Glen Canyon Dam Technical Work Group Meeting
October 20-21, 2015

Conducting: Vineetha Kartha, TWG Chair
Shane Capron, TWG Vice-Chair

Convened: 9:30 a.m.

Committee Members/Alternates Present:
Jan Balsom, NPS/GRCA
Cliff Barrett, UAMPS
Charley Bulletts, Southern Paiute Consortium
Chris Budwig, Int'l Federation of Fly Fishers/TU
Kerry Christensen, Hualapai Tribe
Jerry Lee Cox, Grand Canyon River Guides
Marianne Crawford, U.S. Bureau of Reclamation
Kevin Dahl, National Parks Conservation Assn.
Kurt Dongoske, Pueblo of Zuni
Craig Ellsworth, WAPA
Paul Harms, State of New Mexico
Leslie James, CREDA
Robert King, State of Utah (phone)
Ted Kowalski, State of Colorado
Jessica Neuwerth, State of California
Larry Stevens, Grand Canyon Wildlands Council
Bill Stewart, Arizona Game and Fish Department
Rosemary Sucec, NPS/GLNRA (phone)
Don Ostler, State of Wyoming
Michael Yeatts, Hopi Tribe

Committee Members Absent:
Bill Davis, CREDA
Evelyn Erlandsen, State of Arizona
Chris Harris, State of California
Chip Lewis, Bureau of Indian Affairs
Steve Wolff, State of Wyoming
Kirk Young, U.S. Fish and Wildlife Service
VACANT, Navajo Nation
VACANT, State of Nevada
VACANT, U.S. Bureau of Reclamation

Grand Canyon Monitoring and Research Center:
Kyrie Fry, Communications Coordinator
Ted Kennedy, Aquatic Biologist (phone)
Scott VanderKooi, Center Director

Interested Persons
Melinda Arviso-Ciocco, Navajo Nation
Chuck Bradley, Salt River Project (phone)
David Braun, Sound Science LLC (Science Advisors)
Bill Chada, Bureau of Reclamation
Chris Cantrell, Arizona Game & Fish Department
Jennifer Crandall, State of Nevada
Chrystal Dean, WAPA
Lesley Fitzpatrick, U.S. Fish and Wildlife Service
Ed Gerak, CREDA
Katrina Grantz, U.S. Bureau of Reclamation (phone)
Jessica Gwinn, U.S. Fish and Wildlife Service
John Hamill, Int'l Federation of Fly Fishers/TU
Brian Healy, NPS/GRCA
Beverley Heffernan, U.S. Bureau of Reclamation (phone)
John Jordan, Int'l Federation of Fly Fishers/TU
Sonja Kokos, Bureau of Reclamation
Mike Martinez, U.S. Fish and Wildlife Service
Lisa Meyer, WAPA
Joe Miller, Int'l Federation of Fly Fishers/TU
Jenika Raub, Salt River Project
Dr. Sarah Rinkevich, DOI Tribal Liaison
Seth Shanahan, SNWA
Melissa Trammell, NPS
Bob Unnasch, Sound Science LLC (Science Advisors)
Brian Wooldridge, U.S. Fish and Wildlife Service

Meeting Recorder: Linda Whetton

Welcome and Administrative: Ms. Kartha welcomed the members and the public. Introductions were made and a quorum determined. Guidelines for participating in the webinar were reviewed.

- Introduction to New Science Advisors – Ms. Crawford introduced Bob Unnasch and David Braun with Sound Science LLC. They're developing a workplan and have submitted draft ideas to Marianne for internal discussion. They'll be meeting with GCMRC staff later this week to review what science has been done. Mr. Capron suggested they could be involved in the next Fish PEP and assist with the Lees Ferry trout recommendations.
- Approval of January 20-21, 2015, Meeting Minutes – Motion to approve by Mr. Christensen, seconded by Ms. Balsom. Pending one edit, the minutes were approved by consensus.
- Approval of June 9, 2015, Meeting Minutes – Motion to approve by Mr. Christensen, seconded by Mr. Stewart. The minutes were approved by consensus.
- Review of Action Items (***Attachment 1***).

- Updates –
  - Programmatic Agreement – Mr. Chada. The PA Group is in the process of addressing comments they received on the second draft.
  - TWG Operating Procedures – Mr. Capron. No changes are required at this time.
  - Budget Timelines, Process Paper – Mr. Capron. In transitioning to a 3-year budget process, Table 1 needs to be revised. Much of the detail was input by former GCRMC Chief Jack Schmidt and the right level of detail needs to be determined. The TWG should consider making a recommendation to the AMWG at their February 2016 meeting. He suggested a small group review and the following individuals volunteered to assist in that effort: Shane Capron, Marianne Crawford, Vineetha Kartha, and Scott VanderKooi. The TWG will begin discussions on the FY17 budget and in the fall of 2016, they'll start working on the TWP for FY 2018-2020. Mary Orton can assist as needed.
  - USBR Group Chief Vacancy – Ms. Crawford. Glen Knowles accepted a position with the USFWS in Ventura, California. BOR staff will be rotating in "acting" capacities until that position is filled. Mr. Capron expressed his appreciation for Glen's work in the program.
  - New GCRMC Chief – Mr. VanderKooi. Mr. VanderKooi was selected as the new GCMRC Chief and said he is looking forward to serving in the GCDAMP. Once the LTEMP EIS is completed, he wants to work with GCMRC and the TWG to reconcile past documents with knowledge learned.
  - Recognition of Daniel Sarr – Mr. VanderKooi. GCMRC suffered a tragic loss with the death of Daniel Sarr who died of heat stroke while on a vegetation survey trip in August. Daniel had over a decade of service with NPS, had done Klamath work, and been at GCMRC for about a year. He got his degree in biology in 1998, a Master's in aquatic work during the next decade and went on to earn his doctorate. He was a very good scientist and an enthusiastic person. He leaves behind a wife and a 12-year-old son. The group observed a moment of silence to remember him.

