spring trip for mainstem monitoring was recently launched on June 21. Three trips are currently on the river. A few trips are scheduled for July. The first is GCMRC juvenile chub monitoring (JCM) on July 5.

Q/A: [**Leslie James**] Is the excessive heat warning issued through this Wednesday in the canyon having an impact on these trips? [**Mike Moran**] Would imagine they are experiencing that but have not heard there has been an impact. It is likely to be challenging under those conditions.

[**Larry Stevens**] What happens to the funding for cancelled trips? [**Mike Moran**] We are hoping we can move some of that funding forward to make up for lost information. It is uncertain.

[**Brian Healy**] Guidance from the National Park Service (NPS), which is evolving, is to limit administrative launches to two per week. GCMRC should update the NPS permits office with these proposed launches. [**Scott Vanderkooi**] Our logistics lead is coordinating with Grand Canyon National Park on the schedule and will adjust as needed. [**Mike Moran**] Yes, our launch schedule may be too optimistic. We will work with NPS on this.

- **Discussion About Possible Experimental and Management Actions That May be Implemented in the Next 12 Months and Any Budgeting Issues:**
  [**Lee Traynham**] We are currently implementing our third year of the Macroinvertebrate Production Flows experiment(or "bug flows"). In a week or so, we will enter the fall accounting period for sediment triggers (High Flow Experiment [HFE]). Reclamation will report out on that and provide updates on the maintenance schedule. Early next year, we will again consider and look for conditions for a spring HFE, Trout Management Flows (TMF) and Macroinvertebrate Production Flows, and the informal spring power plant capacity flow. Note that the spring power plant capacity flow is being planned in conjunction with the maintenance at the dam that requires a reduction of flows. No budget concerns yet. We won't know the fiscal year (FY) 2021 budget and funding status until we get direction and guidance in the Energy and Water appropriations bill, which is expected to be finalized by October 1. If it is not, we will likely be in a Continuing Resolution.

  [**Scott VanderKooi**] We will be watching conditions as they develop. The accounting period for HFE starts on July 1st and we will be ready for that. The bug flows experiment is ongoing. There have been questions about monitoring. We have started engaging our citizen scientists again. To help encourage enthusiasm for the experiment, we offered a small amount of money to get people to participate and anticipate extra samples this year. The guides are eager to participate. We are collaborating with NPS at Phantom Ranch for monitoring support. Also have a trip scheduled for next month.

  [**Ken Hyde**] We are still working on the funding paperwork for the brown trout incentivized harvest, but we will hold a kickoff event in October and then will start the rewards for brown trout heads.

  [**John Jordan**] Is this initial incentivized harvest still considered a research project? [**Ken Hyde**] Yes, that's correct, if it meets our goals to reduce the adult brown trout population, we will continue.

[**Rob Billerbeck**] I submitted language to Lee Traynham to revise the vegetation project based on comments from science advisors and the Budget Ad Hoc Group (BAHG) and am starting to pull together a more comprehensive document to address bigger concerns. **[Larry Stevens**] When there are conspicuous populations of nonnative plants along the river, do you have a mechanism for their removal? Is that part of the experimental work? Who would we report observations to and how would you remove those plants? [**Rob Billerbeck**] Absolutely yes, we would remove non-native plants. Lonnie Pilkington is now the point person for Grand Canyon National Park and he would know who can remove those plants. [**Larry Stevens**] What is update on the Paria Beach vegetation work? [**Ken Hyde**] Still waiting on final approval from AZGFD on the project and then kicking off the NEPA analysis and initial planning. That would remove one of the oldest and most dense stands of tamarisk on this part of the Colorado River and include revegetation of native plants. It is a heavily utilized area and will show the public the great restoration efforts on the river. [**Kelly Burke**] We are in the agreement process with the Arizona Water Protection Fund and it was all fully approved by the Commission. The last details are currently being worked out.

- **Updates on Items of Interest That Are in Consideration for Implementation Before Next TWG Meeting:** No comments.

TWG Chairperson and Vice Chairperson Election: Lee Traynham, Reclamation

[**Seth Shanahan**] If we can't get to consensus, there are opportunities to take a vote. We have 20 stakeholders represented on the call although four of them are Department of Interior (DOI) agencies that can't vote on agenda actions. A simple majority of nine stakeholders is needed.

[**Lee Traynham**] A huge thank you to Seth Shanahan and Vineetha Kartha for their service and accomplishments. An overview of position descriptions was provided and an open call for nominations was issued. [**Peggy Roefer**] Supports continuation of Seth Shanahan and Vineetha Kartha for Chair and Vice Chair. [**Larry Stevens**] Moved that Seth Shanahan be appointed to the position of chair and Vineetha Kartha to the position of vice chair to the Glen Canyon Dam Technical Work group for Fiscal Year 2021. [**Kevin Dahl**] Seconded. Motion passed.

Motion made by Larry Stevens, seconded by Kevin Dahl, and approved by consensus:

The TWG reappoints Seth Shanahan to the position of Chair and Vineetha Kartha to the position of Vice Chair to the Glen Canyon Dam Technical Work Group for Fiscal Year 2021.

An Overview of the 3rd Draft of the Triennial Work Plan (TWP) and Budget FY2021-2023: Lee Traynham, Reclamation [Presentation]

[**Seth Shanahan**] The second draft was received on May 18. The BAHG then met June 16-18. The third draft was received last night. These presentations depict changes made based on feedback from the members.

[Lee Traynham] We have formal guidance from DOI and Dr. Timothy Petty, Assistant Secretary for Water and Science, that this Program is to focus on implementing the Long-Term Experimental and Management Plan (LTEMP). Dr. Petty emphasized refining goals and metrics and to acknowledge other basin-wide efforts. There are also compliance obligations and ongoing litigation. Funding remains uncertain. In developing the budget, we assumed there would be a flat funding level of $11.36 million with 80/20 split between GCMRC and Reclamation. There have been many opportunities for stakeholders to engage and provide feedback on the budget and work plan. Reclamation projects A through D totals are close to the proposed FY21 budget of $2,272,000.

Q&A and Discussions

[**John Jordan**] Are the contingency funds in Table C actual dollars? [**Lee Traynham**] That money is actually available. There is a bit of balancing in that we want to have enough funds for insurance purposes, but the more we hold onto, the more challenging is becomes to justify addition annual funding needs.

[**Peggy Roefer**] Is there money in C.13 for the LTEMP models? Is D.7 the river guide that Charley developed? [**Lee Traynham**] Yes, funding in C.13 will allow Reclamation staff to better document the status of those models and determine needs for updates on validation or new tools. We may need to look for additional resources if we need to modernize those tools. This item is for coordination and a status update on those tools. Project D.7 is Charley's vision, but don't know if it relates to his prior work.

