Identify commenter, identify policy/technical

BAHG RECOMMENDATION TO TWG?

**Comments from BAHG discussion (from Thursday April 16, TWG meeting)**

* Jordan - Resend the BAHG call information
* Leslie James - Format for the BAHG call is very helpful to use our time on the calls. BO conservation measures and PA requirements, offered by the federal agencies is appropriate. Almost every project links to the BO or the PA. Helpful if there was clear guidance on what is required of the BO and PA. It would be great to have this information for the BAHG calls. (*Craig E* -*Description of the PA conservation measure. Scalability is an issue. Wide range of activities that meets some requirements. Valid comment)*
* Scott V - Look to USFWS for guidance on conservation measures. Want to be clear about what resource goals we are trying to inform. The role of the science program in prioritizing the work that is done. It is the job of the stakeholders, DOI to prioritize what is important. (*Craig E - Need to hear from PIs this study is really imp to finish. Couple of projects are in a category where they are in the middle of experiments. Need to inform stakeholders how important those experiments are)(Seth - Challenge the stakeholders have is how much of one activity vs. another is the most urgent for us to focus on)*
* Cliff Barrett - Issue of prioritization is really important. Bottomline is people really responsible for this program are fed agencies. need to have them let us know what is most important. What is needed to meet the BO, PA, ROD etc.
	+ *Lee T -Balance between guidance documents (Petty Memo, etc.), implement ROD, general goals, At the same time, Fed agencies will prioritize compliance with various items (BO, PA, ROD, GCPA, NHPA etc.). Some are more prescriptive than the others. Hear the request. Will have the fed agencies weigh in. Need to capture this group’s recommendations as well. “Fine line to walk”.*
* Larry- Urge to revise ecosystem model, to have context for larger discussion
* Billerbeck- Lee laid out priorities and gray areas. BO, environmental commitments in the ROD, experiments are pretty easy to look at as high priorities. Need to tease out beyond that. Changing status of things like BRT, key values that we are trying to protect are at risk, that needs to be a priority. “What are the critical things where we can’t follow through on ROD commitments, experiments and avoiding major threats; and what are ‘nice to haves’?”
* Gwinn - Mirror what Lee and Rob said. Designed the BO in an adaptive management framework.
	+ Want to manage for threats (BRT, etc.), and to hear from this group on priorities. Want to be “meeting but not over-meeting” responsibilities in the BO.

**OVERARCHING/OTHER COMMENTS**

* The proposed GCMRC side of the TWP is $2 Million over budget. Additionally, there has been discussion of starting in 2023, sustainable level of funding from power revenues for the GCDAMP may be closer to ~$10M. How does GCMRC (and Reclamation) plan on prioritizing funding for this and future work plans?
	+ Total AMP funding:
		- 2018: $11,025,363
		- 2019: $11,135,709
		- 2020: $11,247,066
		- 2021: $13,258,000
		- 2022: $13,268,000
		- 2023: $13,520,000
* What monitoring needs to be done every year? Can the frequency of monitoring for some projects be tied to the durational length of the associated experiment?
	+ Experiment runs for 1-3 years: monitor every year
	+ Experiment runs for 4-10 years: monitor every other year
	+ Experiment runs for 11-20 years: monitor every three years

**Comments from Wednesday April 14th**

* Jim Strogen - No funds allocated for temperature control device work or for invasive species pass through the dam controls in the BOR budget. These are both important control measures (including a mechanism to mediate for Dissolved Oxygen). I think it is important to include funding for these efforts in this 3 year budget.
* Jim Strogen - With the COVID shutdown of trips, etc, what happens to those funds?
* BOR- Need legislative action every year to determine how this program is funded.In 2020, funded by hydropower revenues. Usually hydropower revenues are around 21.4 m. Potentially beginning as soon as FY 2023, there is a potential for these revenues to be reduced to 12.4 m per year. There is uncertainty about how these funds will be divvied up. Will need to think in the current cycle, how this program will handle a cut.
* Peggy - No budget for foodbase augmentation.(Scott- *Significant challenges here. To have an effect in such a large river system is a big challenge.Charles Y - It has been done in some large Rivers in the Pacific NW. But question is Where do we want it , at what distance do we want it)*
* Kurt Dongoske - When does Reclamation plan on consulting with the Advisory Council on Historic Preservation and the Arizona State Historic Preservation Officer regarding the adequacy of the proposed triennial work plan to meet Reclamation's compliance responsibility with the 2017 PA?
	+ Lee- *We’ve been in touch with AZ SHPO office, in-person PHX meeting would’ve included a representative from the SHPO. Expecting to schedule a follow-up discussion. Waiting for full doc to share, getting things in place in the meantime.*
* Bill - (*RM 277 is where Lake Mead boundary is at*). Research that is being done is up to Grand Wash cliffs. Study would be upstream from Grand Wash cliffs.
	+ Kelly- Looking at the map, border looks to be ~RM280. How does that boundary relate to Program scope?
		- Jan- *Not sure how W. end sediment actions would be outside the Program.*
* Jim (for Lee on C9&10)- What about BOR work? Know there’s crowdsourcing, but mitigation for temp/DO & invasive passthrough needs to happen: is that foreseeable in this budget?
	+ Lee- *Nothing to implement yet, but opportunities exist for case-by-case analysis in a cost-effective manner. Need to be ready to evaluate alternatives.*
* Strogen - Dissolved Oxygen is a critical issue. Is there a mitigation plan in place?
	+ Lee- *To date, BOR is not presently looking at operations-involved mitigation, but could be up for discussion if interest exists in the Program*
	+ *Magnitude of low DO levels are going to be much worse with low reservoir levels*
	+ *Glen Canyon NRA has offered to help fund a water monitoring platform that would uplink to a satellite and give real time readings. USGS and BOR would need to help with ongoing maintenance and may consider putting an additional platform on the lake so we can track a low DO plume.*
* Reeder- Haven’t heard any discussion of proposed sediment project; testing slower down-ramping rates of HFEs to see if lower-sloping beaches erode slower. Should be a low cost project.
	+ Grams- Could work in a study. Could certainly do it as an experiment, will need discussion with manipulating hydrographs.
		- Jan- *Recall looking at ramp rates, comes up in LTEMP and whenever we talk HFEs.* “it’s fluctuations not ramping rate that affect rate of erosion”
	+ Jim- Is there a way to be more efficient with time and money on HFEs if positive effects could last longer (and more usable)? Would like to see it on project list
* Scott- What are your priorities, etc.? What do we *need* to do, but not necessarily as frequently as during the past.
	+ Lee- *asks that if folks are suggesting new/additional item, please consider tradeoffs that would have to be made (more important than, etc.)*
* Strogen (for Scott)- H4 salmonid monitoring, HBC models talk about interaction with rainbows, but does not touch BNT. Is that due to lack of data, or do we anticipate including BNT in those studies?
	+ Scott- *we want to beef up BNT modeling and use gained knowledge to better understand them. RBT based on data from LCR confluence, and BNT are thankfully scarce there*
		- “At what point do BNT start out-migrating from the Ferry?” something to consider as part of the monitoring
* Erik- Would you mind going over the large increase in USGS Burden between FY21 and 22 again?
	+ Scott- *we lease building from City of Flagstaff, who determined that it is past useful lifespan. Working to get a new building for GCMRC, directly correlates to costs of the new building.*
* Strogen (F5)- relating to Peggy and FLAHG charge, seems like wording in F5 supports need for Spring HFE, being biologically good for the system. But studying doesn’t seem to be in near future. Charge was “ways to have GCMRC to get us to that point”
	+ Scott- *we had participated in those FLAHG calls. As we’ve considered, we’re asked to think about what might be done in lieu of routine Spring High Flows. Idea of power plant flows came up. Recognizing constraints (25 kcfs), seems a bit skeptical that the level is enough for certainty of potential effects. If maintenance flow occurs, and if we could ramp it up to (30+)? kcfs*
* Kelly - Wanted to understand why we couldn’t go over 25 kcfs