GCNRA Restoration Ponds (***Attachment 2***) – Dr. Stevens. Through some restoration activities being done in the GLNRA since 2000, they've been trying to recreate habitat for the Northern Leopard Frog at two sites – Hidden Slough (-6.5R) Leopard Frog Marsh (-9R). He presented slides on Leopard Frog Marsh upper pond construction 2014. In March 2015 they brought in a team of Prescott College students and constructed two more ponds – a middle pond with structures in it and within several months it got surrounded by very dense phragmites. There is a post-dam spring that emerges in landscape there bringing in rather warm but filtered water into the site and then that water gradually works itself into the river. Thus, the spring water is quite different as the sandstone really fiters a lot the ions out of the water. It comes in pretty fresh but also fairly warm and works its way down to the river. The ponds are intermediate in that water quality. Hidden Slough was more of an experimental site as Leopard Frogs probably weren't ever really there in great number. These ponds are overtopped by HFEs but are surrounded by dense vegetation and this is a very low velocity eddy system so there isn't much sedimentation that goes on from HFEs. The sites are monitored for a couple of years to help gage the flow of the spring. They're also concerned about the Niobrara ambersnail at the Leopard Frog marsh site and have been monitoring its population and responses. The snail doesn't occur in the dense phragmites. One thing that concerned them at the Hidden Slough site was that digging there they wouldn't have fresh enough water coming through the soil, it would simply be the rising and failing of the river water table that would water that pond. The salinity and electrical conductivity of that water are really too high for frogs. The water temperatures warm pretty good there. The ponds maintain moderate level of salinity at Leopard Frog Marsh. With the ponds in place, the agencies can bring back the frogs if they choose to. Intervebrates are reproducing in the ponds but not in the river.

- *What triggers when you relocate or translocate the frogs?*
  - *The FWS wanted to see two years of data on how well the habitat maintains itself, evidence that the ponds don't fill in sediment every time we have an HFE and then the Park Service would make any of the final decisions.*
- *Where are frogs now?*
  - *In GLCNRA several springs that feed into the reservoir contain populations of Northern Leopard Frogs, but all populations of Leopard Frogs below the dam have been extirpated in post-dam time.*
- *If the HFEs flood these ponds out, is that going to be a problem after the frogs are introduced there and the species living there? Will that be a problem for HFEs?*
  - *The frogs are not endangered. It would be restoration of a non-endangered species – just bringing back a species that's not listed. They're certainly a concern to the states and the agencies and*

from their reproductive behavior, they actually hop out of the ponds and go into the uplands to over winter so if we have HFEs in the wintertime, that probably won't be an issue. Also, because the velocities of the ponds are so slow, even if the HFEs came at 45,000 cfs, the velocities of the ponds are essentially zero. There's no sediment falling out from the HFEs into these ponds in that reach.

- *What about long-term monitoring?*
  - *Funding concludes this year so if anyone is interested in taking up some monitoring, that would be great. Our job was to create the habitat and determine whether it is/isn't suitable for Leopard frogs.*
- *Are these ponds self-sustaining?*
  - *We only have 2 years of data on the ponds but with no sedimentation, all we did this last year to the helper pond was add a little more structure so there's more places for the frogs to hop out.*

TWG Ad Hoc Group Review (***Attachment 3***) – Mr. Capron. The TWG Ad Hoc Group List was circulated for anyone interested in adding/deleting their names. The groups' charges were reviewed:

- Steering Committee (SCAHG) – Mr. Capron. This group develops agenda for TWG meetings and provides leadership for the TWG. Outside people can participate but a required decision must come from one member/one alternate.
- Socioeconomics (SEAHG) – Ms. James. This group is always looking for new members and needs to fine tune its charge. Ms. James will work with Lucas Bair in arranging for a conference call.
- Budget Ad Hoc Group (BAHG). Mr. Capron. This group will begin working on the FY17 budget in preparation for a TWG recommendation to the AMWG in August 2016.
- Cultural Resources AHG (CRAHG) – Mr. Dongoske. This group convenes based on TWG assignments.
- Administrative History Ad Hoc Group (AHAHG) – Ms. Kartha. With the passing of Jason Thiriot in June, the chair position has been vacant. The CRC staff will continue to provide technical support of the "wiki" website and Mr. Ellsworth will do the technical updates. Ms. Crawford has a contracting package focused on getting the oral histories but feels significant time has passed and would like the AHAHG to review the Scope of Work again. Anyone interested in being the chair should contact Ms. Kartha.
- Species of Management Concern (SMCAHG) – Mr. Stevens. The challenge with re-drafting the White Paper by the end of the year is that the list has been expanded to include non-natives as well. He doesn't think they'll get through the evaluation prioritiziation process which might warrant more attention for the non-natives. He added that the NPS has data on eagle migrations through Grand Canyon, not of GRNP population, but birds that are moving through the Park. Analysis indicates that bald eagle populations coming across the Canyon, which is one of the management concerned species for the overall CRE, have been pretty stable the last 19 years. The golden population, which is also protected under the Golden and Bald Eagle Act, seems to be crashing in the West. Mr. Stevens will e-mail the white paper to the TWG.
- Core Monitoring Ad Hoc Group (CMAHG) – Mr. Capron. Activity by this group has been tabled until completion of the LTEMP EIS.

Upcoming Protocol Evaluation Panel (PEP) Reviews (***Attachment 4***) – Mr. VanderKooi. Update on the proposed PEPs:

- Project Element 8.3. GCDAMP Fisheries Research, Monitoring, and Management Actions protocol Evaluation Panel. Given the size of the fisheries program and what's been learned since the last PEP done in 2009, GCMRC felt it was time to do another review. Development of the panel will be provided by the cooperating agencies, AZGFD, USFWS, and NPS along with assistance from the Science Advisors. The panel will conduct a review of all aspects of the GCMRC fisheries program described in Projects 6, 7, 8, and 9 of the FY15-17 workplan. This will include HBC work done in the mainstem and in the Little Colorado River, population community dynamics in the mainstem and the LCR, focus on various experimental actions to increase the abundance and distribution of native fish.
- Project 11.5. Science Review Panel of Successes and Challenges in Non-native Vegetation Control in the Colorado River and Rio Grande Watersheds. This panel was convened in late June with heavy involvement from the Park Service. With Daniel Sarr's passing, the work is on hold until GCMRC is able to decide what to do with Daniel's position. Recommendations will be sought from this group on planning a scientifically-based riparian management control program applicable to the Colorado River ecosystem in Glen, Marble, and Grand Canyons.
- Project 1.2 – Reservoir Limnology/ecology and linkage Protocol Evaluation Panel – This is something Dr. Schmidt was very interested in and had discussed with Ann Gold prior to her retirement (Sep 2014). With

Bill Vernieu's retirement in May, Reclamation has put the work on hold. Scott has exchanged e-mails with GRCA trying to get this work started again but that was in late August.

