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To: Katrina Grantz, Bureau of Reclamation, Adaptive Management Group, Chief

From: Scott VanderKooi, U.S. Geological Survey, Grand Canyon Monitoring and Research Center, Chief

Date: September 27, 2018

Subject: GCRMC response to HFE deferral request

Katrina,

John Jordan sent me a copy of the September 14, 2018 letter he and the recreational fishing representatives to the Glen Canyon Dam Adaptive Management Program (GCDAMP) sent you with their request to defer implementation of a High Flow Experiment (HFE) in fall 2018. I believe the discussion of risks and tradeoffs among resources when conducting experimental management actions is valuable and appropriate in an adaptive management setting. The Grand Canyon Monitoring and Research Center's (GCMRC) role is to provide a scientific foundation for these discussions such that all parties involved have a common understanding of the status of resources and are aware of the state of the science in regards to potential effects of experimental actions. In reviewing this letter and its associated appendix, my staff and I noted several statements attributed to GCMRC publications, presentations, or in reference to GCMRC science that were either incomplete, inaccurate, or relied on information that may be out of date. I thought it important for GCMRC to develop a response to this letter in the form of this memo in order to clarify what is the most recent scientific information regarding the issues raised by the recreational fishing representatives and what are the interpretations of that information by GCMRC scientists. Below we provide sections from the recreational fishing representatives' letter and its appendix in order in italicized text and provide a response from GCMRC in normal text.

Regards,

Scott VanderKooi

"The conditions that led to last year's motion that was passed unanimously by the Adaptive Management Work Group (AMWG) have not changed or been addressed "

We note that a number of conditions have changed and events have occurred in regards to brown trout and reources of concern since the September 2017 Adaptive Management Work Group (AMWG) motion was passed. The brown trout workshop was held immediately following the September 2017 AMWG meeting and the associated report (Runge et al. 2018) was completed and distributed in April 2018. Monitoring of key resources has continued as outlined in the GCDAMP Fiscal Years 2018-20 Triennial Work Plan. Results of that monitoring were presented by GCMRC at the August 2018 AMWG meeting and included observations that the rainbow trout fishery in Glen Canyon continues to recover and that these fish are in good condition, midge abundance as measured in light trap catches continues to increase from lows observed in 2015, adult humpback chub spring abundance estimates in the Little Colorado River continue to increase from lows reported in 2015 and subadult numbers remain above Biological Opinion levels that would trigger managent actions, and brown trout numbers have dropped considerably from peaks observed in early 2017.

"In addition, the continued presence of green sunfish in the slough area, which led to deferring the 2015 fall HFE, persists and is now compounded by reports of smallmouth bass and striped bass joining them."

The green sunfish issue has been addressed for 2018. National Park Service staff eliminated these fish from the upper slough in September 2018. One smallmouth bass was captured in 2018 with the same number observed in 2017. Prior to that, two were caught in 2013 and one each in 2011 and 2010 (AGFD unpublished data). Five striped bass were observed in August 2018, but this species has been observed in Glen Canyon periodically since the early 1980s. There is no evidence to suggest that the detection of either species was influenced by past HFEs or will be influenced by a HFE were one to occur in 2018.

"Increases in rainbow trout in Marble Canyon (including possible increases in rainbow trout spawning and recruitment in Marble Canyon)"

No increase in rainbow trout near the confluence of the Little Colorado River was observed in 2017 following the fall 2016 HFE. There was, however, an increase in small rainbow trout in this area in 2018 despite no HFE the previous fall (GCMRC unpublished data). This increase is likely linked to a large rainbow trout recruitment event in Glen Canyon in 2017. It appears young rainbow trout disperse downstream during these events. A similar event is believed to have occurred in 2011-2012.

"A reduction in the condition of the aquatic food base, the quality of the Lees Ferry rainbow trout fishery, and the condition of the endangered humpback chub at the Little Colorado River"

Recent data show increased midge abundance as measured in light trap catches, including in 2017 following the fall 2016 HFE (GCMRC unpublished data). Rainbow trout abundance in Glen Canyon continues to increase (GCMRC unpublished data) with good condition factor observed in these fish and catch rates in the recreational boat fishery increasing to be at, or above, AGFD goals in summer 2018 (AGFD unpublished data). Humpback chub condition at the Little Colorado River confluence reached a minimum in 2014, but has since slowly recovered (GCMRC unpublished data).