[Continued] An Overview of the 3rd Draft of the Triennial Work Plan and Budget FY2021-2023: Scott VanderKooi, U.S. Geological Survey (USGS) [Presentation]

[**Scott Vanderkooi**] The GCMRC budget is focused on the science monitoring and the LTEMP resource goals. There was a lot of feedback on the Streamflow, Water Quality and Sediment Transport project, which was unusual. The previous draft had proposed cutting funding for some of the tributary gages which received a lot of feedback and we have been working on this with collaborators. We found funding to cover a portion of the gages that were cut and we're still looking at other options. Some work associated with the Sandbar and Sediment Storage project is at a reduced level. Still struggling to find funding for elements 4 and 5 but are proposing to use experimental funds. Other proposals are tied to the experimental funds that would occur depending on whether certain conditions are met. Mixed responses were received for the Vegetation Management for Archaeological Sites project related to cultural program

history; it is being retained for now. The fourth element on geomorphic research is not being funded in this third draft. Vegetation mapping in the Controls on Ecosystem Productivity project would be proposed for funding from the experimental fund if there is a spring flow. Some work in the Aquatic Invertebrate Ecology project has been reduced. The springtime flow is proposed to be funded through experimental fund. Had hoped to get the new array installed last month for the Humpback Chub Population project, but it will need to be rescheduled for this fall. It was decided to do two more years of Juvenile Humpback Chub monitoring and then curtail that field work in FY23. Elements 8 and 9 were not funded. Had proposed to cut back some of the Salmonid Research and Monitoring work, but AZGFD was able to find ways to retain those trips while other project elements will be reduced, which will create limitations to track trout populations in Glen Canyon. Still planning to fund early life history of brown trout and modeling. Had proposed to cut back on some of the sampling and go to alternating years for the Warm-water Native and Non-Native Fish project, but along with AZGFD, they have come up with an alternative approach on the trips. The channel catfish element will be conducted instead with non-lethal methods and stable isotope analysis techniques will be tested. The Remote Sensing project has been preserved in the budget because it is important to detect long-term changes with overflights, which will be conducted around late May 2021. The Leadership Management and Support project covers salaries. The Lake Powell Water Quality project is not funded by the Glen Canyon Dam Adaptive Management Program (GCDAMP), but it is very important. This is a long-term effort to look at water quality and trends with data going back almost to the time the dam was built. That plan was revised based on comments received from stakeholders and from science advisors. GCMRC has developed written responses to all comments, which were distributed yesterday. Note there was an error in Project A, but a corrected version was sent by email today. The one big shift in budget from FY20 to FY21 is because of the overflights. Budgets for FY22-23 are similar with some slight up and down on funding. A large part of the overall funding is for salaries and to non-USGS cooperators.

Q&A and Discussions

[**Craig Ellsworth**] Have you added up all the anticipated costs to the experimental funds in your budget? [**Scott Vanderkooi**] Have not totaled up costs. Some projects are mutually exclusive so they would not all occur every year and some proposals would need to be considered, if conditions warrant them. [**Seth Shanahan**] It is almost guaranteed there are more projects than experimental funds.

[**Sinjin Eberle**] Which one of the stream gages has funding? [**Scott Vanderkooi**] One of them has funding. As to which one, this is a conversation we need to have. Kanab Creek is not a priority for GCMRC, but the USGS Toxics Program will cover operation costs and it will remain functional. That leaves two unfunded – which gage is a higher priority? GCMRC will also continue to be open to other funding sources.

[**Sinjin Eberle**] Is the vegetation project at risk of going away? [**Scott Vanderkooi**] Element D.1 is being retained because we think it is important for monitoring archaeological sites. Element D.3 is the one that we have gotten mixed responses. The importance of that work is up for discussion.

[**Kirk Young**] For Project H, will the reduction of the Trout Recruitment and Growth Dynamics (TRGD) project impact our ability to evaluate management actions? [**Charles Yackulic**] It will affect our precision to detect impacts. Most of the precision comes from mark/recapture work. We'll have less power to detect impacts with the decrease of that work by a third, but don't know by how much. Perhaps the confidence level will decrease by half.

[**Sinjin Eberle**] Are there sections of the predictive models that are geared toward the Interim Guidelines? [**Scott Vanderkooi**] Those elements of predictive modeling are focused on the resources of interest and understanding the effects of dam operations. That said, those modeling efforts can also be used to inform the Interim Guidelines.

[**Kirk Young**] With Project G, Juvenile Chub Monitoring (JCM)-West work, ending in 2022, will we understand the drivers that facilitated Western Grand Canyon humpback chub population growth? How critical is this? [**Charles Yackulic**] Based on JCM-East, we need 8-9 years to get at the drivers. In general, the smaller the effect, the more time is needed. We can continue to learn from other sources of data, but it would be slower. Think the brown trout modeling was the best we could do with the data we had. [**Melissa Trammel**] What is being traded in years 3 and 4 with the lack of the JCM-West study? [**Scott Vanderkooi**] We had to work our way down to a certain budget number. He assumes most of the decrease of $180,000 was from JCM-West. It was not any one thing that was traded. It was an incremental process of pulling things out. [**Brian Healy**] Does this mean the previous five years of work might be considered a wasted effort? [**Charles Yackulic**] Would not go that far. It gives us an understanding of basic survival and growth. Intensive mark/recapture is the "gold standard" of the data that would help us understand more. It is more of an opportunity lost.

[**Larry Stevens**] Is there a backup plan for FY21 if COVID restrictions continue or get worse? [**Scott Vanderkooi**] We are adapting as it evolves and are hopeful that we will be out there, but the last thing he wants is to put staff in danger. He is open to input from others.

[**Kirk Young**] Will project D.4 provide the value to the Hualapai that they might expect or is this a navigation problem? Maybe we can get overflight maps on those areas that are a problem? [**Paul Grams**] The basic question is what happens to the bed of the river in that reach when there is an HFE or power plant release or other? Does it temporarily scour, and if so, how much? If the bed does change during a flow event that affects boating, this is a management tool and this is the hypothesis. We need to measure this. We would use this data to build a model to try to predict what happens during flows and other conditions. This would also address the Hualapai's concerns. A one-time map of the reach is not a useful navigation aid

because it would be out of date within a few weeks. The purpose is to understand that reach, which is also responsive to the Hualapai's concerns, but the outcome may not change anything.

[**Leslie James**] There is a duplicate paragraph in Project N that is also in J.1 regarding regional economics. Also, references should be limited to hydropower. Recreational resources should be separate from J with hydropower in N. [**Lucas Blair**] Duplicate paragraphs are based on comments from the science advisor. He will either make them specific to hydropower or remove the text from Project N.

GCDAMP Triennial Budget and Work Plan Process Paper – Craig Ellsworth, WAPA [presentation]

[**Craig Ellsworth**] BAHG has held several meetings, the first of which were held before the first draft when early input was provided. The BAHG also met with science advisors at the first draft stage, which was very helpful to hear a third-party, technical point of view. A final meeting was held last week to discuss closing issues and a report back to the TWG. Meeting notes are on the Wiki site. The BAHG identified a number of outstanding issues in their last call, many of which were brought up today. There have also been written comments and discussions with other stakeholders that were not discussed on the BAHG call that are still important for GCMRC and Reclamation to think about.

[**Seth Shanahan**] It is not unusual for the BAHG to not have a recommendation for the TWG to consider. He understands how that happened. Much work was done by the BAHG in the development of the work plan with many items resolved.

Development of Budget Recommendation to the Adaptive Management Work Group (AMWG): TWG Members

[**Seth Shanahan**] This is an agenda action item and we hope to develop a consensus recommendation today although there might still be questions to resolve. Our goals are to: 1) reach consensus, and to 2) draft the language for that consensus item. Recommends a formal process of proposing a motion and then opening it up for discussion along with a list of revisions. [**Kevin Dahl**] Made the following motion. [**Larry Stevens**] Seconded.

Proposed motion: *The TWG recommends that the AMWG recommend for approval to the Secretary of Interior the Triennial Work Plan and Budget FY 2021-2023 as provided to the TWG on June 23, 2020 and as requested to be revised by the TWG during their meeting on June 23, 2020.*

Q&A and Discussions

[**John Jordan**] How are we going to approach this with the spring HFE and GCMRC identifying high value resources that are still missing in the work plan? Would like to have acknowledgment that these issues are still unresolved and we can continue to work on them.

[**Seth Shanahan**] Understand that folks are trying various ways to resolve this. The goal today is to list requested revisions that reflect concerns under which the budget could be approved with the expectation that the revisions will be included through a different process. [**Lee Traynham**] Agree with that. It is important to find the language that will specify the concern.