**Comments from Thursday April 16th**

* Strogen - In terms of available money in this time of reduced budgets, what is the possibility of using the Native Fish Conservation Contingency Fund for projects in G and I for example? Could you explain the rollover ability of those funds and what it can be spent on?
	+ Lee- *NFCCD consists of mostly carry-over funds, with various remaining funds rolled into here. Balance ~$1.7m, “emergency insurance fund”. If the TWG makes a recommendation about utilizing those funds, we can discuss that*
	+ Scott- *For history, we have tapped into fund in the past for similar reasons. The way we justified in the past is that they’ve been to benefit of HBC; caution for sake of preservation of the Fund. Use Experimental Fund first?*
* Capron - Struggling with the process. $2m over budget. How are we going to cut to get within budget? Order of operations, how are we doing this, does it make sense, how are we planning to cut this large amount of money? Task as a group in the discussion is to reach consensus, but also to keep in mind that we need to cut roughly $2m each year.
	+ Seth- *Order presented as such with intention of identifying points of disagreement, but also ones to reach agreement over reduction in effort towards that item. Specificity is appreciated: encourage folks to specifically say where that availability is to shave the budget. Will need to do it project by project. Also a natural tradeoff between projects across the program.*
	+ Craig E. *- Have time on BAHG calls to address smaller issues. Need to spend time as TWG to address the bigger problems.*
* Bill Davis - Re: Submitting comments - April 22nd is the date for submitting comments? Will all those comments from the TWG members be distributed to everyone.
	+ Seth- *1) Yes, written comments are still sought for submission by 4/22; 2) We’ve always done that with comments they certainly should be. Method for distribution is the question.*
	+ Leslie- *As long as we understand that comments are going to everyone, we can tailor them accordingly.*
* Randy - Seems that what is missing is an overall view of prioritization of general resource categories.
	+ Seth- *Note DOI obligations for continued GCD operation, as outlined in LTEMP. “Magnitude in which we accomplish those priorities seems to be a major struggle.”*
* Jess Gwinn- What order are we following today? Consideration of compliance needs, etc.
	+ Seth- O*rder of collective importance, based on BAHG/TWG discussions*.
* Larry - Don't understand the extent of rollover. Stopped field work for the extent of 6 months. If that money is rolled over, would help with the budget shortfall (at least for next year)
	+ Scott- *Logistic cost substantial for Program, savings may exist and have been discussed. Furlough authority comes from higher up. Looking at options for savings that are on the table, may not cover proposed shortfall.*
	+ Seth*- Focus on having the harder conversation of ‘where can we find these opportunities to get to that number’; having the additional funding would be a great conversation to be having.*
* Ben Reeder- Looking at what studies are needed for compliance; in broad sense, can the studies “share the burden”?
	+ Seth- *Is the recommendation by the TWG to have a 20% cut across the board*
	+ Larry- *Easier to approach. May not be satisfactory to folks that may need to complete the work*
	+ Peter - *Over all support the idea of sharing the burden. But there may be some projects that are higher priority than the others. Time to figure out what those are*.
		- Billerbeck - *Agree with Pete and Seth; there may be some leftover money. Can't save all that money at the risk of losing the staff necessary, need to prioritize. Cannot do everything. If we don't have those hard conversations, will get stuck with having funded some nice to haves.*
		- Leslie- *To Peter’s point, maybe the first step is to go through and scrub based on priorities. Then, assess the funding level and ‘consider’ a flat percentage cut.*
		- Kelly - *Looking at priorities in the sense of timing and at the same time looking at the possibility of sharing the burden across the board. Discuss, talk about and decide where the priorities are, if we find these other broader efforts to save by reducing the budget across the board*.
		- Ryan - *As one of the managers, 20% across is not realistic. Risk of crippling any of those programs. Better approach would be to prioritize and select where we need to make those cuts.*
	+ Seth - Work at prioritizing these projects, also think about as the backstop a 20% cut across the board would work.
* Craig E. - Additional opportunities for outside funding. Eventually need to have discussion on if extra outside funding opportunities exist to augment AMP funds.
* Strogen - Can we identify project reqs for compliance issues be the first ones that we talk about? If they’re at the level they need to be, talk about other programs.
	+ Seth- *think we have some of those issued teed up in order presented; if we feel we’re at a place for budget, think we can start into that process.*
* Larry - Larger issues where we don’t have agreements yet:
	+ - First issue is to revisit program goals; we need it for this program. May have to be a policy decision for the AMWG. Lot of time has gone by. Related to the issue of where we are and how to develop a coherent plan. Don't have a mechanism to talk at that level. Fairly low cost exercise to engage in (especially electronically). KA gets us up to some level of understanding; recommendations from KA may not be carried forward in a multi-level budget planning process.
		- Need to understand how to resolve needed experiments specifically for spring time HFE. May take more environmental compliance. How do we do it? Resolve in these three years. May not happen under natural conditions.
		- Issue of how to really mitigate equalization flows. Will devastate the sediment budget again.
	+ Seth - Goals of the program are set clearly. LTEMP identifies resources goals/objectives. Harder conversation is understanding what they mean and how to accomplish them. Need metrics. Fits within the continuing difficulty of implementing adaptive management. Components of a typical adaptive management program we struggle with. Hampering our ability to understand tradeoffs and priorities. Need a clear line item in BOR’s (maybe GCMRC’s) budget, we should spend some amount of money for someone to own this issue.
* Scott V- Not in favor of 20% cut across the board. “*This is where the hard work happens*.” We put out a lot of good ideas, but not all of them are equal and as important to do right away as others. May create more problems than it necessarily solves.
	+ Kelly- Generally, would you say that these projects and proposed budgets have been looked at in scope of a ‘less than optimal budget scenario’?
		- Scott- trying to keep budgets as flat as possible, but also asked for new projects. Lot has been done but not entirely: “we still have work to do.”