Invasive Species Threats, Green Sunfish (***Attachment 5a***) Mr. VanderKooi. A timeline was presented for eradicating green sunfish (GSF). On October 27-29 a salvage operation is planned for common carp and flannelmouth suckers followed by treatments for Nov 4 and Nov 14. Mr. Healy (***Attachment 5b***) said the AZGFD and the NPS are co-leads in trying to eliminate GSF from the backwater sloughs. This is urgent due to the risk of negative interactions with native fish particularly the HBC if GSF disperse downstream in large numbers. Two subsequent removal trips using electrofishing, seining and trapping methods failed to deplete the population despite removing over 3,000 fish. Chemical treatments will most likely provide the greatest likelihood of success. Once NPS gets the NEPA process completed, AZGFD will seek a permit to use Rotenone.

- *How long have the green sunfish been in the backwater? Have they been washed down with the HFEs or is this something that is new?*
  - *AZGFD has been monitoring the big slough for some time. The back slough hasn't been evaluated and is pretty isolated. Potentially the sunfish could be coming through the dam. Temperatures are warmer in that area (20º). It could be a breeding ground.*
- *What's the likelihood of GSF coming from the dam - from the turbines or the HFE bypasses?*
  - *It's likely they came through the turbines last year. They're pretty small but their ability to reproduce and proliferate are of concern. Some have also been found in Kanab Creek.*
- *Is there any way to prevent GSF from going through the penstocks?*
  - *The Corps of engineers has put in a lot of screens. It's an expensive effort and are large complex structures with high price tags. More discussion may be needed.*
- *How does turbidity relate to the curtain going across?*
  - *It is what it is. The turbility curtain can be at same location as the net.*
- *Dead fish will be picked up so condors don't eat them and people won't see piles of dead fish. A news release should be distributed advising people of the GCDAMP's supportive of this removal effort.*
- *As much as it would be appreciated to have volunteers assist in the effort, the actual application is pretty limited and people must wear protective equipment and fit tests are required for using Rotenone.*

Lees Ferry Fisheries Update

- Lees Ferry Recreational Trout Management Recommendations (***Attachment 6a***) – Mr. Hamill. The purpose for putting the recommendations together was to complement the work that NPS and AZGFD had done for the fish management plan. Currently, the Lees Ferry trout fishery is ecologically unstable due to an impaired aquatic food base and high levels of trout recruitment that results in a population that exceeds the carrying capacity of the river. Their highest priority recommendation is to puruse establishment of a more diverse aquatic food base by testing alternative flow regimes in conjunction with repatriating the Lees Ferry Reach with native aquatic invertebrates including may- caddis-, and stone-flies. Their goal is to establish, maintain and enhance a wild self-sustaining blue ribbon trout fishery at Lee's Ferry that doesn't affect the native aquatic community downstream. They tried to develop balanced recommendations to that support other values such as hydropower, conservation, archaeological site protection, building beaches, and to provide a dependable quality and stable fishery that sustains economic interests that depend on this fishery for their livelihood. There needs to be an action plan in place.
- Mr. Stewart said this has been an unprecedented effort by their agency in terms of the support they've received from the anglers and the collaboration of this management plan. He presented a table of the objectives and strategies if the objectives aren't met (***Attachment 6b***) along with the angler recommendations:
  - Size structure indicative of a stable RBT population (YOY = 20-50% of population)
  - Angler catch rate >1 fish/hr for RBT ≥ 14"
  - Angler catch rate >0.1 fish/hr for RBT ≥ 20"
  - A robust body condition (Kn ≥ 1.0 in summer months)
  - A diverse aquatic food base with 10% abundance of EPT species

The following recommendations were offered:

  - Real time DO information from GCD
  - Development of a low DO action plan
  - Development of food base enchancement strategies
  - Creation of an ad hoc group to address strategies for reaching objectives
  - If sand budget allows, there is support for a Spring HFE
- *Whenever the group is talking about DO issues, the Power Office needs to be notified. Reclamation was having mechanical issues at Flaming Gorge in 2005 when there was a DO incident.*
- *The water quality work was suspended when Bill Vernieu retired in May. Reclamation hasn't determined how it will go forward with the program.*

- *The Fisheries Management Plan, Colorado River-Lees Ferry 2015-2025 plan was approved on September 30, 2015 (**Attachment 6c**).*

GCMRC Evaluation of Trout Management Recommendations (***Attachment 6d)*** – Mr. VanderKooi distributed copies of his memo to the TWG Chair dated October 19, 2015, which offered responses to the Lees Ferry Recreational Trout Fishery Management Recommendations. He stressed that GCMRC was talking about "science" recommendations and not "management" recommendations. He went through the various sections but hasn't looked into the stock assessment model because Josh Korman had responded there were already two stock assessment models and suggested this particular section be reworded to say that existing stock assessment models should be used to provide a more robust interpretation of the CPUE time series if that time series is to be continued. Mr. Hamill asked why GCMRC had only commented on five of the 14 recommendations. Scott told him that they reviewed the recommendations in terms of science and that some of them fell into policy areas, which GCMRC remains neutral on.

  - *There are statements about equalization flows and opening Interim Guidelines and the State of Colorado is unwilling to open those discussions.*
  - *Nevada has already looked at things as part of the LTEMP process and with respect to equalization flows, there are a lot of laws on the books that wouldn't allow those to be done.*
  - *With respect to equalization flows, the trout response in 2011 exceeded the 2008 spring high flows. You should also be concerned with trout response to equalization flows.*
  - *One way to proceed is to have a trout ad hoc group that would take the recommendations, take GCMRC's review of that, consider LTEMP and the PEP, and put together a recommendation for the AMWG and get buyoff from the entire TWG.*
  - *These equalization flows are high flows provided by mother nature. They have to go somewhere and the Law of the River provides a way for them to be distributed. It's actually less of a high flow than if we just sent it down river. High flows are in the system and they have to go down.*
  - *The AZGFD is one agency that holds wildlife for public trust and needs to make sure that if there are effects through dam operations through the revising of the LTEMP, that there's legislative actions that have been approved through the Fish and Wildlife Coordination Act and NEPA. If we see through data areas that are impacted through changes in operations, they need to be looked at in ways to mitigate them. Those recommendations provide really good alternatives to mitigate those areas and whether it's not equalization flows or it's another one of these other translocations of bugs or things like that, that we can put together to mitigate those things so that the operations don't continue to fluctuate where we have fish kills and too many fish in the water. .*

The IFFF/TU are looking for follow-up on the AMWG motion and focusing on whether the recommendations are science-based and is a reasonable approach to management. The ad hoc group's initial task would be to consider GCMRC's review, whether it's science-based, and make a recommendation to AMWG to accept or recognize it as a science-based recommendation that warrants further consideration by AMWG and the greater community without delving into policy level details. Mr. VanderKooi said he would perform another review and comment on all the recommendations in the report.
Ms. Kartha introduced the following draft charge for the TWG's consideration:

Draft Charge: The Trout Ad Hoc Group (TAHG) will evaluate the GCMRC technical eview of the Lees Ferry Recreational Trout Fishery Management Recommendations per the AMWG motion on

8/27/15, and make a recommendation to the TWG at our January 2016 meeting, on whether the recommendations are science-based and represent a reasonable approach to management of the Lees Ferry trout fishery. The TWG will consider the recommendation and make a recommendation to the AMWG at its Feburary 2016 meeting.