[**Kurt Dongoske**] Why should the TWG accept this third draft when it hasn't had time to review and comment? [**Seth Shanahan**] We have been working through a lot of revisions in real time. A schedule was set early on to get AMWG approval in early August. The third draft was always expected the day before this TWG meeting. Seth requested that the group consider the presentations and whether their points of concern were addressed in those presentations, which reflected what was changed between the second and third drafts. Were any key concerns not addressed that would prohibit us from reaching consensus? [**Craig Ellsworth**] A lot of things discussed on the last BAHG were cut and that's concerning to a lot of the members. There is hesitancy on how this will still meet the program's needs. [**Seth Shanahan**] He does not disagree, but the schedule forced Reclamation and GCMRC to resolve these issues in the third draft. If you have not heard your concerns addressed in the presentations, then this is what we need to hear now.

[**Ben Reeder**] Acknowledges the huge challenge to trim down this budget and recognizes the scientists who have had to do this. It is concerning from the Grand Canyon River Guides to see this shift of funding from the physical sciences to fish, especially to non-native studies. We also need to value and hear the Hualapai's concerns about the need to study the Western Grand Canyon.

[**Kirk Young**] Was there discussion on the Salmonid Project about combining AZGFD's Lees Ferry efforts with two TRGD sites instead of one? Quantitative information would be a priority given the planned management actions to address brown trout. There is a need to relate those two efforts. Should research proceed without an effective means to evaluate brown trout management actions? [**Scott Vanderkooi**] AZGFD has argued this is an important dataset to maintain. We have had discussions about how to better coordinate. [**Ryan Mann**] He had provided a comment on where there was overlap with the TRGD and where they were separate. They are answering different research questions. He is open to how he can help integrate those two programs, but there are definitely different sampling approaches. The TRGD project is an intensive mark/recapture sampling effort to get at growth and recruitment while the other is less intensive and broader in scope. It is his opinion these two programs are more complementary to each other rather than providing the same information.

[**Peter Bungart**] Between the first and second draft there was the provision to do data collection for B.6.5. Since that time, the Hualapai passed a resolution supporting B.4. He had heard from Scott Vanderkooi and Lee Traynham that some form of that project would still move forward. At this point, he would like clarification and certainty about how it will move

forward. The requested revision is to include the B.4 work element in the budget. [**Scott Vanderkooi**] B.6.5 is the proposal to collect data in the Western Canyon. That language was revised in the second version to include options for that work in the spring. In the current draft, we have not identified how to fund that modeling element that is in B.4. [**Paul Grams**] Thinks the cost of B.4 would be about $65,000 for each year of the budget. B.6.5 is the one-time field work component around the flow. That is why it is being proposed in the Experimental Fund and is separate. It could be a two-year project, but the plan was for all three years. The problem was that B.4 and B.5 would be somewhat complementary in which a post-doc would work on both projects. [**Scott Vanderkooi**] B.4 is about $58,000 for the first two years and $64,000 in year three. Does it matter what the timing is to do the B.4 portion of the project? For example, if we don't have an HFE until FY23? Can we wait to bring a person on later? [**Paul Grams**] The way the revised draft was written, we would do the field work around an HFE or a pulse flow, whichever occurs first. This gives us the ability to do it no matter what. Could probably cut down some of that first year because a post-doc would probably not start by this September.

[**Kevin Dahl and Leslie James**] Suggest a tradeoff at Havasu Creek and LCR at $17K each by cutting D.2 ($39K, $36K, and $54K) and D.3 ($28K, $29K and $0) and fund the LCR gages in B.1 ($17,000 each) as well as part of B.4. [**Scott Vanderkooi**] The challenge with this is almost all the funding for both elements is for the salary of the social scientist. We've redirected staff to other elements, but there has to be alignment with their expertise – this is the problem. If there is not support for element D.3, then that can be pulled, but it doesn't free up funds because it would involve redirecting staff to other work. [**David Topping**] If we partner with the Uranium project, Havasu Creek would likely be funded. We'd still be missing one of the LCR gauges.

[**Shane Capron**] Would like for the Project N text change to read, "modeling a change in the ramp rate to improve hydropower resources." [**Scott Vanderkooi**] Thinks "other resources" are mentioned there. Concerned about isolating this one particular project. [**Lucas Blair**] Had mentioned in the description that improving hydropower would be consistent with downstream resources.

[**John Jordan**] Requests including a project element for funding consistent with the FLAHG charge. This would utilize existing research and existing knowledge. A large part of this is a paper exercise to collect accumulated knowledge. [**Scott Vanderkooi**] There are at least four elements to look at potential springtime flows. [**John Jordan**] They are separated and are not coordinated. A spring HFE needs to be looked at as a whole. Those four projects should address it, but we need something to pull together the information. [**Seth Shanahan**] The FLAHG and other things take up a lot of staff time that should be in the budget. Can Scott develop a project with no budget because it has been found to get things done organically through staff time? [**Scott Vanderkooi**] We do have to be responsive and adapt to issues as they arise, but we do not want to add large unfunded mandates. He is concerned that many items are already funded at unrealistically low levels. Because the high flows are episodic, it makes complete sense to tie

those to the experimental funds. The other source of funding is to redirect staff time to another project. That might free up time, but there will be consequences to other projects. [**Vineetha Kartha**] Regarding the AMWG action item report, don't think it is appropriate for the TWG to further an AMWG charge. [**Lee Traynham**] In May, we closed out the action item with no objections from the group that the remaining items were to be addressed by the FLAHG. Agree that it is not appropriate for the TWG to set policy direction in the work plan. Appreciates the effort to find compromise and hears Vineetha's concerns. We need to be aware of that line. [**Seth Shanahan**] Can see that point. AMWG created a process (i.e., the FLAHG), and was not charged to approve the creation of unfunded mandates. This is where we might need staff to help. The TWG is advisory to AMWG and the AMWG is advisory to the Secretary. Let's not expect that everything we recommend will be accepted. We need to reach consensus and have some reasonable chance of our recommendations being accepted.

[**Seth Shanahan**] Made a request to revise Line 6 that would: "Remove Reclamation B.4, TWG Chair reimbursement [$25,000 for FY 2021]."

[**Craig Ellsworth**] What about trout monitoring and JCM-West? [**Kirk Young**] Still thinks TRGD is not prudent as proposed. He requested a revision for AZGFD and USGS to look at combining data needs and expanding TRGD, if possible. [**Ryan Mann**] From AZGFD's perspective, we would be supportive of including a second sampling site. Would probably need to work with GCMRC to address the sampling design cost if it is combined. [**Scott Vanderkooi**] The cost estimate of going from one TRGD site versus two sites may be about $67K. Given previous explanation regarding staffing, is there any reconsideration of proposal to cut D.2? That funding would just be shifted around. [**Kevin Dahl**] How you do staffing is not our concern, but if we don't have to balance, he is fine with taking it out. [**Seth Shanahan**] It merits keeping it in. [**Peter Bungart**] Maybe there is an option to reduce some of the effort in D.2? [**Kevin Dahl**] That is acceptable.

[**Leslie James**] Can it be assumed that the paragraph discussed with Lucas earlier today will be removed and doesn't need to be identified in this motion? [**Lucas**] Happy to consolidate that information just in Project J. [**Leslie James**] That is acceptable.

[**Kirk Young**] Can we consider JCM-West FY23 funding using COVID canceled trip savings? [**Scott Vanderkooi**] The current proposal is to use that funding for overflights in FY21.

[**Seth Shanahan**] It is clear we need more time. Vineetha will email the proposed revisions and the motion drafted to see if we can get to a recommendation in the morning.

Public Comments:

None.

Meeting adjourned at 3:45 PM PDT

Day 2: June 24, 2020
Start Time: 9:03 AM Pacific Daylight Time
Conducting: Seth Shanahan, Technical Work Group [TWG] Chair
Meeting Recorder: Carliane Johnson, SeaJay Environmental

Welcome and Administrative: Seth Shanahan, TWG Chair

- Introductions and Determination of Quorum (16 members). [**Seth Shanahan**] Met quorum with 17 members present.