"Inadequate persistence and availability of sandbars in Marble Canyon and other critical reaches into the high-use summer boating season"

We will leave it to resource managers and stakeholders to define what is "adequate" regarding sandbar persistence and availability. We do note, however, that forgoing a fall HFE when sediment resources are available will result in continued transport of that sediment downstream and eliminate an opportunity to offset erosion of sandbars and beaches that results from normal dam operations, tributary floods, and hillslope runoff. The restoration of sediment to sand bars may be particularly warranted this year, given recent reports of significant gullying occurring during the 2018 monsoon season, which is still ongoing.

Attachment 1.

"It is possible that fall HFEs have played a complicated role in encouraging immigration of large brown trout from downstream reaches."

Yes, but we also note that the second half of this sentence, which was taken from the summary of Runge et al. (2018), states "but it is also possible that this immigration arose from a unique set of circumstances unrelated to fall HFEs."

"There is a 64-percent chance the intrinsic growth rate is large enough to sustain long-term growth; under this circumstance we forecast the population growing to 3 times, or possibly even 10 times, the current size."

It is important to recognize that this risk remains at some level whether or not a fall HFE occurs in 2018. If fall HFEs are a causal factor driving increases in the brown trout population in Glen Canyon, then yes, stopping them would reduce this risk although it is unclear by how much. If fall HFEs are not a driver of brown trout populations, however, then this risk remains regardless of whether fall HFEs occur or not. Runge et al. (2018) observed that several factors, including fall HFEs, may play a role in driving brown trout population dynamics in Glen Canyon, but there was not a strong signal in the data to identify one of these as more important than the others.

"Strategies designed around [reducing] the frequency of [fall] HFEs would work to reduce brown trout abundance if, in fact, fall HFEs are a causal driver of increases in immigration or reproduction."

Similar to the discussion above, the critical phrase in this sentence is "if, in fact, fall HFEs are a causal driver…" As noted by Runge et al. (2018), the strategy would only work if this were the case, otherwise there would be little to no effect. They also state that although a limited number of causal variables have been identified (e.g., water temperature, rainbow trout density, frequency of fall HFEs, brown trout density), no strong correlation signal exists in the data suggesting one is more likely than any other.

"This concept is founded on observations from the Natal Origins project which indicate that the number of rainbow trout at the LCR can be reduced by limiting the frequency of fall HFEs when trout abundance in Marble Canyon is high…Modeling has indicated that foregoing a fall HFE in a year with a large sediment input from the Paria River allows enough fine sediment to remain in Marble Canyon to provide a small increase in turbidity (from ~5 NTU to ~35 NTU) over the subsequent winter."

We agree that it is an intriguing hypothesis to be able to control rainbow trout abundance at the Little Colorado River confluence by limiting growth through modest increases in turbidity levels. There is, however, no consensus among scientists at GCMRC that limiting HFEs will affect turbidity to the degree that it may affect ability of trout to feed. Tributary inputs are the dominant control on winter turbidity levels in Marble Canyon (GCMRC unpublished data). A small decrease in turbidity may result from fall HFEs, but post-HFE tributary inputs easily offset any decrease in turbidity caused by conducting an HFE.

"Reducing the number of fall HFEs would have a negative impact to sediment-related resources unless the sediment accounting periods in the HFE protocol could be adjusted to allow for fall sediment from the Paria be used for a spring HFE, of which a number of resources would benefit including foodbase, the trout fishery, and recreational beach use."