# BUREAU OF RECLAMATION BUDGET

## D. NHPA Compliance and Cultural Resources Program Management

D.1. Cultural Resources Program Administrative Costs

D.2. Support to Reclamation for Cultural Resources Compliance

* The Pueblo of Zuni is concerned that the amount of funding identified here is insufficient for the effective engagement of a competent and qualified contractor to assist in this program. Moveover, the funding allocated throughout this triennial work plan for compliance with the PA demonstrates a profound lack of knowledge and experience in the amount of funding necessary to carry out PA compliance related activities.
* This section should be elaborated more on what this entails. It is weak and confusing in its vagueness. If it is for rehiring a cultural expert, a new Bill Chada; this is an inappropriate amount for any master’s degree holding cultural expert aiding in cultural endeavors as part of the program. I recommend as a minimum $50,000 for such a hiree if this is the purpose of the line item. Still, it is a high priority that Bill’s position needs to be filled to mitigate work load and have someone with such expertise within the Bureau of Reclamation to aid in these endeavors.

D.3. Cultural Resources Monitoring – Grand Canyon (NPS)

D.4. Cultural Resources Monitoring – Glen Canyon (NPS)

D.5. Tribal Associative Values Studies and Mitigation

* The description presented here is very vague with respect to “mitigation.” Please explain what associative values (NRHP Criteria) are being addressed in developing the mitigation.
* The description states that Reclamation is still reviewing tribal proposals. Which tribal proposals are still being considered, why is it taking so long for Reclamation to decide which proposals are appropriate, how was the funding allocated for this section determined, are the tribes to assume that all their submitted proposals will be funded through this amount, or will Reclamation, at some point respond to the Tribes?
* It was said “Only members of these tribal cultures can assess the value of various resources to that culture.” How well we collaborate to define the goals of canyon resources based on a healthy mix of western science and tribal culture will determine our successes. Tribal activities such as the work reported by Jakob should be continued and encouraged. The survey methods used in the TWP surveys were called into question during the 5-year LTEMP process through peer reviewed, published studies, and would likely not have been supported by all members of the SEAHG had that work group been involved as anticipated. Need to separate out which activities are required by NHPA section 106 and which are not. That could help dictate funding sources.

D.6. Cultural Sensitivity Training Development - Tribal Expertise

* It is clear after reviewing all the proposed work plans associated with PA compliance, that Reclamation is not considering the importance of and added value that a properly developed and implemented cultural sensitivity training component would bring to this program. The cultural sensitivity training is mandated in the PA for a reason, it was requested by the Tribes and agreed to by Reclamation, because the Tribes were frustrated with past and continuing institutional paternalistic approach and the lack of demonstrated cultural appropriateness and sensitivity inherent in this program… A well-developed cultural sensitivity training program will directly build more trust, enhance relationships, and ultimately better compliance outcomes and should be viewed by this program as a vital preventative, proactive, collaborative and carefully thought out and crafted measure. Unfortunately, that is not what is presented here...

D.7. Cultural Sensitivity Training Video

* This description and budgeted amount reflects a grand lack of understanding of the level of effort required to produce an effective and meaningful training video. This video(s) should be developed in accordance with and utilized in the cultural sensitivity training curriculum. The description offered suggests that Reclamation may view this video development as the cultural sensitivity training session, which causes one to think this video may be intended by Reclamation as a public relations device more so than what the stated goals and intentions propose.
* Sara - On the training development and the video, if nothing was completed, does that money carry over ?
	+ Lee- *In the current program if the dollars not spent, will be reprogrammed more than likely. Most likely to move to NHPA contingency fund*.

D.8. Contingency Fund for NHPA Section 106 Compliance

* Please explain the analysis Reclamation conducted to arrive at the amount of funding needed to perform mitigation in the Canyon. A simple review of the past 20 years of funded mitigation under the 1994 programmatic agreement would suggest that this level of funding is insufficient if Reclamation actually intended to fund mitigation in the next 3-year cycle.
* Sara - how much would be carried over into this one?
	+ Lee- *200K in this bucket*.

D.9. Tribal Resources Monitoring

* Kim Yazzie (Navaho): Trying to find proposals from Melinda and Richard.
* Hopi river trip: ethnographic work including interviews by female leaders that can’t attend the river trips.
* Encourage opportunities to integrate tribal perspectives and participation in work being done on other resource topics.
* Investigate how gardening occurred along the river corridor. How do modern cultigens compare to what was been grown historically?
* How did the tribes interact with each other? Investigate cross canyon routes, political alliances, etc.
* New beaches forming below Diamond Creek that weren’t there pre-HFEs? Were there beaches here pre-dam?
* Hualapai river running and increase in in-river sandbars. How are operations/HFEs effecting in-river sandbars? Erosion of the Lake Mead deltaic deposits. See GCMRC B.4.

D.10. Tribal Participation in the GCDAMP

* Bill - Supporting the tribal activities. Need to separate out what is required by the NHPA and what is not.
* Lee - All of these line items are tied to PA reqs, supporting NHPA. Projects under D5 are being reviewed. Waiting for written comments from BOR and being reviewed by BOR for consistency with NHPA. Will also be working with Advisory Council and AZ SHPO to confirm these, consistent with NHPA.
* Peter - Tribes have been monitoring on the River for quite a few years. Some of the proposals are geared towards expanding tribal knowledge. Do enhance significance of the area and tie into NHPA issues as well.
* Kelly - Investigating gardening along the River corridor. Would be very interested to see how much gardening would be supported.

Craig E. - Not the best format to get tribal input. There are issues that the tribes have attempted to relay to the program. How are such concerns (re:communication format) going to be addressed by Reclamation?

Helen- Regarding year-to-year contingency fund and contract $ rolling, will that be rolled over, as well? Mitigation of excavation etc ? Lee- Need to talk with tribal reps as a group with NPS to understand.

* Sara - 1) Contingency fund v. new funding - Building up a contingency fund, how does that interplay with the current year obligations for monitoring and mitigation. (Budgeted for on an annual basis. 2) Tribal resource monitoring under D9, different from D3. Is it an overlap?
	+ Lee- 1) *as far as obligations for monitoring and mitigation, is made on an annual basis. Looking at annual work plans so that monitoring in particular will always be a line item in budget. ‘Extra flexibility’ from contingency funds is for urgent need/quick response. 2) D3 and D4 are both monitoring and surveys that NPS does. D9 is specifically for funding that goes to the Tribe that have the ability to conduct the trips. To support the monitoring and documentation for supporting those River trips. So they are separate.*

## C. Program Administration, ESA Compliance, and Management Actions

C.1. Administrative Support for NPS Permitting

* What has been the actual experience re costs/timeliness? If projects in the field are reduced this category should be reassessed?

C.2. Contract Administration

C.3. Integrated GCDAMP Stakeholder River Trip

* Scheduled for 2022

C.4. Science Advisor Program

* Again there is a question of a return of a science advisor, when many TWG members are all scientists in an advisory role, a bit of a redundancy. Those who have been a part of this program for a long while have discussed past issues and the nonnecessity of such a role and position within the program. A $150,000 budget for two reviews is a lot of money, which could be appropriated elsewhere. There is also the worry of contracting a scientist out of the program, who has no experience in the program involving themselves, when we are a program filled with scientists who advise already. Under scrutiny this item unless a good explanation and reason for a new science advisor is provided, should be dropped, the funding spent elsewhere.