- Unresolved Issues from Yesterday's Meeting. [**Seth Shanahan**] We are really close to consensus on the draft TWP. There is a proposed motion on the table, which was sent to everyone yesterday. A few non-substantive edits were made. Kirk Young also sent a request late yesterday that was added as Item #8 to "prioritize the use of available, unprogrammed and unspent funds from FY 2020, 2021 and 2022 towards funding GCMRC G.6 (JCM-West) in 2023." [**Peter Bungart**] Supports this. Can we pare back rainbow trout work to support other resources? [**Seth Shanahan**] Believe that might be what is happening when GCMRC is planning to sample in only a single reach rather than three. Does this reflect that de-prioritization? [**Scott Vanderkooi**] See Project H in the Work Plan. There is a substantial drop (close to a third) from FY21 to FY22. He also supports the suggestion for GCMRC and AZGFD to work together closely. [**Ryan Mann**] Can't think of sampling efforts on rainbow trout that doesn't gain information on brown trout. Probably no further reduction in data except for adjusting sampling location.

- No objections or requests for further discussion were received. Seth asked the TWG members to vote on the motion made by Kevin Dahl, seconded by Larry Stevens and amended per discussion. There was no opposition and the motion passed by consensus.

  The TWG recommends that the AMWG recommend for approval to the Secretary of the Interior the Triennial Work Plan and Budget FY 2021-2023 as provided to the TWG on June 23, 2020 and as requested to be revised by the TWG during their meeting on June 23 and 24, 2020. (full motion with amendments)

Monitoring for the Southwestern Willow Flycatcher and Yuma Ridgway's Rail in Glen and Grand Canyons: Greg Holm, NPS [Presentation]

[**Greg Holm**] This work is conducted as part of the LTEMP biological opinion which includes conservation measures to conduct Southwestern Willow flycatcher (SWFL) surveys once every two years and Yuma Ridgway's rail (YRRA) surveys once every three years. Most of this discussion is about SWFL. USFWS survey protocols require SWFL vocalizations at certain times of the day and during the season at each site. It is difficult to accomplish this with transportation on the river. We are starting conversations with USFWS on plans to become more efficient with the surveys or to use recording devices rather than physically being there. From Lees Ferry to Phantom Ranch, there's been a noticeable decrease in breeding pairs since the 1990s. From Diamond Creek to Pearce Ferry, those surveys have been inconsistent. Less

standing water in that reach has changed vegetation, which the SWFL need for nesting. Number of nestlings has declined.

There is very little data about numbers of SWFL prior to construction of Glen Canyon dam, but information suggests they were not common or successful breeders in the Colorado River system. Earlier studies in the 1980s typically detected a couple of breeding pairs each year. It was similar to data in the 1990s with typically 1-2 nests detected from Lees Ferry to Phantom Ranch, and maybe a few migrating through. Most of those early surveys were done by GCMRC and/or contractors and not NPS staff. In 2005, NPS started surveys from Lees Ferry to Phantom Ranch in which about one bird was detected each year. From 2010-2012, NPS started to follow the USFWS protocols (i.e., three per season) and to determine best habitat between Lee's Ferry and Pearce Ferry. Acoustical equipment was installed at the best sites. If SWFL were detected, a nest survey was conducted. A total of ten single detections were made those three years out of 25 sites surveyed. This indicates migrating birds are using the river habitat, but not nesting. Of the six recording devices, only one detected SWFL, but there had been technical difficulties with the equipment. They also assessed 46 sites for SWFL breeding habitats with ten considered suitable habitat, 20 as potential, and 16 as unsuitable that were removed from the list. In 2016, there was one targeted survey in Cardenas Marsh, but no SWFL were detected.

The first year the three surveys were started again was in 2019 as part of the Biological Opinion. Based on historical data and surveys, 17 sites with suitable or potential habitat were chosen to survey, but three sites were discarded because habitat had changed to unsuitable. No SWFL were detected. This downward trend in both migrating and breeding birds may be due to a combination of factors such as hydrological variability and tamarisk leaf beetle damage. The take home message is that the part of the Grand Canyon that flows through the park probably does not provide extensive stands of breeding habitat or consistent standing water that would provide source for prey. Park habitat will probably remain marginal compared to other areas where they thrive. Based on surveys from the past 40 years, SWFL seems to exist as widely dispersed populations that are not self-sustaining. At River Mile 275 on the right there is a spring and marsh that had a stand of willow and tamarisk. Unfortunately, in 2018 that entire stand caught fire and burned all the willow. This was probably the best habitat for SWFL along the river and it will need some time to recover.

For YRRA at river mile 275, the spring is where beavers have created three or four acres of marshland. This is the only spot NPS predicted YRRA might exist if they are in Grand Canyon National Park (GRCA). The USFWS YRRA protocols require two surveys. NPS surveyed six sites around that marsh, but no YRRA were found. Instead, they found Virginia rail, sora rail, and least bittern during the first survey, with only Virginia rail found during the second survey. This shows that marsh birds are using this habitat. NPS will continue the surveys. There is also a soundscape program at GRCA in which detectors were installed at the marsh in March 2020. These recordings will be analyzed to see if they can detect YRRA. GRCA does not have the kind of habitat that YRRA need except at River Mile 275. Surveys conducted in the Lake Mead Delta in 1996 and 1997 identified YRRA below Spencer Canyon. There is no good information about whether they were found in GRCA. Recent surveys conducted by NPS in 2019 were also

frustrating at River Mile 275 because of the helicopter traffic that starts early there, making it a challenge to hear the marsh birds.

Although not part of the biological opinion, NPS is also interested in yellow-billed cuckoos, which prefer willow habitat. There are recorders in Burnt Springs Canyon, but haven't analyzed that yet. Will do that when we have river missions past that area. That spot is also very busy with helicopters so the sounds will need to be teased out.

Q&A and Discussion

[**Kurt Dongoske**] Based on climate change and droughts, does that mean habitat for SWFL will no longer be available? [**Greg Holm**] It is problematic, but will probably continue to see them as long as there is tamarisk.

[**Craig Ellsworth**] Does NPS produce a monitoring report for Reclamation following these surveys? If so, where are they? [**Greg Holm**] SWFL information was sent to Reclamation. For YRRA, it might have only been a datasheet [**Lee Traynham**] Reclamation has received the data sheet, but no report, which is expected at the end of 2022. Lee will discuss an interim report with Greg.

[**Ben Reeder**] Any sign that willow habitat is replacing tamarisk that is being lost to the beetle? [**Greg Holm**] Have not seen this and does not see willow habitat expanding in the places where tamarisk is dying. [**Larry Stevens**] He sees no evidence of this either. Seep willow is becoming dominant, which is not suitable habitat for SWFL.

[**Charles Yackulic**] Have you looked at Jim Hatten's (geographer with USGS) range-wide habitat map to see if there are any other suitable patches in the Grand Canyon? [**Greg Holm**] He has not, but previous investigators might have. [**Larry Stevens**] There is likely suitable habitat along some of the perennial tributaries (e.g., Tapeats Creek).

[**Leslie James**] Are there formal letters of compliance provided by NPS or Reclamation? [**Lee Traynham**] Reclamation provides a synthesis of activities related to the Biological Opinion conservation measures to USFWS. Most recent summaries for 2018 and 2019 will go out soon.

A Review of the Modeling Procedures Used for Triggering High-Flow Experiments: Paul Grams, USGS [Presentation] and Jeremiah Drewel, Reclamation [Presentation]

[**Paul Grams**] The idea for the HFE protocol is to make the best use of sand over the course of "accounting periods" from July 1 to December 1 then from December 1 to June 30. The basic concept is tracking Paria River sand inputs. The objective of the two accounting periods is to build the sandbar while maintaining a positive sand mass balance, which is a relative measure (not an absolute amount) and depends on which period is being used. A mass balance over a long time (20 years) was used to evaluate the alternatives in LTEMP. This duration will be used to evaluate the results of the long-term experiment in sand storage.