Concerns noted:

- *It's important to put stakeholder viewpoints into perspective. There is already a comprehensive fisheries management plan and an LTEMP EIS underway. These will present opportunities for how the recommendations can fit in. There are also management responsibilities that have nothing to do with the AMWG or the TWG that have to be considered. Be cautious of the charge and look at the biological and scientific merits of what the angler plan is.*
- *GCMRC is not a management agency so if it's carried forward to a workplan situation, it might need to be part of the Park Service's management plan.*
- *It's unclear where the NPS CFMP and the management's responsibilities the agency has in that reach. The AZGFD has a water body in the state of Arizona and what I see here are management goals that have been adopted by AZGFD and how those two processes reconcile.*
- *The motion talks about GCMRC conducting the technical review and the TWG evaluating it and reporting its findings to AMWG. We can find whatever we want and can find that some of these recommendations are inappropriate or we can find that some of them are not well timed in terms of LTEMP or because of the pending PEP review. We can make findings about whatever we want. It should be related to these recommendations and to their technical review, but I don't think we're bound by the same technical review. That was directed just to GCMRC.*

Revised Charge: The TAHG will evaluate the GCMRC technical review of the Lees Ferry Recreational Trout Fishery Management Recommendations per the AMWG motion on 8/27/15, and make a recommendation to the TWG at our January 2016 meeting. The TWG will consider the recommendation and make findings to the AMWG at its Feburary 2016 meeting.
Chair: Bill Stewart **Members**: Mark Anderson, Chris Budwig/Joe Miller, Kerry Christensen, Kurt Dongoske, Craig Ellsworth, Paul Harms, Brian Healy, John Jordan, Vineetha Kartha, Jessica Neuwerth, Seth Shanahan

Tribal Reports –

- 2015 Zebra-Tailed Lizard Monitoring Hualapai Reservation (***Attachment 7a***) – Mr. Christensen. The 1983-4 flood event on the Colorado River caused river raft operations to drive over the dunes for raft take out and launch. No more zebra-tailed lizards could be found at Diamond Creek and they were deemed as extirpated in Grand Canyon. In 2012, Reclamation funded a Hualapai project to implement a translocation and monitoring effort at the Diamond Creek dunes. Twelve lizards were translocated from Peach Springs Canyon to Diamond Creek. With such a small population there are no projects in the work plan. They're looking at increasing the genetic diversity and add more males and females.
- August 2015 River Trip-Navajo Historic Preservation Department – (***Attachment 7b***) – Ms. Arviso-Ciocco. The teachings from their oral and ceremonial histories comes with age and it's felt that when a person has gray hair, they are able to speak indepth about their histories and way of life. She presented a map depicting their aboriginal land boundaries. Prior to starting the August 2015 river trip, they did an offering and songs were sung. for safe journeys and safe passage. One needs to have specific passageway knowledge to be able to get through it and so it's always very meaningful.. The bridges are used for traditional offerings and are made before crossing the bridges.. They observed in the hogan areas that a lot of the pot chards are gone since the last trip.
- Southern Paiute Vegetation and Cultural Resource Monitoring Program (***Attachment 7c***) – Mr. Bulletts. He presented pictures indicating an increase in sediment as well as vegetation change and the effects of the tamarisk beetle from 2011-2015 at the Beach in South Canyon. Sand deposits above Kanab Creek show an increase in deposition between 2013 to 2015.

Public Comment: None

Adjourned: 4:50 p.m.

Glen Canyon Dam Technical Work Group Meeting
October 20-21, 2015

Conducting: Vineetha Kartha, TWG Chair
Shane Capron, TWG Vice-Chair

Convened: 8:15 a.m.

Committee Members/Alternates Present:

Jan Balsom, NPS/GRCA
Cliff Barrett, UAMPS
Kerry Christensen, Hualapai Tribe
Jerry Cox, Grand Canyon River Guides
Kevin Dahl, National Parks Conservation Assn.
Bill Davis, CREDA
Kurt Dongoske, Pueblo of Zuni
Evelyn Erlandsen, State of Arizona
Paul Harms, State of New Mexico
Robert King, State of Utah
Glen Knowles, Bureau of Reclamation
Ted Kowalski, State of Colorado
Jerry Myers, Federation of Fly Fishers
Jessica Neuwerth, State of California
Larry Stevens, Grand Canyon Wildlands Council
Bill Stewart, Arizona Game and Fish Dept.
Rosemary Sucec, NPS/GLNRA
Jason Thiriot, State of Nevada
Steve Wolff, State of Wyoming
Michael Yeatts, Hopi Tribe

Committee Members Absent:

Charley Bulletts, Southern Paiute Consortium
Jerry Lee Cox, Grand Canyon River Guides
Chris Harris, State of California
Kirk Young, U.S. Fish and Wildlife Service
VACANT, Navajo Nation

Grand Canyon Monitoring and Research Center:

Helen Fairley, Social Scientist
Dave Lytle, Director SBSC
Chris Schill, Budget Analyst
Scott VanderKooi, Center Chief

Interested Persons

Mary Barger, U.S. Bureau of Reclamation
Bill Chada, Bureau of Reclamation
Marianne Crawford, U.S. Bureau of Reclamation
Katrina Grantz, U.S. Bureau of Reclamation
Beverley Heffernan, U.S. Bureau of Reclamation
Leslie James, CREDA
Joe Miller, Int'l Federation of Fly Fishers/TU
Dr. Sarah Rinkevich, DOI Tribal Liaison
Seth Shanahan, SNWA
David Walters, U.S. Geological Survey

Meeting Recorder: Linda Whetton

Welcome and Administrative: Ms. Kartha welcomed the members and the public. Introductions were made and a quorum determined.