C.5. Experimental Management Fund

C.6. Native Fish Conservation Contingency Fund

* End of FY16 carryover = $1,060,000
* End of FY17 anticipated carryover = Approximately $1,400,000
* End of FY20 anticipated carryover = TBD

C.7 and C.8. Experimental Vegetation Treatment

* The Pueblo of Zuni strongly recommends consultation regarding the use of herbicides in vegetation treatments.
* Relationship to dam ops is poorly linked. This program should be reconstituted as a management action and funded from NPS sources.
* Many of the conclusions from these projects have been known for years or follow patterns seen elsewhere and the projects are probably not worth continuing given a constrained budget. Work completed as an “experimental vegetation” project should be reassessed as a management action and transferred to NPS for management and funding.
* What is the experimental nature of vegetation treatment in GCNP and GCNRA?
* How does this relate to GCMRC Project Element D.1? Is there a coordination of sites?
* Is there a reporting element for these projects and are those reports accessible?

C.9. Evaluation of Means to Prevent Fish Passage through GCD

* The Pueblo of Zuni sees this as a potential proactive measure to reduce non-native fish populations below GCD and would prefer emphasis on non-native fish control be on proactive measures like this rather than lethal management actions.

C.10. Evaluation of Temperature Control Methods at GCD

C.11. Southwestern Willow Flycatcher and Yuma Ridgway’s Rail Surveys

* What is the reporting requirement for this element for these projects and are those reports accessible?

Peggy -

* With the Science Advisor program where did that money go? Did it go to the conservation fund? (*Yes*);
	+ Seth- *$ for SA on an annual basis still very important. Need a person to connect the dots, between adaptive management etc. Need an additional line item*.
	+ Larry - Need for SA has been recognized. Contracting lately has not been efficient: it takes 2 years to get up to speed, SA contracts are only 3years long. BOR needs to take careful look at the duration of the contracts. (Lee - *option to have for 5 years long. Ran out of money before we reached the end of 5 years*)
* 3yr. KA process: isn't it something that we do every year? (*Can be revised. Need to think about how we utilize that person's time. Big-picture discussion on modeling resources*.);
* With experimental vegetation treatment. Is there a plan for this ? - (Rob - *Yes there was a white paper laid out by Todd Chaudhary, laid out 7-8 years ago. Updating it. Specifics being adopted every year.* Tied to dam ops. *Working with GCMRC, looking at it as an experimental implementation. Meeting specific environmental commitments in the ROD.*)
* Were high uses places, etc. picked? (Rob- *invasive species management, revegetation, species where cultural resource sites can be benefitted, camping resource sites*.)
* Money is not allocated correctly for Ridgeways, SWFLS, (*Lee- will allocate it correctly, 10k in 21, 7k in 22, 10k in 23*)

Jim - 1) re: DO mitigation - would it have a placeholder here? 2) If there is a fishkill at the state’s blue ribbon Lees Ferry, then what?

* Seth- *1) Yes, that seems like an appropriate place.*
* Lee- *2) don’t want to see a fish kill; emphasis on monitoring and seeing plumes coming. But in terms of dealing with that, given lead time, that’s a great question for the group.*
* Larry *- aerating water coming through the turbines. DO levels were increased in the release water. Cost is something to think about. would it come out of the emergency fund.*
* Seth *- Monitoring is in the Program- what we’re going to do is something that Jim is teeing up. Are there alternatives that we could go to if a low DO were to occur?*
* Ryan *- What has changed from the past - LTEMP DFC says "operate GCD to achieve the greatest benefit to the trout fishery in GCNRA without causing excessive detriment to other resources". How can we make that case?*
	+ Lee- Don’t think anything’s necessarily changed; looked at potential of mitigating similar condition in ‘05, aerating releases overnight. Did provide some benefit, but was reviewed after the fact with a number of concerns expressed. Operation of turbines in ‘rough zone’, brought out various issues.
* *Bill - Who has the responsibility to develop a plan to mitigate or prevent low DO?*
* *Jim - Situation that we could have this year or in the future. Need to have something on the table right now so it doesn't happen.*
	+ *Seth- interpreted as desire for a new line item to identify opportunities for resolving the issue, should it present itself.*

Jacob - 1) Acknowledging the issue of short contract times, issues that come with it. 2) Administrative history. Talking with people that have been in Program for a long time, SAs problems, need to understand it so we can mitigate it in the future.

Sara - C9-10 no funding allocated? Are they placeholders? - (Lee- *Both are items that are laid in BO. Are Placeholders, what actual work and specific tasks need to be determined*. Tech services center is leading an effort for a new mechanism to address these challenges. White paper on TCD was distributed previously. Hoping to leverage efforts outside the program) Will it be determined in the 2nd or 3rd rendition? (Hoping to have it by the second)

* Jim - Anticipate putting some funds in those categories by the end of this process (i.e., 3 years) - (*Yes*)

##

## Projects Funded Outside the GCDAMP

* Razorback sucker monitoring and research
* Brown trout control
	+ Does this include any funding for incentivized harvest at Lees Ferry?
	+ Determine if there is a way to fund the NPS incentivized harvest of brown trout.
	+ Could brown trout incentivized harvest at Lees Ferry be (partially) funded with Native Fish Conservation Funds?
	+ Could a greater bounty be paid if the fish was caught with a guide?
* Humpback chub translocations
* Lake Powell water quality monitoring
* Reservoir release temperature control methods

 Peggy - DO string above GCD: NPS is looking at putting a platform out there. Is BOR working with NPS to do that? Consider putting platform above GCD

* Deemer- *measures temperature, conductivity*
* Jeff- *Ken was looking for platform funding, wanted to put it up by Bullfrog.*

Bill- Quagga mussels monitoring?

* *Monitored at several sites, one near Dam intake, others*

Larry- GCWC has done two major riparian restoration projects, looking to engage in the Paria Beach project. Haven’t received much attention, but might be informative. Benthic anoxia dominates the system, seems to be closely related to decreased flow fluctuation (Bug flows).

Incentivized Harvest - Asking for additional monies outside of that. Best to have formatted in a way that other GCMRC programs are.

## A. Adaptive Management Work Group (AMWG) Costs

A.1. AMWG Program Management

A.2. AMWG Member Travel Reimbursement

A.3. AMWG Reclamation Travel

A.4. AMWG Facilitation and Notetaking

* IF necessary, should be limited to meeting attendance/facilitation not to exceed $35K

A.5. Public Outreach - Public Affairs and Public Outreach Ad Hoc Group

* POAHG is basically inactive –assumes this is all for BOR in house?