For HFE implementation, a short accounting period is used as a practical matter over an annual period to coincide with most likely sediment inputs from the Paria River. The HFE design is

based on recent inputs, which are higher in the fall. LTEMP estimated that 26% of the years might trigger a spring HFE based on data going back to 1963. However, if we look at just the past 20 years, there might have been sufficient sediment only once since 1998. We can't explain why sand inputs are not consistent in spring and summer or if this is a permanent change.

What do we do about this? If there is a desire to shift the trigger or to have more spring HFEs, maybe we can merge the accounting periods into one. Then we could either have a decision point to do an HFE in the fall or wait until spring. We might evaluate certain conditions that would be better for a spring HFE. A single annual accounting period is also consistent with the approach adopted in the LTEMP. A back of the envelope estimation suggests about 300 metric tons of accumulation is needed to trigger an HFE. There was only one year in which this would have been a better choice to have waited until spring to do an HFE.

[**Jeremiah Drewel**] Before we can even start working with the model, we need to know the target date for initiating an HFE and then determine the facility's capacity for that week. This is how the HFE discharge curves are developed. The model will then determine the maximum duration of the HFE to achieve a positive sand mass balance. All sand data are on the GCMRC website. When the model is run, zero sediment input is assumed from that date to the end of the accounting period. We are not trying to forecast any sediment coming out of the Paria River because it is too variable. The projected Glen Canyon Dam release data are converted to hourly flow to anticipate the flow out of the dam through the end of the accounting period. The two model inputs are sediment and flow. This is then split into three different sediment categories: upper bound (Sed UB), zero bias (Sed ZB), and lower bound (Sed LB). The model is run three times for the ZB and UB scenarios. The model outputs five files, one of which is the sediment mass data to show which HFE should be triggered based on a positive sediment balance. For this spring, the model shows no HFE conditions will be met. There has been hardly any input from the Paria River from December to June.

[**Jim Strogen**] Would changing the accounting window allow for more frequent spring HFEs and can this be done within the constraints of LTEMP? [**Paul Grams**] Practically, we could do it, but management would have to determine if it would be compliant with LTEMP. [**Lee Traynham**] No, under the LTEMP protocol, the accounting periods are separate and that would not be consistent.

[**Craig Ellsworth**] Is channel mapping outside or below Marble Canyon viewed in the decision-making process? [**Paul Grams**] No, it will be used to evaluate the effect of doing this over many years. The LTEMP protocol was designed to result in a certain condition after 20 years.

[**Ben Reeder**] Is it possible to schedule future dam maintenance to allow HFE windows for both spring and fall opportunities? [**Lee Traynham**] Yes, our operators make every effort to be flexible with the maintenance schedule for the HFE windows. Some can't be moved around. They will accommodate experiments as much as possible.

[**Larry Stevens**] Since the LTEMP model is not consistent with spring HFEs to occur, do we need to adjust how closely we can match the natural hydrograph to correct this? A better logic might be to match sediment balance with springtime HFEs. Can we time a springtime HFE to minimize the loss of sand and still duplicate the timing of the hydrograph? It is in keeping with the LTEMP to try to do this. [**Paul Grams**] He does not say the model is not consistent with the purpose of LTEMP. One of the objectives is to test a spring HFE, but we won't get a trigger. We can design a protocol that makes sense for the sediment. It might not be as good as the fall, but it is certainly a way to come up with a balance to allow that to occur. [**Rob Billerbeck**] Where NPS started with LTEMP is believing that we stick more closely to a natural hydrograph, which was evaluated with the early models. Unfortunately, given the unnatural state of the dam, the natural pattern performed badly for sediment. We did not have any other model to determine effects on other resources. We chased that down extensively based on all the best available science and working closely with GCMRC with the sediment windows. There was still a lot of concern about the absolute sand mass balance. There was a lot of data at the time, so it was agreed to keep the sediment windows as they were. There were questions about the timing of the windows, but at that time, it was based on best available information, which suggested that spring HFEs would increase.

[**Jim Strogen**] Would spring HFEs have a positive impact on the channeling situation at the west end of the river? [**Paul Grams**] That's more of a research question about what might or might not have an impact. That is a hypothesis for any HFE. Maybe we can answer that better in the future.

[**Ben Reeder**] If the accounting period was to be addressed, what winter flows would be ideal to keep sediment in place at the Paria River for a spring flow? [**Paul Grams**] It would be a tradeoff. Steady low flows over the winter are probably unlikely. Would need to find a balance, if that is desired.

[**Craig Ellsworth**] LTEMP goals associated with sediment have more to do with the amount of sediment on beaches (about the 8,000 CFS level). If we are monitoring that, why should we also be monitoring how much sand is on the bed of the river via channel mapping, considering the expense of doing so (Project B.2)? [**Paul Grams**] The whole approach is predicated on having enough sand available. LTEMP is an experiment because we don't know the long-term trend of sand balance. Channel mapping would put us in a better place to know how to design the next flow plan. We need to know what flows are causing erosion or not. With both Projects A and B, we can then figure out when and where this erosion happens. A negative balance would mean a need to re-evaluate HFEs.

[**Larry Stevens**] We understand LTEMP is a political decision and how that was developed. LTEMP is facing a challenge. We requested a study of spring HFEs, not to conduct them as a management action. Now this is a task that no one wants to face. However, that does not make the concept wrong. If we can learn from this TWP and in future TWPs how to hold a full-scale HFE that puts us in a good position to conduct this as an experiment to learn about

appropriately timed spring flows. This is important for the life cycle of a river. How do we get there? [**Vineetha Kartha**] This is a conversation that both the TWG and AMWG need to have.

[**David Brown**] Doesn't channel mapping also provide detail on where the sediment is accumulating in the channel (for example, Kwagunt Rapid) and subsequently where that sediment may land after an HFE? [**Ryan Mann**] Is the sediment mapping integral to quantifying the sediment mass balance? [**Paul Grams**] Yes, it is integral to quantify mass balance on the long-term basis for evaluating LTEMP. It does tell us where sediment is accumulating.

The Importance of Springtime High Flows in Sustaining Invertebrate Communities: A Regional and National Assessment: Daren Carlisle, USGS [Presentation]

The USGS Water Quality Assessment program assesses spring flows and river ecosystem health (refer to the circular: *Flow Modification in the Nation's Streams and Rivers* for details). Modification of natural flows is among the top five in the list of problems that are reported by state agencies who manage water quality. A key relationship in flow regime is between biological integrity (Y axis on the model in the presentation) and natural streamflow (on the X axis). USGS has been working on defining these. Modeling is required to understand natural flow because we don't always have before/after knowledge from the flow modifications. Spring flow metrics (such as annual maximum daily flow) were used to determine how much the flow departs from natural conditions compared to the probability of an "impairment," which is defined as a biological community that has shifted due to human activities and is different from the regional reference conditions. The modeled natural conditions used data from about 1000 gages with long-term stream flow records. Generally, these are average conditions over a 10- to 15-year period, but the models can also show annual conditions. The biological data was pulled from National Rivers and Streams (NRSA) and National Water-Quality Assessment (NAWQA) sampling sites that were linked to gages with at least 10 years of stream flow data. This resulted in 700 gauged sites with invertebrate community information. Chemistry data and watershed features, such as urban land cover and riparian zones, were used as covariates.