- River Trip Reports. The following comments were provided from those who participated on river trips this past year.
  - *Shane Capron: I went on the second half of the HBC aggregation survey this past summer and also went last summer. We seem to be seeing a lot of HBC in the lower river, a lot of small fish. Appreciate going out with FWS and they did some backwater seining along the trip and it was amazing the number of native fish seen, had great discussions with Bill Pine about how well we're doing on recovery and just a fantastic number and different age classes of HBC down there as well as other native fish.*
  - *Jessica Neuwerth: I went on half of the AMWG river trip in July and it was a very fun experience. It was my first time in the canyon and my first time seeing it since I was really small so it was an interesting experience being down there and seeing all these things in person that we talk about at these meeting. Got to see HBC which was pretty exciting and got to know a lot of the people in this room and at this table better. It was definitely a learning experience.*
  - *Vineetha Kartha: Want to thank Loretta and Sarah for putting the AMWG river trip together. I got to see Brian Healy's skills and seeing some HBC captured. Larry Stevens was talking to us one night and just grabbed something from the air and he had a beetle in his hands. I would encourage people to go on a river trip especially with Larry, Brian, Shane, or Scott because it really is a life*

changing experience. It was for me because I went on the Navajo Nation river trip last year. It provided me a lot of strength, both spiritually and emotionally, and also understanding the concepts a lot more strongly than I had before. If you go on tribal river trip, you develop a much better understanding of where the tribes are coming from. It helps strengthen relationships and I formed very strong bonds with everyone that was on the river.

- *Sarah Rinkevich: I want to give a shout-out to Larry Steven. While we were on the river trip, he would get on one of the boats and orate and I just want to say that Larry knows everything that's in the canyon.*
- *Beverley Heffernan: I want to second my thanks to Larry for his help on the river trip and his information and to Vineetha for leading us in stretching exercises every morning.*
- *Larry Stevens: I do not know everything. These trips are so great because they allow people to understand different points of view, the Grand Canyon's endless dimensions of processes, species and human interactions all going on in one place. The more you investigate those dimensions, the harder it is to push an agenda either for or against some policy. There are tradeoffs at every junction. It's a fantastic opportunity and essential to this program to have people interact with the Canyon and its resources.. It allows those conversations to take place and have to meaning. Having spent a lot of money on HBC, , it's hard to understand how passive and gorgeous that animal is. We're all always on a journey and the journey is to take care of that place and that's what we're trying to do.*

If people are interesting in helping on an NPS monitoring trip, they should contact Brian Healy.

Mercury and Selenium in the Colorado River (***Attachment 8a***) – Mr. Healy. The NPS has a large non-native fish control project in BAC and,in consultation with tribes, they provided trout to tribes for beneficial use. Mercury in fish is a concern where consumption is involved. The federal agencies are responsible to provide that information to the state and to work with the public. The two species that were being removed and provided for consumption are rainbow and brown trout, which are generally low in mercury relative to other fish species that are commonly caught and eaten by people. For example, RBT mean Hg = 0.11 ppm, BT = mean Hg ppm, contrasted with average can of albacore tuna that's about 0.35 PPM. Preliminary data indicate relatively low mercury levels from trout in BAC are lower than the national average. Additional fish will be collected in February from the BAC inflow reach. GCMRC has also collected some additional fish from the mainstem.

Dr. Ted Kennedy (***Attachment 8b***) – Mercury and selenium concentrations were found in the mainstem Colorado River throughout GRCA and GLCA and were relatively high compared to other large rivers and to various EPA thresholds. Mercury and selenium were seen in organic matter, algae, invertebrates and fish exceeded various protective thresholds for fish, wildlife and in some cases humans. Although some fish exceeded human thresholds, there are fish that humans would actually target for consumption so the risk to human appears to be low. Mercury concentrations were low in RBT in GLCA, well below any human risk thresholds so human health risks associated with this sport fishery appear to be very low. Mercury concentrations were found in small trout from downstream locations where some of these areas have been targeted for trout removal which suggests that more work is needed to better assess human health risks. As Brian presented, the samples NPS has collected are relatively low. Managing explosure risks in GRCA will continue to be a challenge because sources of mercury and selenium are well beyond Park boundaries. The Colorado River in GRCA is a very remote ecosystem but it's also heavily altered. One alteration that many of us are familiar with is changes in the physical template, specifically water clarity. Prior to closure of the dam, the river was extremely turbid. . After closure of the dam water in the Colorado River is now about 1,000 times clearer than it was before the dam. This has led to a proliferation of filamentous algae and increases in primary production. This change in the physical template has changed the structure of the food web by allowing algae to proliferate. Another change were the wide range of water temperature fluctuations going from 30º C to 0 on an annual basis prior to closure of the dam. After closure of the dam, it's uniformly cold water temperatures and not very much seasonal variation.

Dr. David Walters – Data on contaminant exposure are generally lacking from the Grand Canyon segment owing to the difficulty of collecting samples from such a remote and inaccessible area. He offered the following key findings:

- Mercury (Hg) and selenium (Se) concentrations are relatively high in the Colorado River food web throughout Grand Canyon.
- Hg and Se in organic matter, algae, invertebrates, and fish exceed protective thresholds for fish, wildlife and humans.
- Hg concentrations were low in rainbow trout in Glen Canyon, so human health risks associated with this popular sport fishery are low.
- However, Hg in trout was higher downstream. Some of these areas are targeted for trout removal, which are provided for human consumption.
- Managing exposure risks in Grand Canyon will be challenging because sources of Hg and Se are beyond Park boundaries.

- *The data that we're looking at is from 1991 from the selenium and mercury data but the fish data is more current at 2009?*
    - *The mercury data was associated with the Navajo Generating Station study and was collected in 1991. The selenium data was collected in 1989-1999. Our data came from 2008. The 1991 study was an SO2 study.*
- *Could these high metal levels be part of the puzzle where we're not seeing EPT below the dam? Are these levels comparable to other tailwaters that have high levels of those insects?*
    - *That 1991 study was not a mercury specific study, it was largely centered on SO2 for some visibility analysis. As part of the EIS work with Reclamation on the life extension of NGS, we'll be looking at emissions and deposition of the surrounding area and will also be analyzing the effects of other local, regional and global desposition of mercury and selenium in the various watersheds surrounding the plant. That's coupled with ecological risk and human health risk assessments as well. That information should be out by middle of next summer for review. The data was from 1991 but published in 1999. If emissions from NGS are making their way against prevailing winds all the way down to Hopi Point, the NGS is a potential source of mercury which is another type of emittant to the food web. We fully acknowledge in the paper there is a large global pool but it seemed important to acknowledge there's this point source that's approximate to Grand Canyon that could be contributing.*
    - *There are very few types of these data from tailwaters in large western rivers to compare to so there's some uncertainty there. Even at these levels, they would not be toxic to invertebrates and that the main changes in the invertebrate community are probably more associated with the gross changes in the river itself in terms of daily peaking, cold temperatures, etc., rather than toxic effects. The levels we're seeing here don't think can explain the absence of EPT.*
- *Your study is about mercury and selenium which are two of many possible contaminants in the system. Do we have a portrait of the array of contaminants that we should be concerned with including arsenic, uranium, and others that might be affecting our resources?*
    - *Mercury and selenium were targeted for this particular study. The 2007 paper came out before we initiated our research and showed that mercury and selenium were relatively high. We have not measured anywhere in the canyon on organic contaminants like pesticides or legacy contaminants like PCB. In 2012 we did a very preliminary study on trace metals in the Lower Colorado River and then in 2013 we followed that up with a larger look at trace metals at a few sites on the mainstem and focusing also on a few tributaries, in particular Mankoweap, Kanab and the LCR. We have trace metal data from those systems and we looked there at again organic matter, larval insects focusing on black flies as well as adult insects in those parts of the basin.*
- *We can't draw a conclusion about the relative relationship between the naturally occurring mercury or atmospheric mercury from other parts of the world and the amount that's deposited as a result from the powerplant operations in that area?*
    - *That's correct. Mercury work is being done in Lake and believe that part of what they're going to do is try to get at the source of issues.*
- *We have a selenium management plan in Colorado that we're involved with in the context of the Gunnison PBO and the Upper Colorado River Recovery Fish Program and was wondering if you're aware of either other management programs for selenium and/or mitigation activities associated with mercury?*