A.6. AMWG Other

* Administrative History – should be complete by now? If not, could defer for final compilation. In any event the AHAHG should be consulted as to what components are incomplete/desired

## B. Technical Work Group (TWG) Costs

B.1. TWG Program Management

B.2. TWG Member Travel Reimbursement

B.3. TWG Reclamation Travel

B.4. TWG Chair Reimbursement/Facilitation

* seth - as long as seth is the chair, will not be accepting funding for the chair position.

B.5. TWG Other

# GCMRC BUDGET

All budget items should be broken down via project for further explanation and exploration of applied funds. See H comment. For example, it may also serve in finding new ways to shape how we present the connectivity of our efforts instead of this breakdown of separate elements. Finding ways to emphasize interconnectedness of projects for example.

## Project N. The Economic Impact of Electrical Production at Glen Canyon Dam: Hydropower’s Role in Facilitating Renewable Energy Integration and Mitigating Emissions

* How did work done for the 18-20 TWP address “Identify ways of reducing the impact of experimentation to hydropower?”
* Where was the work presented by Lucas at the 2020 ARM on reoperating GCD to reduce emissions addressed in the 18-20 TWP?
* WAPA is withdrawing the Project Element N.1 partnership from the 21-23 TWP and recommending it be replaced with the Project N outlined in the 18-20 TWP with some modifications.

Project Element N.1. The Economic Impact of Electrical Production at Glen Canyon Dam: Hydropower’s Role in Facilitating Renewable Energy Integration and Mitigating Emissions <new>

* The work undertaken by GCMRC during 2019 does not take into consideration the economic and financial “value”, or resource stacking preferences, of the utilities who have long-term contracts for the GCD resources, particularly including tribal entities. Should this information be important to the AMP, consideration should be given to tasking WAPA/Argonne with this research. Project N work should be undertaken to implement the hydropower flexibility prioritized in Dr. Petty’s guidance memo. No further emissions work funded by the AMP is required.

**Comments from TWG on Project N:**

* Leslie-
	+ Project N as proposed is significantly different than that from last TWP, and as discussed and included in Program. Having seen writeup of Project N, would indicate that there’s some strong concerns about the proposal, and that we’re in discussions with WAPA in looking at “going back to original intent and focus of Memo on hydropower”, but until conversations are concluded, offer to send out revised project once finished.
	+ Encourage looking at mitigation or improvement of hydropower resource, in accordance with LTEMP objectives. Project is laudable, but especially with budget restraints, we think N as described is not appropriate at this time.
* Seth- any sense on the level of effort proposed, what to expect?
	+ Leslie- *Scott, is it possible to get info on charges to the original Project N budget*? One voiced concern was taking away funding from other projects; been trying to incorporate end without putting large additional cost in the budget.
		- Lucas*- right: currently ~$30k/yr. If things were reorganized as written (refocusing on specific experiment support), best guess is $ would be more evenly distributed over the three-year term.*
* Seth- discuss at back once we receive further detail

## Project D. Effects of Dam Operations and Vegetation Management for Archaeological Sites

* In reviewing the proposed GCMRC Triennial Work Plan one factor became obviously noticeable; the biological and physical programs have robustly developed research and monitoring components that critically and effectively address the resource needs of the adaptive management program which is in stark contrast to the cultural program. The cultural program presented in this Triennial Work Plan appears to lack purpose, direction and focus, in part, because 75% of the projects proposed for the next triennial cycle represent resurrected projects that were either deemed by the stakeholders as unnecessary or not producing beneficial data or results for the adaptive management program. It is disappointing that a program designed to address those qualitative humanistic values that represent the very foundation of the adaptive management program as expressed in the Grand Canyon Protection Act and the enabling legislations that created both National Park systems are nonexistent. The current cultural program appears to be only a step-child of the physical program because it blatantly ignores the multiple, treasured associative values that the five participating Tribes have for this sacred place by singularly focusing, for over the course of a decade now, on the study and quantification of windblown sand. I continue to struggle to understand why this situation persists within GCMRC. I question whether this is an artifact of GCMRC being housed within the United States Geological Survey, a self-admitted Cartesian dualistic and materialistic science providing agency where only quantitative data is considered valid, or is it a product of GCMRC's long standing resistance to seriously and meaningfully engaging with and thereby validating non-Westernscience epistemological systems and other forms of knowing the environment within the Canyon, or a combination. I remain confounded and frustrated!
* In the stated project summary and purpose, GCMRC suggests that this project responds to a goal to "maintain the diverse values and resources of traditionally associated Tribes." One sincerely doubts whether GCMRC employs anyone who possesses the cultural competency to be able to evaluate the condition of traditionally important resources from the associative values of any particular Tribe. To suggest that this is the purpose and/or product of this project misrepresents GCMRC's capabilities and is insulting to the participating Tribes.

Project Element D.1. Dam Operations, Vegetation Management, Archaeological Sites

* The purpose of this project is to quantify changes in the physical condition of river corridor archaeological sites in Grand Canyon as a function of: (i) dam operations, (ii) vegetation management, and (iii) natural processes. What about visitor, recreationist, and/or researcher impacts to these sites?
* If vegetation removal is making for a better camping beach, are you also increasing the likelihood of visitation and disturbance to the arch site? How is this being addressed?
* What is the time frame for the aeolian sand transport / vegetation removal experiment? Would a time frame of 3 years (using the Bug Flows experiment as an example) be an appropriate time frame for data collection followed by time for data synthesis and reporting? If longer, could data collection be reduced to every other year?
* How were archaeological sites selected for this experiment? How many Type 2b, 3, and 4 sites are included in this experiment? If these types are not included in the experiment, how does this experiment address site conservation at anything other than a Type 1 or 2a site?
* Aeolian transport work has shifted from sediment categories to archaeological and cultural resources. In any event, this work is not high priority and was expected to be completed a couple of years ago. Further research in this area should be discontinued, unless non-AMP funds are available.

Project Element D.2. Monitoring Landscape-scale Ecosystem Change with Repeat Photography <new>

* The description of this project states that it was begun by GCMRC in the 2015-2017 triennial work plan, but was not funded in the 2018-2020 work plan, if I recollect correctly, the Technical Work Group did not support the continued funding because of the lack of beneficial results. Has GCMRC produced a draft report on the results of this past effort in analyzing historic photographs and has this report been provided to the stakeholders for review? It is difficult to support this proposed effort in the absence of a report that demonstrates the benefit of this analysis to this program and persuasively advances for continued support. In the absence of this report, I cannot support a continuation of an effort that was not supported by the stakeholders over the past three years. The justification presented here is not convincingly substantiated that this is critically needed information.

Project Element D.3. Cultural Program Administrative History <new>

* This effort has already been accomplished or is being accomplished as the description presented acknowledges. A history and summary of the historic preservation compliance for this program is encapsulated in Reclamation's Historic Preservation Plan. Additionally, the administrative history of the Adaptive Management Program is currently being performed by Dr. Hirt of Arizona State University. These two separate efforts together will more than accomplish what is proposed here. This proposed effort represents redundancy. Funding this proposed effort will not substantially benefit the program.
* We did not feel this item was a good use of funds and time, since the history has been documented before, it may just need to be put into a more easily accessible place like the wiki, if it has not been done so already.