A value of 1.00 on the X axis reflects natural flow. The model shows a dramatic increase in biological impairment (on the Y axis) once flows get below 50% of maximum observed/natural. The histograms show what this data look like going into the model. There is a lot of uncertainty, but once the value is below 0.5, there is an increase in invertebrate community impairment. The same patterns can be seen across the region (i.e., reduced spring flows result in increased community impairments). For the west, annual maximum flows occur in June around the Rockies, which is considered "spring" here. Spring flows are more or less the natural condition. There are also dramatic changes in water temperatures, which is an important cue for insect emergence. The vast majority of species have their emergence period in the spring. There is no smoking gun, but high spring flows, which are associated with warmer temperature and time of emergence, suggest they are important factors at both national and regional scales. The circular referenced (linked above) also has a chapter that talks about managed systems.

Q&A and Discussion

[**Larry Stevens**] Have you tested the serial discontinuity with impoundments? [**Daren Carlisle**] It is on the table but requires finding nested gages and biological data that match. We need to work on this next.

[**Scott Vanderkooi**] How are seasons defined? [**Daren Carlisle**] It is based on the meteorological season with spring being March, April, May. [**Larry Stevens**] That's relevant to us because our spring starts between the 6th and 9th of June. [**Daren Carlisle**] June is "spring" in the Rockies, too.

[**Jim Strogen**] What evidence have you found from other dammed locations? Are they in the same place as we are? [**Daren Carlisle**] Generally, the midwestern and eastern rivers are under U.S. Army Corps of Engineers' (USACE) flood control. They still have reduced spring flows but tend to release later in the summer when flows would naturally be low. This results in reduced spring and artificially high summer flows, which is not unlike what you get in the west. The USACE hedges their bets where they increase impoundments in the fall. That is probably similar in a lot of places.

[**Vineetha Kartha**] How was the composition of fish at the sites you were looking at? Were there non-natives and endangered species? [**Daren Carlisle**] This study was only with invertebrates. An electrofishing analysis was done that showed an overabundance of non-natives and losses of native species in highly modified systems. Also saw a shift to more general species that had no specific requirements for flow or habitat.

[**Jim Strogen**] I am hearing that it would be best to increase the bug life in the river and increase the ability to have more life events for springtime. Is that correct? [**Daren Carlisle**] Yes.

An Overview of the Grand Canyon River Guides' Adopt-a-Beach Program and a Discussion About How the Program May Help with Understanding the Status of the Recreational Experience and Sediment Resources: Ben Reeder, Grand Canyon River Guides [Presentation]

[**Ben Reeder**] Zeke Locke has led this program since 2005. This presentation is an overview of the program and how it can be used to track the LTEMP resource goals for recreational users. This is citizen science that is conducted before and after flows to track beaches over time and at different water levels. The volunteers are given cameras, instruction sheets, and data sheets. There are many reasons a beach might change over a season such as rain, wind, people, vegetation, daily fluctuating flows, etc. They also look at the quality of the beach with certain conditions noted. Instructions include how to replicate photos in the same places. Questions are then asked in the analysis about the changes and the reasons for that change. It has been found through the HFEs that sand can be piled up, but is it useable for recreation? This project helps when an HFE is needed and whether it will be effective for recreation. Some of the photos were used in 2018 to strongly recommend an HFE once a trigger was met. Ben wonders if a lower down ramp rate would help build beaches based on these observations. In February

2020, they started discussions with GCMRC to make the Adopt-A-Beach information available to everyone on GCMRC's website. The Grand Canyon River Guides would love to see a spring HFE.

[**Thomas Gushue**] We have an application that is similar to the Sandbar Remote Camera Photograph application that is specific to Adopt-A-Beach and is updated with recent photos. See: https://grandcanyon.usgs.gov/gisapps/adopt-a-beach/index.html.

[**Larry Stevens**] You have enough frequency of photographs to document rate of loss during summer months. Do you have enough over the winter to visualize this? [**Ben Reeder**] He and Zeke have been discussing this especially after an HFE with fresh deposits of sand and how to monitor over winter months when flows can mirror higher summer flows. Unfortunately, it is difficult to do with volunteers only working in summer. Zeke has a small sample from private winter trips and they are brainstorming on how to expand that dataset.

[**Jan Balsom**] Maybe we can expand this citizen science with other NPS programs? The Private Boaters Association (PBA) monitors for the NPS on the Colorado River Management Plan (CRMP), which is focused on recreational impacts. A campsite inventory is part of that program. NPS tries to coordinate as much as possible with the camera photography program, which is focused more on dam effects, but many of these are the same sites. There may be 600 sites in CRMP versus 200 in the GCMRC program. We need to try to get more efficient on data collections and not duplicate efforts. [**Ben Reeder**] That is a great idea. He will pass it on to Zeke to get in touch with PBA to sign up if they have a winter launch or after a fall HFE. Any winter trip would be useful. [**Seth Shanahan**] The CRMP should be an agenda item in the future.

[**Larry Stevens**] We have a lot of information on suspended sediment transport, but not much time has been spent on flotsam transport. Is this available? [**Ben Reeder**] There are many examples such as Sticks Camp that have photos of driftwood. There are probably a handful of different places like this. Maybe this is something to look at when the Flickr account is up.

[**Scott Vanderkooi**] Requested a link to the online application. This is similar to cameras with the 45 sandbar sites that has been developed over the last few years. It is a good resource for repeat photos.

[**Paul Grams**] He noted that one of the things in Project B.1 is an analysis to better integrate these Adopt-A-Beach observations to supplement annual monitoring.

[**Seth Shanahan**] Do you have confidence that the Adopt-A-Beach program can be revised or expanded to achieve these efficiencies? [**Paul Grams**] Think so. It probably depends on what you need to know. It is a broad, subjective measure other than "sandbar volume." We are then left with the question as to whether that metric can be used to assess the recreational goal, which is difficult to measure directly. The goal is to help bring those two aspects back together and understand their relationship. The type of efficiency depends on whether we want to redefine our objectives. [**Seth Shanahan**] Are there ways the program can measure the improvement of the quality of the recreational experience? [**Ben Reeder**] Zeke wants to keep some consistency on the datasheets for accurate comparison, but maybe we can ask about

other metrics. Some of the complaints that are heard from customers about camp sites often depends on what part of the canyon they are in. Where the canyon narrows, the sites will be smaller. Some of these places can be challenging to camp. Part of that question has to consider where they are in the canyon.

Lees Ferry Dissolved Oxygen Monitoring and Management: TWG Members Discussion with a presentation by Bridget Deemer: *Metalimnion low dissolved oxygen events in Lake Powell and their transport downstream*

[**Bridget Deemer**] What controls dissolved oxygen (DO) is a density boundary layer that forms due to temperature (called metalimnion or thermocline) and is affected by nutrient loading due to decomposition. There is also chemical oxygen demand from large sediment inflow events. At different temperatures, certain levels of DO can be lethal for trout. We care about these low DO zones because advection or movement occurs from large sediment inflows plus high production that is pulled across the lake faster than it can mix with the reservoirs. One consequence of this is that the plume of low DO water has higher temperatures that can compound the concern for fish. The combination of gas exchange and primary production is elevating downstream temperatures. This has been identified as a significant concern to rainbow trout. This tends to happen when lake levels are low, but that is not the only predictor. The CE-QUAL model does a good job of predicating low DO events, but not the penstock heights of these event. Quarterly trips and monthly samplings are done, but there is no early warning system. Sonde data are now available on the GCMRC data portal and it is hoped to get this to the stakeholder group. A proposal was also submitted to the USGS/NPS Water Quality program to get real-time information. This could be really powerful for Lake Powell if we could get a site that is upstream of Wahweap in which we might be able to see this plume coming. It would require a significant amount of someone's time and the sensor would need to be kept at a certain depth.

Q&A and Discussion

[**Peggy Roefer**] Would a string or sonde be useful? [**Bridget Deemer**] A string at the dam would be helpful for predicative purposes. For early warning, you would need one DO sensor farther up reservoir to see the plume before it arrives at the dam. It depends on what your goal is. The CE-QUAL model gives a maximum of the low DO zone, but it does not give height at which the low DO will arrive at the penstock. That is the one unknown in which we won't know if it will be a problem for the outlet water or not.