  - *Not beyond what anyone has. There's quite a bit of work being done in the Upper Colorado on selenium. I don't know about the rest of the basin. In terms of mercury, the big is the EPA rule on reducing emission from coal-fired powerplants.*
- *In the early 1990s there were significant issues with selenium concentration in the irrigation systems in the Central Valley in California that resulted in embryonic issues especially among birds. One of the results of that issue was the development of a variation of cattail or tully that was used to sequester selenium so it could be harvested out of large irrigation systems. I will get references to you but there's a been a lot of work done.*

Glen Canyon Dam Annual Operating Plan (***Attachment 9a***) – Ms. Grantz. The Colorado River Annual Operating Plan is a report of Colorado River hydrology and reservoir operations for past year and projections for the upcoming year. The purpose is to illustrate the range of possible reservoir operations that could be expected in the upcoming water year. It's not just for Glen Canyon Dam but for all the major Colorado River reservoirs. The plan reflects all the operational rules, guidelines and decisions that have been put into place for the Colorado River reservoirs. The 2016 AOP is currentely being developed and will be submitted to the Secretary of the Interior in the upcoming weeks.

Basin Hydrology – The snowpack for WY2015 peaked at 74% of average on 3/9/15, a month earlier than average. It was very wet in May 2015 and saw snow accumulations in the high elevations. The runoff from the snowpack was basically gone at a typical time. Currently Lake Powell is at 51% full and the other basin reservoirs are at higher full levels. Lake Powell can hold about 4 years of runoff and doesn't fluctuate as the other reservoirs. All the precipitation in May helped turn things around with Lake Powell at 94% of average unregulated inflow. Looking ahead to Water Year 2016 the forecast is expected to be 78% of average inflow. At this point in the water year and with almost no snow accumulation, it's a wide range of 57% of average to 148% of average. There is a 10% chance the inflows could be higher or lower. The forecast over the past two months has been decreasing because the forecast is very sensitive to additional conditions at this time of year and there isn't a whole lot of information to use. The decrease over the past month was 840 kaf which is a pretty significant decrease for one month.

The August 24-month study is very important because of its projection of January 1st elevations establishes the Lake Powell operating tier for the upcoming water year. If in the Upper Elevation Balancing Tier, April 24-month study projection of September 30th, storage could shift to Powell operations to balancing or equalization for the remainder of the water year. We are expecting to have an April adjustment to balancing releases with a total release from Lake Powell of 9.0 maf. With the maximum probable inflow forecast, we would expect an adjustment to equalization releases with a total release of 11.4 maf. If inflows are in the range of about 5 maf to 14 maf, an April adjustment is expected to balancing releases and a release of 9.0 maf. If things get really dry and inflows in April are projected to be less than 5 maf, an April release would not be done and a 8.23 maf release would occur. If it's really wet and inflows are over 14 maf, an adjustment to equalization would be done and those releases would range from 11 maf or greater. Looking ahead to WY2017, it looks likely for an upper elevation balancing tier so possibly an April adjustment to equalization but this month we're right on the threshold and under the minimum probable scenario of having a 7.48 maf release.
Attachment 9b – Memo from Secretary Ken Salazar dated May 23, 2012, Subject: Directive on Implementation to Improve Conditions in the Colorado River in Grand Canyon National Park and Glen Canyon National Recreation Area.
Attachment 9c – Memo from AS-WS Anne Castle dated July 18, 2012, Subject: DOI Glen Canyon Leadership Team for HFE and Non-native Fish Control.

2015 HFE Discussion – Mr. Scott VanderKooi. The DOI Technical Team Report (***Attachment 10a***) was provided by PDAS Jennifer Gimbel announcing there would be no high flow experiment this year.

- Biological Resource Updates (***Attachment 10b***) – Mr. Scott VanderKooi. The following HBC updates were provided:
  - 2015 spring abundance estimate of 105-199 mm HBC = 921 (95% CL: 756 to 1086)
  - 2015 spring estimates considerably lower than recent years. Potentially due to early run timing, skipped spawning, or population decline.
  - 2015 run timing similar to 2014. Fewer detections could be due to skipped spawning or population decline.
  - Lower Condition observed in 3 of last 4 trips. Supports hypothesis of skipped spawning due to less energy available to devote to reproduction.