Project Element D.4. Holocene Map of Fluvial Sediment in the Colorado River Corridor <new>

* If memory serves, this effort has been repeatedly considered over the course of the past 10-15 years of the program, but has never received sufficient stakeholder support to warrant funding. Given the current coverage of the river corridor by the National Park Service most, if not all, historic properties have been identified and recorded. Identifying locations where new historic properties may be uncovered (i.e., discovered) is not a critical information need for this program. Rather, it is a §11O responsibility of the Grand Canyon and Glen Canyon National Park Service. In addition, the discovery of historic properties is covered by the existing PA. The need for this effort is not convincingly advanced.

Larry: Experiments didn’t seem incredibly successful; regrowth is quite rapid, opportunity for sand movement may be limited. How much modification of plans will take place?

* Joel- *in terms of experience, we’re hoping for “double whammy” of removing the sandbar followed by HFE.*
* seems to fit “nice to know” category; not critical but knowledge for future use beneficial

Leslie- Does Joel’s description tend to move this project more into a management action/maintenance mode?

Rob-

* Point folks to S. 6.4 of LTEMP ROD; vegetation mitigation considered an important environmental commitment in the ROD. Also note Petty Memo, prioritization implications. GCPA intent\*
* Peter- *I support Rob’s comments and reasoning. Losing momentum on this project would be detrimental to its overall success. As he notes, archaeological sites are non-renewable resources. We can’t just recruit new ones as we can with fish…*
	+ Rob- *per Pete’s comment, the vegetation project is conducted in partnership with tribes - this is an important aspect of the project.*
	+ *looking at D.1 talking about camping beaches outside archaeological sites, from what I witnessed I’ve seen room for efficiencies in management.*

Craig E.- Can we talk about the experimental timeframe?

* Joel- *timeframe of three years could make sense, given where we’re at right now.*

Helen -Maximizing efficiency means we’re using existing projects (under compliance programs) to evaluate vegetation. But this ties into longer-term compliance issues.

Larry- for Joel or Rob: notes new nonnative plant infestation each time going down the River - who should this be reported to?

* Rob- *We would love to hear about this. Direct email to Lonnie would be ideal for Grand Canyon, John Spence for Glen*
* Jeff- *last year, we were taking out some of the new stands of ravenna grass.*
* Emily- been working with Lonnie to get permission for science tech on river trip for specific ravenna grass

Seth- Whether something is necessary, see D.2 and D.4: might not be as important for a few yrs

* Helen-
	+ *D.2- Wasn’t in the last work plan, however, last year we were fortunate for volunteers to help collect historical photo matches. Amassed information over the last several years to now analyze and put in a publication format* *to be accessible in future*.
	+ D.4- *accumulation of data is scattered around. We anticipate spending at end of Work Plan to get assembled in GIS*
* Kevin Dahl- One of the problems with this review is that the budget information is not broken down into each number sections. Can that be made available soon?

Craig- D.2-4 will reflect upon Petty Memo to see if they are directly tied. If not tied to current guidance, needs a strong justification to move that forward, given current budgetary stance.

Leslie- Is it possible to understand how much of the total Project D budget is assigned to D.1?

Theresa Pasqual- Could D.3 find an alternative source of funding? Does AZSHPO have a grant that might cover this? I think in terms of moving the needle, I believe D3 isn’t a priority the way that others are.

##

## Project A. Streamflow, Water Quality, and Sediment Transport and Budgeting in the Colorado River Ecosystem

* Consider adding a temperature sensor at the Hite gage.

Project Element A.1. Stream Gaging and Hydrologic Analyses

* Identify how the following gages help address management actions or experiments such as whether or not to have an HFE. If these gages are not being used to address a critical management action or experiment we would suggest reducing their priority for AMP funding.
	+ Water Holes Canyon above the mouth
	+ Paria River near Kanab, UT
	+ Badger Creek below highway 89A near Vermillion Cliffs, AZ
	+ Tanner Wash below highway 89A near Bitter Springs, AZ
	+ House Rock Wash above Emmett Wash near Cliff Dwellers, AZ
	+ North Canyon near Cliff Dwellers, AZ
	+ Shinumo Wash in Twentynine Mile Canyon near Cedar Ridge, AZ
	+ Moenkopi Wash at Moenkopi, AZ
	+ Moenkopi Wash near Cameron, AZ
	+ Little Colorado River at Grand Falls, AZ
	+ Little Colorado River near Cameron, AZ
	+ Bright Angel Creek near Grand Canyon, AZ
	+ Shinumo Creek
	+ Kanab Creek above the mouth near Supai, AZ
	+ Havasu Creek above the mouth near Supai, AZ

Project Element A.2. Continuous Water-quality Parameters

* The CRE continues to change as we encounter different flow cycles, temperature fluctuations, food base alterations, etc. and predicting the future becomes a crap shoot. Since habitat changes fluctuate widely, we should continue to expect biological resource responses to also fluctuate widely. Monitoring at gauging stations should be continued, especially oxygen and temperature parameters. Project Element A.3. Sediment Transport and Budgeting

Project Element A.4. HFE Experimental Fund

**Comments from TWG on Project A:**

* Peggy: Can I find out the cost of gauges? Is the value worth its collection?
	+ David Topping- *actually real cheap. We have the largest data set in the world on the topic. per gauge, ~$1-2k/yr, based on sediment sampling. Total <$10k.*
		- *Includes O&M, staff time, associated effort. Goes out twice a year, takes a few office days to process data. Very low replacement over 15yrs.*
		- *Most expensive gauge (~$22k) above LCR is “basically biology gauge”*
	+ Has USGS shown interest in picking up gauges? *(not for science’s sake)*
* Craig E.*-* difficulty squaring expenses in A.1 and such a low gauge costs.
	+ David- *a lot of other interpretive, database & website work, other cost factors*
* Larry- How do we mitigate the impacts of equalization flows? Would love to see contingency plan to minimize sediment losses during higher-flow events
	+ David- *Once we see equalization, Would be nice to have conversations on what could be done, what we can define as an interpretive product.*
* Seth- Hearing the response that they’re essentially all required: important for the group to know if that’s the case. Perhaps we’re in a place where the magnitude may need to be reduced to have it fall in line. Challenge will be identifying reduction opportunities without excessive interpretive losses.
	+ David- *you can’t. Something for USGS to work out: Salary restraints, etc. to have a “slimmer” budget yet still cover the bases. 20% cut a “blunt instrument”*
	+ Scott*- challenges exist, but detailed dive not needed at this point. What would be beneficial would be hearing the input we’ve had, and work internally.*

## Project B. Sandbar and Sediment Storage Monitoring and Research

* We would like to test how slowing down ramping rates following HFE peak flows could create lower sloping beaches, and if these beaches would be less susceptible to erosion and are more user friendly for recreational use.
* Much of the sediment work could be done on a less frequent basis. The GCMRC aptly demonstrates with modeling the dynamics of sediment transport and bank and bed storage. Tracking Paria and LCR inputs may be all that is needed on an annual basis.
* How has the reduction in large floods in the LCR affected HBC habitat in the LCR? Are habitats becoming more frequently filled in with sand?
* Need to identify criteria for sandbar size and distribution to meet the LTEMP goal.