[**Jim Strogen**] How far downstream from the dam would low DO be a problem? [**Bridget Deemer**] A big part is due to algal production. At 8-mile site, algal production is elevating DO in the middle of the day, but there is still low DO at night that is similar to what is coming off the dam.

[**Craig Ellsworth**] When do you expect the sonde below the dam to be online? [**Bridget Deemer**] If this were normal times, we would be close by now. The next step is putting an electrical outlet at the dam. That has been ordered, but don't know when it will be installed.

[**Tom Gushue**] Trying hard to get field work done. We have the components to put in right above the jet tubes. We might need help with that coordination to get the work scheduled. We need 1-2 site visits with USGS staff. Could use help with that. The impetus for this is the low DO that typically occurs in the fall.

[**Seth Shanahan**] Who has the responsibility to report to the TWG if a low DO is coming? [**Scott Vanderkooi**] Working to getting the instrumentation in place and online in real-time so people can be watching for this. Happy to discuss reporting to the TWG. GCMRC often reports on various conditions. Also developing systems to make this easier to report. [**Lee Traynham**] Reclamation is committed to report as frequently as possible such as with Heather's operational updates. [**Jeremiah Drewel**] Usually in quarterly trips we can see this plume. Currently, we are not doing quarterly trips so that information is now less available.

[**Leslie James**] What would be done if a plume coming? [**Jim Strogen**] The simplest would be a series of bubblers below the dam. Would that do it? [**Bridget Deemer**] That is a common solution. Can use regular air or compressed oxygen, which would be more efficient. Don't know what would be needed in this system. [**Seth Shanahan**] A bubbler might be a series of flexible tubes or pipes at different depths and air or oxygen is injected. Is that it? [**Bridget Deemer**] Someone looked into this already. SolarBee uses solar power to pump surface water to the bottom. It would not work for our system. There are also compressed oxygen tanks. [**Peggy Roefer**] The Technical Service Center (TSC) should look into these systems. [**Ryan Mann**] Are those systems typically used on lakes and reservoirs and could they be adapted to a river system? [**Bridget Deemer**] She is more familiar with them on lakes where surface water has more oxygen. That's not the case here. [**Scott Vanderkooi**] There are many ways to aerate. The challenge here is the scale with a large river and relatively high flows to determine whether you can use air or other methods. It's not impossible to do.

[**Bill Davis**] During an HFE, is water being drawn from deeper water? If that's the case, are we exacerbating the low DO condition by doing HFEs in the fall? Do we know what the effect is of low DO on invertebrates? [**Bridget Deemer**] No, the bypass tubes are very good oxygenators. There is a paper on this elevated DO during HFEs. Not sure about effect of low DO on invertebrates. [**Ryan Mann**] Think there are concerns about this, but don't know if it's the same as it is on fish communities. [**Scott Vanderkooi**] At low levels, low DO could be a concern for some but not all invertebrates. This is mitigated as you move downstream. It is really only a problem at the dam.

[**Seth Shanahan**] Should the TSC be involved? [**Lee Traynham**] That expertise does not come for free. It is a great suggestion. A number of folks at TSC are interested in looking at this, but they need more clarity on scope and what we want. It is hard to come up with meaningful mitigation unless we have the monitoring in place with respect to risk. Are we in a good spot in our understanding of the monitoring and risk assessment? [**Clarence Fullard**] Will start these discussions with the TSC and Dr. Mike Horn. There are some unknowns to discuss with the TSC.

[**Seth Shanahan**] How much more confidence would additional monitoring give us? We are not meeting again until October. Given what is known now, should we expect a concern this fall and

how confident are you in that? [**Bridget Deemer**] Haven't yet looked at the abbreviated quarterly trip and don't know if it was enough to run the CE-QUAL model. Biggest uncertainty is whether the low DO can reach the penstock height. [**Jeremiah Drewel**] Probably don't have enough data, but we might be able to piece together enough to determine the inflows. The model results won't be as confident as if we had data from a normal quarterly trip. [**Ryan Mann**] We know based on previous events and reports from anglers that there are concerns on fisheries. One thing that's missing is how far down from the dam the low DO levels will persist and what is the effect to the trout fishery? A sonde downstream might help determine those impacts. That is an important piece. [**Bridget Deemer**] We do have a good understanding of how DO mixes below the dam from the three sondes. We just don't know how that reflects on fish physiology on the diel pattern with low DO at night and then high DO during the day. Our models can integrate how that oxygen is mixing and moving in the river. [**Ryan Mann**] It also depends on the temperature from the dam that complicates that issue. The risk is there for a catastrophic potential effect. [**Bridget Deemer**] Yes, we don't have a sense of those microhabitats. It can vary a lot from the main channel.

[**Charles Yackulic**] How dependent is this on ecosystem respiration? The other way to look at it is that the vegetation community is contributing to depressing DO levels at night. If you had a disturbance event in the spring or summer, you would clear out that material and have lower DO. Don't know if that's trivial or not. [**Bridget Deemer**] Think that's based on the 2012 paper. It is a good point. [**Scott Vanderkooi**] It did not appear that inflows were on the same order as 2019 so this condition is less likely. Temperatures were also projected in the river to be relatively low compared to last year when they were warm. What matters is how low does DO go? It seems less likely this year than last year to affect trout. [**Seth Shanahan**] Hearing options that we need to improve DO and our monitoring capacity to know when it might be a problem. Other controlling factor we might consider is vegetation. Next step is to hear back from Reclamation about what they are advancing with the TSC and then hear from the technical staff on options.

Emerging Issues

[**Seth Shanahan**] Would like to have Reclamation and USGS report back regarding monitoring and mitigation for a low DO event. Request Jan's colleagues at NPS provide information about CRMP. Would appreciate Ben, Zeke, and GCMRC's feedback on whether or not the Adopt-A-Beach surveys could be expanded to support existing programs. An improvement to Heather's presentation with temperature and DO would be to add thresholds for humpback chub as a reminder about whether we might be having a problem.

[**Vineetha Kartha**] There were questions during the modeling and flycatcher presentations. Can we have a discussion on the impacts of spring HFEs on these resources? [**Larry Stevens**] Comments that had been sent in about HFEs suggested we have a full-day brainstorming about what we do and don't know. [**Cliff Barrett**] We also need to consider the timing on the value of power production. There are different impacts depending on whether it is a spring or fall HFE.

[**Larry Stevens**] It might be useful to have a review of Ted Kennedy's recent publication on mercury production. [**Jim Strogen**] Also for uranium mining around Grand Canyon. Do we have information on water flowing through the Grand Canyon?

[**Lee Traynham**] We should be wrapping up the Administrative History project this fall so maybe the Ad Hoc group can report out on that product. [**Larry Stevens**] Would be happy to pursue that.

Public Comment

[**Alicyn Gitlin**] This is in reference to Rob Billerbeck's comments about procedural problems with the LTEMP analysis and that the naturally patterned flow alternative was not analyzed with public input. This was only discussed behind closed doors and the Sierra Club did not get a chance to review that. Our comments were never part of the LTEMP analysis. It is interesting to see those comments coming up now. She is happy to see these items being brought to the table.

Closing Comments

[**Seth Shanahan**] We are an adaptive program and we are learning and integrating as we go. He appreciates the presentations and dialogue. The final budget recommendation will come out on July 29. That will give the AMWG time to review and provide a recommendation to the Secretary.

[**Scott Vanderkooi**] Within USGS this summer, there might be shifts in leadership position. David Lytle is starting a detail at USGS headquarters. Scott will be serving as acting director starting on Monday and through the end of the fiscal year. Joel Sankey will be serving as acting GCMRC chief.