  For Rainbow Trout:
  - Considerable declines in abundance in all reaches over Sept 14 – Jan 15 interval. Jan & April 15 estimates downstream of LCR below NNFC trigger.
- Overview of 2014 HFE (***Attachment 10c***) – Mr. Ron Griffiths. The following results were provided:
  - Overall Change in sand mass in the Colorado River between RM0 and RM225 (Lees Ferry to Diamond Creek) during 7/1/14-1/1/15 was:
    +0.59+9.92 million metric tons; sand deposited in lower Marble Canyon and East Grand Canyon, sand evacuated from western Grand Canyon and west Central Grand Canyon
  - Overall change in sand mass in the Colorado River below RM225 (below Diamond Creek) during 7/1/14-1/1/15 was:
    +1.4+0.1 million metric tons
- 2015 Paria River Sand Inputs
  - Zero bias value for 2015 Paria sand inputs is approximately 1.1 million metric tons, almost an additional 400,000 metric tons in June.
  - Flood event on 8/12/15 is an example of "hyperconcentrated flow," this flood input over ¼ of the total 2015 Paria sand input.
  - All samples through 8/27/15 have been processed by the laboratory, most recent processed sample is from 9/17/15.
  - The processed samples represent 80% of the total number of Paria samples collected this year compared with 52% of the samples at this time last year.
- 2015 Marble Canyon Mass Balance. Comparison of Marble Canyon zero bias sand mass balance with previous years 7/1 through 9/28
  - 2015: +650,000 metric tons
  - 2014: +1,200,000 metric tons
  - 2013: +1,900,000 metric tons
  - 2012: +720,000 metric tons
  - 2011: -580,000 metric tons – equalization flows
  - Sand was evacuated from upper Marble Canyon during equalization flows – likely from retreating sandbars and June Paria inputs
  - Sand deposited in lower Marble Canyon – in storage underwater or below the 20k CFS flow level
  - The total change in sand mass balance for Marble Canyon from 7/1/15 to 9/28/15 is 650,000 metric tons plus a likely additional +300,000 metric tons input from the Paria River since 9/28 (next update will occur on 11/9).

- *I would express some caution in attributing all of the incremental losses to balancing flows especially if you have Paria River flows. But even if there weren't the Paria flows, there's only a portion of those flows that occurred in July that were due to additional flow because of balancing.*
- *Given the projected operations into next spring, do you have an estimate of how much sand might be available for an HFE in the spring?*
  - *Not at this time. If we have approximately 1 million metric tons and we export 100,000 per month – the rate of sand being exported from Marble Canyon is dependent upon how much sand is actually in Marble Canyon. As the Paria enriches the system, we export more sand and as it winnows it down, the export rate decreases. It's hard to predict.*
- *Given higher flows, whether they're balancing or equalization, what's the best way to conserve mass balance in these scenarios?*
  - *The HFEs are certainly building or maintaining most of the sandbars that we're monitoring. There's a non-linear relationship between sediment transport and flow and at these higher flows there is*

more sediment transport. The highest volume months move the most sand. If you want to preserve that sand in some capacity, we have means of doing that through HFEs.
    - *In terms of the water and redistribution among months, it's a challenge because we need to stay within the annual volume. In a high release year, especially equalization releases, we don't know that until we're a good way through the water year and have lost a lot of the flexibility to move that water around.*
- *If we take a single grain of sand that's up on one of the upper beaches and that little piece gets eroded, does it go all the way down to Lake Mead or does it stop somewhere along the way?*
    - *Once the sand is entrained, it doesn't just shoot to Lake Mead. It might only move 10 feet. The sand is slowly moving downstream as more comes in from the Paria River.*
- *We're now on the third HFE and haven't seen any reports on the results. Is there a definitive report of the analysis done of the impact of the HFEs?*
    - *The HFE Workshop held in February 2015 served as the mechanism for reporting on the HFEs. Reclamation had a commitment to hold a workshop but not produce a written report. The Technical Team Report includes a review of all the resources.*

HFE Decision Process – Ms. Grantz. The Technical Team worked for the past several months evaluating existing data and the status of all resources in the canyon. By mid-September there was enough sediment in the system to conduct a 96-hour HFE. However, in assessing the status of the biological resources and the concern for potentially disbursing Green Sunfish downstream in the Colorado River, the Team felt an HFE shouldn't be done. Two treatments would be needed to deal with the GSF and given all the logistics that go into scheduling an HFE, there wasn't enough time. Ms. Heffernan added there is a commitment under the Memorandum of Agreement for the HFE Protocol to give a minimum of 30 days notice to the Tribes and consult with them after that notification if desired.

2015 November Dam Operations – Ms. Grantz. Reclamation is going to release 600kaf with fluctuations between 7,000 cfs and 13,000 cfs. They are coordinating efforts with NPS on the treatment and removal of GSF and AZGFD and WAPA have been collaborating on that. To assist in that treatment effort, steady flows of 9,000 cfs for 3 days will be done. Two treatments and associated flows will be about 10 days apart. The volume for November will remain the same. The overall fluctuations may adjust in order to keep the volume the same, but they're keeping the flows steady because the fluctuations can cause a challenge for the turbidity curtain and also that somewhat flow of 9,000 cfs means there is less volume of water in that backwater slew to treat. Final dates haven't been set yet but they're targeting the first week of November for the treatment. There are less impacts to hydropower by doing them over weekends.

Conceptual Ecological Models (***Attachment 11***) – Ms. Kokos. About six years ago she was hired to develop the adaptive management program for the MSCP. The AMP's short term goals is to build an adaptive management framework and ensure research and monitoring projects can answer management's questions and needs. Adaptive management is a process that clearly incorporates learning into the management process. It answers why a project succeeded so that it can be replicated, or why a project failed and what needs to be done to succeed in subsequent actions. They needed to define their goals in terms of how they were going to manage each one of their conservation areas for the 20 species for they have habitat creation goals for. It was a year-long process and they developed some management guidelines, essentially measureable attributes that they could measure out on the landscape that would inform them how they would manipulate habitat. There was an existing vegetation monitoring project that was going on and she interpolated the data for the Palo Verde Ecological Reserve outside Blythe, California. One of the disconnects between biologists and managers is how to actually communicate what's important. They begin with a question, have a design in mind, determine what data will be collected, how data will be analyzed, have an idea of expected outcomes and then plan for a recommendation. The program developed some conceptual ecological models but can be used for research and monitoring. The LCR MSCP Species Conceptual Model follows the current best practices and incorporates information from databases, literature, and experts.

LTEMP (***Attachment 12a***) – Ms. Balsom. The Draft EIS was sent to the Cooperating Agencies on June 29. The Draft Appendices were sent out on July 31, with the exception of the SDM Report (August 3) and the Wholesale Ratepower Analysis (August 7).

Next Steps:

- Sept. 30, 2015 Cooperating Agency comment deadline
- October 2015 Biological Assessment
- December 2015 Public DEIS
- February 2016 Public Meetings
- March 2016 Biological Opinion
- April/May 2016 FEIS and Record of Decision

Ms. James said that a couple of her members who are cooperating agencies, have reviewed the drafts and submitted comments but in terms of cooperating agency discussions on a preferred alternative, that hasn't happened. Jan said she would mention on the next phone call.

As a stakeholder, not a cooperating agency, Mr. Miller said he doesn't think the recreational fishing group has been aware of the ability to have these meetings/phone calls. There were some over a year but as alternatives have narrowed down, they haven't been involved and the process should be more visible.