Project Element B.1. Sandbar and Campsite Monitoring with Topographic Surveys and Remote Cameras

Project Element B.2. Bathymetric and Topographic Mapping for Monitoring Long-term Trends in Sediment Storage

* Alternate channel mapping with beach surveys every other year to reduce monitoring costs for the sediment project.

Project Element B.3. Control Network and Survey Support

Project Element B.4. Bank Erosion, Bed Sedimentation, and Channel Change in the Colorado River Arm of the Lake Mead Delta in Grand Canyon <new>

* Consider funding the bathymetry study from Bright Angel Creek to National Canyon to facilitate modeling of Glen and Grand Canyons for sediment.
* Hopi supports Hualapai in proposing this project.
* Concern is that there has been an increase in channel sandbars through the old Lake Mead delta creating navigation issues for Hualapai and recreational boating.
* Do HFEs or other operations erode terraces and create bigger in channel sandbars?

Project Element B.5. Streamflow Modeling <new>

Project Elements B.6-B.9. Sandbar and Riverbed Response to Experimental Actions (to be funded only when experiments occur)

**Comments from TWG on Project B:**

* Paul Grams- Aeolian is not in this project.
	+ ‘Generally, this could probably be cut back a bit: don’t need to do it every year’
		- We provide Pre-HFE sandbar assessments, Post-HFE reviews. Are they still necessary sans HFE? *(We don’t do pre/post surveys, do 1/year)*
	+ Scott- *Several proposed elements funded through Experimental Fund, should they occur. I.e. extended-duration HFE.*
		- Paul- *not necessary, but some people would love to see that*. *Long standing issue of interest and concern, legitimately affected by dam operations.*
		- Peter- *good summary, but area in proximity to dam is not the only issue; navigability of the river corridor is another. If some stakeholders are willing to push it off, then we may never get to understand the situation in that part of the system. Just because it’s far from the dam doesn’t mean it shouldn’t be of lesser importance, and deserves further attention*.
	+ Seth- hearing interest in W. GC drivers, are there opportunities to do less research without losing too much information (channel mapping, etc.)?
		- Paul- *the other side of the coin is “what kind of data do we need”, but the data need for longer-term assessment is less immediate*.
		- Interest in understanding what is happening, what could eventually be done for the benefit of resources and goals, etc. focused on the long-term perspective of the out year.

## Project H. Salmonid Research and Monitoring Project

Project Element H.1. Rainbow Trout Monitoring in Glen Canyon

* How will ADGFD/NPS administer the brown trout incentivized harvest? CREEL, tagging fish, administer rewards?
* Evaluate and prioritize any duplicative monitoring being done in Lees Ferry and in the LCR.

Project Element H.2. TRGD Fieldwork

* Can TRGD help with the brown trout incentivized harvest: provide abundance estimates, PIT tag fish, map “hot spots” to fish, etc.
* Outline what questions are outstanding and what needs to be done to address those questions to be prepared to conduct a TMF trial.
	+ Pre- and post-TMF YOY rainbow trout estimate
* As Korman and Yard say, we should be cautious about doing TMFs without a better understanding of the level of recruitment we are attempting to control. Also, other methods to control impacts of RBT on humpback chub may include a more serious look at turbidity. TMFs should be delayed until we have a better understanding of recruitment trends. Depending on design, TMFs may also enhance downstream movement of trout as evidenced by the Natal Origins work.

Project Element H.3. Brown Trout Early Life History Stages in Glen Canyon <new>

* What is leading to the pulsed recruitment events of brown trout in Lees Ferry?
* Are fall HFEs making for better spawning conditions in the Lees Ferry reach? Are they flushing gravel and is there any way to evaluate? Discuss with Grams. Could look at the section below Waterholes, measure what is coming in vs what is going out? Look at pre and post HFE spawning habitat conditions?

Project Element H.4. Salmonid Modeling <new>

* Further develop the risk assessment to address brown trout population increase at Lees Ferry and effects on humpback chub at the LCR.
* H versus I: We all know and understand now that Rainbow trout does not impact chub as we worried decades ago. The question is how much H and I is to be spent on rainbow trout versus these other efforts. We should expect less money being appropriated to Rainbow trout projects for this and future ongoing programs. It would be good in the budget to see the breakdown of H and I to see which projects are receiving what part of that 500,000 dollar pot and to determine if this is adequately being split and put to use. It is a catch-22; we need to see how all the small subjects impact the greater whole, but we of course do not have the budget for everything. These are good line items to use as an example for breaking it down clearly and can help show the bigger picture so serve for future budget proposals and projects.

##

## Project I. Warm-water Native and Non-Native Fish Monitoring and Research

* At what interval should we be conducting reviews of what nonnative fish pose the greatest current risk to humpback chub recovery and other native fish populations? Example: should we be shifting focus from rainbow trout to brown trout/other?
* Include monitoring and reporting of crayfish.
* What came of the eDNA proposal? Can eDNA detect population size?
* Is Pierce Ferry a barrier to nonnative fish? Has it contributed to the shift from a non-native to to a native fish community by reducing connectivity to Lake Mead (especially for channel catfish)?
* Turbidity and predation: Will this continue? Lab vs field inconsistencies. Lab: as turbidity goes up predation goes down for sight feeding fish (rainbow trout). Field: when turbidity goes up predation by rainbow trout actually goes up. Is this because chub are moving more when turbidity is higher? Making them more susceptible to predation?
* Consider funding David Ward’s study of the predator/prey dynamic for all native fish.
* Consider funding additional non-native fish eDNA trips if this analytical method proves helpful.

Project Element I.1. System-wide Native Fish and Invasive Aquatic Species Monitoring

Project Element I.2. Invasion and Colonization Dynamics of Warm-water Invasive Fish

* Is Pierce Ferry a barrier to nonnative fish?
* Invasive species coming down the LCR. Pools between Grand Falls and Blue Spring produce a lot of fish that get flushed into the LCR every monsoon season. Who is addressing this? Navajo Nation land. Is this “in” the program as “mitigation of dam ops in the ecosystem?” Is there flexibility on research to figure out what is going on? Who is responsible for management of that area?

Project Element I.3. Impacts of Channel Catfish on Native Fish in the Little Colorado River <new>

* With tribal approval, consider removing catfish and green sunfish from the LCR.