Fall HFEs are scheduled for either October or November such that they are conducted shortly after most sediment inputs from tributary floods occur. Changing the sediment accounting periods is a policy decision, thus outside the scope of GCMRC's responsibilities. Nonetheless, GCMRC scientists agree that greater flexibility in sediment accounting would, in turn, add flexibility for managing sand using HFEs and may increase the likelihood of triggering sediment-enriched spring HFEs. We do note, however, that sediment deposited in the fall accounting period would not just remain in place until spring, but would continue to erode and be transported downstream. The rates and volume of sand transport is dependent on water release volumes and flow variations, but under winter operations implemented in recent years, only years with the highest sediment inputs in summer and fall would result in sufficient sediment being retained to trigger an HFE in spring. Finally, while data following the 2008 spring HFE indicate positive responses in the foodbase, trout fishery, and at most sandbar sites, it is by no means a certainty, particularly in regards to biological resources, that the same responses would be observed following a future spring HFE.

"Fall-timed floods are bad-to-neutral for foodbase. Fall HFEs do not increase abundances of midges and blackflies which are primary food items for rainbow trout and humpback chub."

Midge abundance as measured in light trap catches continues to increase from lows observed in 2015, including in 2017, a year that followed a fall HFE. This is in contrast to earlier observations of declining catches in years following the 2012 and 2013 HFEs. The lack of a consistent response suggests other factors than HFEs are influencing aquatic insect abundance. Fall HFEs were designed to manage limited sediment resources such that they were used to build or maintain beaches and sandbars, thus a lack of a positive response from aquatic insects is not surprising.

"Since 2013, condition of humpback chub and annual number of spawning adults at the LCR have been low."

Humpback chub condition at the Little Colorado River confluence reached a minimum in 2014, but has since slowly recovered (GCMRC unpublished data). A lower proportion of humpback chub spawned in the Little Colorado River in 2015 and 2016, but increases were observed in 2017 particularly among small adults (GCMRC unpublished data). Overall adult humpback chub abundance in the Little Colorado River was also lower in the LCR in 2015 and 2016, but increased in 2017 and 2018 (USFWS unpublished data).

"Midge catch rates in light trips and drift biomass at the LCR have decreased by >50% since 2013."

As noted previously, midge abundance as measured in light trap catches continues to increase from lows observed in 2015 including in 2017, a year that followed a fall HFE.

"Fall HFEs appear to reduce trout growth in fall and winter in Glen Canyon when assessed based on differences among years but nutrients released from GCD and trout competition appear to have a bigger effect on growth than fall HFEs."

Rainbow trout in Glen Canyon lost weight during intervals that included two fall HFEs (2012 and 2014) and gained weight during two others (2013 and 2016). Rainbow trout in Glen Canyon showed positive

growth in winter 2015 after three consecutive fall HFEs and also in winter 2017 after the fall 2016 HFE (GCMRC unpublished data). As noted, nutrients and competition appear to be more important factors affecting rainbow trout growth in Glen Canyon than fall HFEs.

"The controlled floods conducted in November 2012, 2013, 2014, and 2016 did not cause long-term increases in campsite size."

In each case of the HFEs listed, sandbar-building results were generally consistent with the results from previous sand-enriched HFEs as described by Schmidt and Grams (2011). All HFEs resulted in substantial deposition at all sandbar types (see Mueller et al., 2018 for description of sandbar types), but not at all individual sandbars, followed by erosion of about half the new deposits within 6 months. Data from these surveys indicate that there has been some net increase in the size of reattachment sandbars since the beginning of the HFE protocol in 2012. The size of other types (Mueller et al., 2018) of sandbars has fluctuated, with no significant net increase or decrease. Thus, repeated HFEs under the protocol have caused cumulative increases in the size of some sandbars.

"Campsite surveys conducted approximately 11 months after each of those events have not detected any long-term net gains in campsite area."

Deposition of sand during HFEs has caused temporary increases in campsite area; however, there has been a net long-term decline in campsite area caused primarily by vegetation encroachment (Hadley et al., 2018a; Hadley et al., 2018b). Although HFEs do not prevent vegetation encroachment, HFEs do provide increases in campsite area – even if those increases are temporary. Anecdotal reports from river guides indicate that hillslope runoff from summer rainstorms has caused substantial erosion at many sandbars. HFEs have typically restored sandbars dissected by gullies from hillslope runoff.

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