LTEMP Science Plan (***Attachment 12b***) – Mr. Vanderkooi. GCMRC was tasked with providing a science plan for the LTEMP. In discussions with Glen and others, it was made clear to them that if there was a preferred alternative, the science plan would be for that. They had hoped to not have to write a science plan over the eight alternatives when only one would be the accepted alternative. GCMRC can't produce a science plan until they know what that alternative will be. He provided what components would comprise a science plan and the need to reconcile previous program documents with that.

- *For Zuni, the river itself is a living being and a cultural resource.*
- *Hope GCMRC will be a definitive party to what the science plan consists of and its implementation.*
- *With the LTEMP, this would be a good time to look at what is still being done in terms of monitoring and factor in what needs to be continued versus what we've perhaps already answered well enough.*
- *Need to discuss the process for archiving information so its available to the program and future stakeholders.*
- *We can do a better job of maintaining historical documents.*
- *Perhaps the Annual Reporting meeting could be an avenue for providing information on the state of the resources. We should develop a summary of exisiting knowledge.*
- *A lot of good work went into the MRP and the Knowledge Assessment was never finalized. We don't want to lose that information and should consider bridging what we've learned from past efforts into the science plan.*
- *There is new technology that could really help in getting the administrative history done.*
- *The models Argonne did for the LTEMP EIS need to be kept in the AMP.*

Adjourned: 12:45 p.m.

Respectfully submitted,

Linda Whetton
Upper Colorado Region
Bureau of Reclamation

Next Meeting:
(Tue) January 26, 2016 9:30 a.m. – 5 p.m.
(Wed) January 27, 2016 8:15 a.m. – 5 p.m.
(Thu) January 28, 2016 8:15 a.m. – 3 p.m.
at Arizona Department of Water Resources

Key to Glen Canyon Dam Adaptive Management Program Acronyms

ADWR – Arizona Dept. of Water Resources
AF – Acre Feet
AGFD – Arizona Game and Fish Department
AIF – Agenda Information Form
AMP – Adaptive Management Program
AMWG – Adaptive Management Work Group
AOP – Annual Operating Plan
ASMR – Age-Structure Mark Recapture
BA – Biological Assessment
BAHG – Budget Ad Hoc Group
BCOM – Biological Conservation Measure
BE – Biological Evaluation
BHBF – Beach/Habitat-Building Flow
BHMF – Beach/Habitat Maintenance Flow
BIA – Bureau of Indian Affairs
BO – Biological Opinion
BOR – Bureau of Reclamation
BWP – Budget and Work Plan
CAHG – Charter Ad Hoc Group
CAP – Central Arizona Project
GCT – Grand Canyon Trust
CESU – Cooperative Ecosystems Studies Unit
cfs – cubic feet per second
CFMP – Comprehensive Fisheries Management Plan
CMINS – Core Monitoring Information Needs
CMP – Core Monitoring Plan
CPI – Consumer Price Index
CRBC – Colorado River Board of California
CRAHG – Cultural Resources Ad Hoc Group
CRCN – Colorado River Commission of Nevada
CRE – Colorado River Ecosystem
CREDA – Colorado River Energy Distributors Assn.
CRSP – Colorado River Storage Project
CWCB – Colorado Water Conservation Board
DAHG – Desired Future Conditions Ad Hoc Group
DASA – Data Acquisition, Storage, and Analysis
DBMS – Data Base Management System
DOE – Department of Energy
DOI – Department of the Interior
DOIFF – Department of the Interior Federal Family
EA – Environmental Assessment
EIS – Environmental Impact Statement
ESA – Endangered Species Act
FACA – Federal Advisory Committee Act
FEIS – Final Environmental Impact Statement
FRN – Federal Register Notice
FWS – United States Fish & Wildlife Service
FY – Fiscal Year (October 1 – September 30)
GCD – Glen Canyon Dam
GCES – Glen Canyon Environmental Studies
GCT – Grand Canyon Trust
GCMRC – Grand Canyon Monitoring & Research Center
GCNP – Grand Canyon National Park
GCNRA – Glen Canyon Nat'l Recreation Area
GCPA – Grand Canyon Protection Act
GIS – Geographic Information System
GLCA – Glen Canyon Nat'l Recreation Area
GRCA – Grand Canyon National Park
GCRG – Grand Canyon River Guides
GCWC – Grand Canyon Wildlands Council
HBC – Humpback Chub (endangered native fish)
HFE – High Flow Experiment
HMF – Habitat Maintenance Flow
HPP – Historic Preservation Plan
IG – Interim Guidelines
INs – Information Needs
KA – Knowledge Assessment (workshop)
KAS – Kanab Ambersnail (endangered native snail)
LCR – Little Colorado River
LCRMCP – Lower Colorado River Multi-Species Conservation Program
LTEMP – Long-Term Experimental and Management Plan
LTEP – Long Term Experimental Plan
MAF – Million Acre Feet
MA – Management Action
MATA – Multi-Attribute Trade-Off Analysis
MLFF – Modified Low Fluctuating Flow
MO – Management Objective
MRP – Monitoring and Research Plan
NAU – Northern Arizona University (Flagstaff, AZ)
NEPA – National Environmental Policy Act
NHPA – National Historic Preservation Act
NNFC – Non-native Fish Control
NOI – Notice of Intent
NPCA – National Parks Conservation Association
NPS – National Park Service
NRC – National Research Council
O&M – Operations & Maintenance (USBR Funding)
PA – Programmatic Agreement
PBR – Paria to Badger Creek Reach
PEP – Protocol Evaluation Panel
POAHG – Public Outreach Ad Hoc Group
Powerplant Capacity = 31,000 cfs
R&D – Research and Development
RBT – Rainbow Trout
RFP – Request for Proposal
RINs – Research Information Needs
ROD Flows – Record of Decision Flows
RPA – Reasonable and Prudent Alternative
SA – Science Advisors
Secretary – Secretary of the Interior
SCORE – State of the Colorado River Ecosystem
SHPO – State Historic Preservation Office
SOW – Statement of Work
SPAHG – Strategic Plan Ad Hoc Group
SPG – Science Planning Group
SSQs – Strategic Science Questions
SWCA – Steven W. Carothers Associates
TCD – Temperature Control Device
TCP – Traditional Cultural Property
TEK – Traditional Ecological Knowledge
TES – Threatened and Endangered Species
TMC – Taxa of Management Concern
TMF – Trout Management Flows
TWG – Technical Work Group
UCRC – Upper Colorado River Commission
UDWR – Utah Division of Water Resources
USBR – United States Bureau of Reclamation
USFWS – United States Fish & Wildlife Service
USGS – United States Geological Survey
WAPA – Western Area Power Administration