##

## Project F. Aquatic Invertebrate Ecology

* What happened to the nutrient supplementation experiment to be done during the overflight mentioned on the first set of BAHG calls?
* Prioritize working on a synthesis of 2018-2020 Bugflows experiment including the weekday/weekend drift work. Produce report/paper on bugflows.
* Please consider food base augmentation in the LCR.
* Food base work should be given more attention, particularly since we have not yet discerned the causative factors for the dramatic changes in the past 30 years.
	+ Peggy: “is there nothing we can do on this issue? Worried we’ll eventually forget about it and lose interest.”

Project Element F.1. Aquatic Invertebrate Monitoring in Marble and Grand Canyons

Project Element F.2. Aquatic Invertebrate Monitoring in Glen Canyon

Project Element F.3. Aquatic Invertebrate Monitoring of Grand Canyon Tributaries <new>

* Is this overlap of Larry’s synthesis of EPT in the Grand Canyon Ecoregion he did in 2018?

Project Element F.4. Fish Diet Studies <new>

Project Element F.5. Spring Powerplant Capacity Flow (Experimental Fund) <new>

* Will this also include an evaluation of a cobble bar treatment during the apron maintenance or overflight flows?

## Project C. Riparian Vegetation Monitoring and Research

Project Element C.1. Ground-based Riparian Vegetation Monitoring

* Need a consistent plan for ecosystem monitoring implemented over the 20-year LTEMP

Project Element C.2. Mechanistic Experiments with Plant Species of Interest <new>

Project Element C.3. Predictive Modeling of Vegetation Responses to Dam Operations

* Integrate changes of vegetation type or structure on wildlife (feed, habitat). Change of veg over time and effects of wildlife, longer than just the last few years, pre-dam to present. Beaver, bighorn, mule deer. Look for collaboration with NPS wildlife unit.

Project Element C.4. Vegetation Management Decision Support

## Project E. Controls on Ecosystem Productivity: Nutrients, Flow, and Temperature

* Consider updating the models used in the LTEMP analysis for use in the future.
* Fully fund Charles Yackulic's position for work on ecosystem modeling. We need him working full time on AMP projects.
* Provide time and funding for Charles Yackulic to complete his ecosystem model and model of Gross Primary Productivity.
* Consider adding a series of dissolved oxygen sensors to the temperature sensors above Glen Canyon Dam.
* Consider monitoring to determine the actual extent of low dissolved oxygen concentrations below Glen Canyon Dam in low dissolved oxygen events. Consider adding an aeration system (Solar Bee?) below the dam if these events continue to occur.
* Need to look at some basic physiology of HBC (and FMS). Why don’t HBC get skinny when they are starved? It looks like they have really low basal metabolic needs. What would happen to HBC metabolic rates under warmer water conditions?
* Can we see a response in chub growth, survival, condition, etc. from the warming that occurred in 2019. What are the implications or effectiveness of trying to increase warming with the LTEMP’s LSF experiment?

Project Element E.1. Phosphorus Budgeting in the Colorado River <new>

Project Element E.2. Rates and Composition of Primary Producers in the Colorado River <new>

* Is there a way to tie in a habitat quality component for aquatic macroinvertebrates? Look further at anoxic substrates, chara, and effects on the aquatic macroinvertebrate community?
* Consider studies of how nutrient limitation affects production. Consider a small pulsed nutrient addition to measure how is it taken up? Where does it go? Does it increase production? Are nutrients bound with higher pH or turbidity further downstream?

Project Element E.3. Productivity at Higher Trophic Levels

* Develop an SRP model for GPP and fish condition to make ecosystem level predictions.

###

## Project G. Humpback Chub Population Dynamics throughout the Colorado River Ecosystem

* Can parasite monitoring be done only every 5-10 years? Should other parasites be included other than tapeworm and anchorworm?
* It appears native fish in western Grand Canyon are on the upswing while nonnative numbers are down. However, as water temperatures increase, this trend may disappear if nonnative predatory fish from Lake Mead move upstream. Projects which should be continued: LCR Projects, Translocations Projects, and Aggregations Projects. Projects which could be delayed given budget constraints: Bioenergetics Studies, Predation Studies, Parasite Monitoring, and Genetic Studies.

Project Element G.1. Humpback Chub Population Monitoring

* How does habitat quality in the LCR affect chub population dynamics? Floods, flushing, sand accumulation, calcium carbonate build up.

Project Element G.2. Annual Spring/Fall Abundance Estimates of Humpback Chub in the Lower 13.6 km of the LCR

Project Element G.3. Juvenile Chub Monitoring near the LCR Confluence (JCM-east)

Project Element G.4. Remote PIT Tag Array Monitoring in the LCR

Project Element G.5. Monitoring Humpback Chub Aggregation Relative Abundance and Distribution

* How many chubs are in WGC?

Project Element G.6. Juvenile Humpback Chub Monitoring in Western Grand Canyon (JCM-West)

* What are the drivers for HBC in the WGC?
* How do we keep the increases of native fish going in WGC?
* Otolith data: Determine if local production in the mainstem WGC or tribs in WGC? Otolith microchemistry have been collected, just need to evaluate the data.
* More monitoring should be down in the western Grand Canyon. What are the drivers for HBC in the WGC? How have resource availability changed? Fewer nonnative fish making more resources available for native fish? Need a trophic study.

Project Element G.7. Chute Falls Translocations

Project Element G.8. Backwater Seining

Project Element G.9. Assessing Yearly Variability in Humpback Chub Hatch Dates <new>

## Project J. Socioeconomic Research

Project Element J.1. Predictive Models for Adaptive Management <new>

* Continue to develop the TMF study plan. Design TMFs that can be implemented coincident with and without substantially interrupting a variety of operational scenarios (normal operations, equalization, spring HFEs, etc.). While making sure the focus of the experiment remains on trout management, monitor the impacts of increased fluctuations and ramp rates to hydropower production, recreation, and sediment. Conduct a recreation survey of impacts of increased fluctuations and downramp rates during a TMF experiment.
* In an effort to reduce the duration of bypass for HFEs, identify the minimum duration needed for HFE to rebuild sandbars that meet the LTEMP goals for sediment-related resources? Was the 60h HFE in 2018 as effective at building sandbars as the 96h HFEs in 2012, 2013, 2014, and 2016? At what point does bar building become saturated and then you are just transporting sediment downstream for the remainder of the HFE?
* Would a shorter duration HFE following a very large sediment input year allow for the possibility of having a second shorter duration HFE later?

Project Element J.2. Brown Trout Incentivized Harvest <new>

Project Element J.3. Recreation Monitoring and Research <new>

* This is the only project element addressing the Recreation resource. Will this investigate: Sandbar campsite area, angling preferences, preferences in flow variation (minimum/maximum flows and fluctuation range), and Crowding both in Glen and Grand Canyons?

## Project K. Geospatial Science, Data Management and Technology Project

Project Element K.1. Enterprise GIS, Geospatial Analysis and Processing

Project Element K.2. Data Management and Database Administration

Project Element K.3. Remote Monitoring and Advanced Technology Support

## Project L. Overflight Remote Sensing in Support of Long-Term Monitoring and LTEMP

Project Element L.1. Overflight Remote Sensing

## Project M. Administration