[**Seth Shanahan**] In remembering and honoring Charley Bulletts, please support his family with cards and letters. Follow up with Theresa if you need the family's contact information. Seth is going to miss his involvement and friendship.

Meeting adjourned at 2:25 PM PDT

Meeting Attendees Day 1

TWG Members/Alternates Present

Jan Balsom, National Park Service (NPS), Grand Canyon National Park (GRCA)
Clifford Barrett, Utah Municipal Power Agency (UMPA)
David Brown, Grand Canyon River Guides (GCRG)
Kelly Burke, Grand Canyons Wildlands Council (GCWC) (Alternate)
Shane Capron, Western Area Power Administration (WAPA)
Kevin Dahl, National Parks Conservation Association (NPCA)
Bill Davis, Colorado River Energy Distributors Association (CREDA)
Kurt Dongoske, Pueblo of Zuni
Craig Ellsworth, WAPA (Alternate)
Charlie Ferrantelli, State of Wyoming (Alternate)
Michelle Garrison, Colorado Water Conservation Board (CWCB)
Jessica Gwinn, U.S. Fish and Wildlife Service (USFWS) (Alternate)
Paul Harms, New Mexico Interstate Stream Commission
Brian Healy, NPS, GRCA (Alternate)
Ken Hyde, NPS, Glen Canyon National Recreational Area (GLCA)
Leslie James, CREDA
Vineetha Kartha, Arizona Department of Water Resources (ADWR)
Jakob Maase, Hopi Tribe
Ryan Mann, Arizona Game and Fish Department (AZGFD)
Craig McGinnis, ADWR (Alternate)
Jessica Neuwerth, Colorado River Board of California (CRBC) (Alternate)
Bill Persons, International Federation of Fly Fishers (FFI)/Trout Unlimited (Alternate)
Ben Reeder, Grand Canyon River Guides
Peggy Roefer, Colorado River Commission of Nevada (CRCN)
Seth Shanahan, Southern Nevada Water Authority (SNWA)
Larry Stevens, GCWC
Lee Traynham, Bureau of Reclamation (Reclamation)
Steve Wolff, State of Wyoming
Kirk Young, USFWS

United States Geological Survey (USGS)/Grand Canyon Monitoring and Research Center (GCMRC)

Lucas Bair
Ann-Marie Bringhurst
Kim Dibble
Paul Grams
Thomas Gushue
Meredith Hartwell
Mike Moran
Emily Palmquist
David Topping
Scott VanderKooi
Charles Yackulic

U.S. Bureau of Reclamation (Reclamation)

Tara Ashby
Kathy Callister
Clarence Fullard
Heather Patno
Kerri Pedersen

Interested Persons

Peter Bungart, Hualapai Tribe
Richard Begay, Navajo Nation
Rob Billerbeck, NPS
Martina Dawley, Hualapai Tribe
Sinjin Eberle, American Rivers
Ed Gerak, CREDA
Amy Haas, Upper Colorado River Commission (UCRC)
Jeff Humphrey, USFWS
Carliane Johnson, SeaJay Environmental
John Jordan, FFI/Trout Unlimited
Sarah Larsen, UCRC
Scott McGettigan, State of Utah
Emily Omana Smith, NPS, GRCA
Amy Ostdiek, State of Colorado
Theresa Pasqual, DOI Tribal Liaison
Billy Shott, NPS, GLCA
Erik Skeie, State of Colorado
Melissa Trammel, USFWS
Mary Ellen Walsh, Arizona State Historic Preservation Office (SHPO)

Meeting Attendees Day 2

TWG Members/Alternates Present

Jan Balsom, NPS, GRCA
Clifford Barrett, UMPA
Shane Capron, WAPA
Kevin Dahl, NPCA
Kurt Dongoske, Pueblo of Zuni
Bill Davis, CREDA
Kurt Dongoske, Pueblo of Zuni
Craig Ellsworth, WAPA (Alternate)
Charlie Ferrantelli, State of Wyoming (Alternate)
Michelle Garrison, CWCB
Paul Harms, New Mexico Interstate Stream Commission
Brian Healy, NPS, GRCA (Alternate)
Leslie James, CREDA
Vineetha Kartha, ADWR
Jakob Maase, Hopi Tribe
Ryan Mann, AZGFD
Craig McGinnis, ADWR (Alternate)
Jessica Neuwerth, CRBC (Alternate)
Bill Persons, FFI)/Trout Unlimited (Alternate)
Ben Reeder, GCRG
Peggy Roefer, CRCN
Seth Shanahan, SNWA
Larry Stevens, GCWC
Jim Strogen, FFI/Trout Unlimited
Lee Traynham, Reclamation
Steve Wolff, State of Wyoming
Kirk Young, USFWS

USGS/GCMRC

Lucas Bair
Daren Carlisle
Paul Grams
Thomas Gushue
Mike Moran
Emily Palmquist
Scott VanderKooi
Charles Yackulic

Reclamation

Tara Ashby
Kathy Callister
Jeremiah Drewel
Clarence Fullard
Kerri Pedersen
Robert Radtke

Interested Persons

Peter Bungart, Hualapai Tribe
Richard Begay, Navajo Nation
Rob Billerbeck, NPS
Sinjin Eberle, American Rivers
Alicyn Gitlin, Sierra Club
Greg Holm, NPS, GRCA
Jeff Humphrey, USFWS
Carliane Johnson, SeaJay Environmental
John Jordan, FFI/Trout Unlimited
Sarah Larsen, Upper Colorado River Commission (UCRC)
Scott McGettigan, State of Utah
Nic Medley, New Mexico Interstate Stream Commission
Emily Omana Smith, NPS, GRCA
Amy Ostdiek, State of Colorado
Theresa Pasqual, DOI Tribal Liaison
Gene Seagle, NPS
Erik Skeie, State of Colorado
Melissa Trammel, USFWS
Mary Ellen Walsh, Arizona SHPO

Abbreviations

ADWR – Arizona Department of Water Resources
AMWG – Adaptive Management Work Group
AZGFD – Arizona Game and Fish Department
BAHG – Budget Ad Hoc Group
CFS – cubic feet per second
CRBC – Colorado River Board of California
CRMP – Colorado River Management Plan
CRCN – Colorado River Commission of Nevada
CREDA – Colorado River Energy Distributors Association
CWCB – Colorado Water Conservation Board
DO – Dissolved Oxygen
DOI – U.S. Department of the Interior
FFI –Fly Fishers International
FLAHG – Flow Ad Hoc Group
FY – Fiscal Year (October 1 – September 30)
GCDAMP - Glen Canyon Dam Adaptive Management Program
GCMRC – Grand Canyon Monitoring and Research Center
GRCA – Grand Canyon National Park
GCRG – Grand Canyon River Guides
GCWC – Grand Canyon Wildlands Council
GLCA – Glen Canyon National Recreational Area
HFE – High Flow Experiment
JCM – Juvenile Chub Monitoring
LCR – Little Colorado River
LTEMP – Long-Term Experimental and Management Plan
NAWQA –National Water-Quality Assessment
NPS – National Park Service
NRSA - National Rivers and Streams Assessment
PBA – Private Boaters Association
Reclamation – Bureau of Reclamation
ROD – Record of Decision
YRRA –Yuma Ridgeway's Rail
SED LB – sediment lower bound
SED UB – sediment upper bound
SED ZB – sediment zero bias
SHPO – State Historic Preservation Office
SWFL – Southwestern Willow Flycatcher
TRGD – Trout Recruitment and Growth Dynamics
TMF – Trout Management Flows
TSC – Technical Service Center
TWG – Technical Work Group
TWP – Triennial Workplan
UMPA – Utah Municipal Power Agency
UCRC – Upper Colorado River Commission
USACE – U.S. Army Corps of Engineers
USFWS – United States Fish & Wildlife Service
USGS – United States Geological Survey
WAPA – Western Area Power Administration